Naval Submarine Medical Research Laboratory

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E-Guard: Expediting Submarine Escape Time Calculations

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14. ABSTRACT

When faced with a distressed submarine (DISSUB) scenario, Sailors rely on the DISSUB Guard Book to make decisions about whether to await rescue or attempt an escape. Unfortunately, a 2020 preliminary research study demonstrated that performance on Guard Book-required calculations is poor, with only about 50% of individuals arriving at the correct answer. The current study tests whether an electronic version of the Guard Book (E-Guard) may help Sailors overcome some of these calculation errors. Forty-five active-duty submariners completed escape time calculations using either the paper Guard Book or the E-Guard; calculations were conducted both in an unstressed, laboratory environment, and in a classroom immediately upon completion of an emergency training simulation in the Damage Control trainer. Submariners were significantly more accurate and completed the calculations significantly faster when using the tablet-based E-Guard compared to when using the traditional paper version of the Guard Book. Recommendations for how to improve performance on both paper Guard Book and E-Guard platforms are provided.

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Table of Contents

Abstract

When faced with a distressed submarine (DISSUB) scenario, Sailors rely on the DISSUB Survival Guide (i.e., the DISSUB Guard Book) to make critical decisions about whether to await rescue or attempt an escape. However, a 2020 preliminary research study from the Naval Submarine Medical Research Laboratory (NSMRL) demonstrated poor performance on Guard Book-required calculations, with only about 50% of individuals arriving at the correct answer (i.e., the correct time to start escapes, based on oxygen depletion, carbon dioxide buildup, or compartment pressure buildup) to help augment their survival-based decision-making in a DISSUB scenario. The current study tests whether an electronic version of the Guard Book (E-Guard) may help Sailors overcome some of these calculation errors. Forty-five active-duty submariners completed escape time calculations using either the paper Guard Book or the E-Guard; calculations were conducted both in an unstressed, laboratory environment, and in a classroom immediately upon completion of an emergency training simulation in the Damage Control trainer. Submariners were significantly more accurate and completed the calculations significantly faster when using the tablet-based E-Guard (86% were accurate in a mean of 7 mins) versus the traditional paper version of the Guard Book (where only 33% were accurate in a mean of 29 mins). This finding held across stress conditions, supporting the use of E-Guard in environments with similar mental demands/stressors to a DISSUB scenario. E-Guard use also eliminated errors made on the paper Guard Book attributed to misunderstanding instructions, table reading and rounding, and time conversion, although errors attributed to user interface/user experience (UI/UX) were introduced. Recommendations for how to improve performance on both paper Guard Book and E-Guard platforms are provided.

1.0 Introduction

In the unlikely event that a submarine becomes distressed, survivors may need to conduct an escape if the conditions aboard the boat deteriorate to a point that would not support human life. For example, oxygen (O_2) may decrease to dangerous levels, or carbon dioxide (CO_2) may accumulate within the submarine. To make the critical decision of when to initiate an escape, crew members must refer to the Distressed Submarine (DISSUB) Survival Guide (i.e., the DISSUB Guard Book), which contains the necessary steps and procedures for how to survive, while awaiting rescue or escape from the submarine.

Located within every compartment aboard every submarine, the Guard Book contains instructions for determining submarine survivor start escape times (i.e., the time remaining before escapes must be started to prevent survivors from being exposed to potentially lethal atmospheric conditions aboard the submarine—conditions of which compromise the acumen and, with prolonged exposure, the overall health of the crew), but the calculations are not trivial. To perform these calculations, DISSUB survivors must consider factors including the

current CO_2 and O_2 levels, the amount of supplies available to absorb CO_2 or to provide O_2, the percent of the submarine compartment that is flooded, the number of survivors fit and unfit to escape, and more (e.g., NAVSEA, 2013).

Unfortunately, recent research conducted by the Naval Submarine Medical Research Laboratory (NSMRL) demonstrated that only about 50% of individuals are able to successfully complete these Guard Book calculations and arrive at the correct escape time (Moslener et al., 2020). Moreover, those individuals took approximately 40 minutes to complete the calculations. This implies that the crew of a submarine experiencing a DISSUB event would expend a significant amount of time only to have about a 50/50 chance of correctly making the critical decision that supports their survival.

Recent NSMRL research has identified a large number of stressors expected to be present during a DISSUB event (Chabal et al., 2019), and has highlighted the probability that these stressors are likely to impair submariners' cognition and their ability to conduct critical escape operations (Chabal et al., 2020). Guard Book performance during an actual DISSUB event is therefore likely to be even worse than what was observed in an unstressed, laboratory setting (Moslener et al., 2020). It is necessary to develop ways to mitigate and/or eliminate errors on the start escape time calculations from the Guard Book in order to promote the maximum likelihood of survival.

A prototype electronic version of the Guard Book (E-Guard), which runs on Android-based tablets, has been developed by NSMRL. The E-Guard provides an input-based electronic interface to submariners collecting crucial information in a DISSUB event (e.g., atmospheric conditions, number of survivors), performs automatic back-end calculations based on those inputs (*Nuclear Powered Submarine Atmosphere Control Manual*, 2013), and provides start escape time recommendations. The overall goal of the application is to overcome the human error inherent in pen-and-paper calculations, with an expected outcome of increased accuracy and decreased calculation time during a DISSUB scenario. However, though use of the E-Guard is expected to result in more accurate and more efficient escape time decisions, this prediction has not yet been empirically tested. Human subjects testing is necessary to ensure that changing the format of the Guard Book does not introduce any unanticipated errors (e.g., Moslener et al., 2020).

The goal of the current research is to empirically test E-Guard performance both under unstressed (laboratory) conditions and following stressed conditions similar to what might be expected during a DISSUB scenario. DISSUB conditions will be imposed by testing the performance of students at the Naval Submarine School (NAVSUBSCOL) on Submarine Base New London, CT while they are undergoing routine, planned training in emergency simulators. In addition to comparing E-Guard escape time calculation performance to performance on the original, paper version of the Guard Book, this research will characterize the types of errors committed on each version and will make recommendations for

formatting- or content-based changes that are expected to improve performance on required escape time calculations.

2.0 Methods

2.1 Design

The current study followed a 2x2 mixed experimental design, with stress (unstressed/ laboratory, stressed) as a within-subjects variable, and platform (paper Guard Book, E-Guard) as a between-subjects variable. Dependent variables of interest included start escape time accuracies, final calculation response time, and the type of errors committed during completion of the paper Guard Book and E-Guard start escape time calculations.

2.2 Participants

A total of 45 volunteers (one female) completed the study, under the IRB-approved exempt protocol NSMRL.2022.0013. Volunteers ranged in age from 18-38 years (M = 23.6 years, SD = 4.4 years). The majority of volunteers indicated that their highest level of education was a high school diploma (26 volunteers); two volunteers completed trade school, seven completed "some college," two completed an associate degree, and eight completed a bachelor's degree. All volunteers were active-duty submariners, with a mean service length of 3.9 years (SD = 2.9 years). Thirty-nine volunteers were Enlisted, five were Officers, and one did not report his rank. At the time of study enrollment, volunteers were randomly assigned to complete calculations using either the paper Guard Book (22 volunteers) or the E-Guard (23 volunteers).

An additional 18 volunteers (three of whom were female) completed both paper and E-Guard calculations under only unstressed conditions. These volunteers ranged in age from 23-39 years (M = 29.9 years, SD = 3.0 years), with a mean time of service of 8.2 years (SD = 3.6 years). Two of these volunteers were Enlisted; 16 were Officers. Education levels of this group of volunteers skewed higher, with 9 reporting a master's degree, 7 reporting a bachelor's degree, one reporting "some college," and one reporting a high school diploma. Outcome measures from these individuals are provided in Appendix A.

2.3 Materials

2.3.1 Scenario Sheet

As in Moslener et al. (2020), volunteers were provided with a scenario sheet containing information regarding a DISSUB event. Information included values for all required variables (e.g., number of survivors, O_2 and CO_2 levels, number of O_2 candles) to be used as inputs for their Guard Book calculations. Volunteers received one of two possible scenario versions, with different scenarios provided for Session 1 and Session 2, and with scenario order counterbalanced across volunteers. See Appendix B for both versions of the scenario sheet.

2.3.2 Paper Guard Book

Volunteers were provided with the CO_2 and O_2 escape time calculation procedures from the Forward Compartment SSN 774 Class Guard Book, which outlines the required inputs (see Figure 1) and steps and procedures, and provides the data look-up tables for calculating escape times. See Appendix C for the Guard Book answer sheet and calculation packet that were provided to participants. Volunteers completed all calculations using a laminated version of the paper Guard Book, a grease pencil, and a handheld calculator.

TABLE 1
DISSUB CONDITIONS DATA

Data Time and Date Table 1 information was gathered: *Transfer to Calculation Box #3 (OP6B-4) and Calculation Box #6 (OP6B-14).*	_____ **Time (24Hr) (DD - MM / YY)**
---NOTE--- *This Time/Date shall represent only one point-in-time for all Table 1 information.*	
Number of Survivors (FWD): Transfer to Tables 6A, 6B, 6C, 10A, 10B & 10C.	_____ Survivor Total **(2)**
Survivors FIT to escape (FWD): Transfer to Tables 2A, 2B, 3 & 8.	_____ FIT to Escape **(3)**
---NOTE--- *A FIT survivor is defined as having full use of both arms and able to stand upright in the escape trunk while it is being flooded. Personnel unable to perform this task due to injury, nausea or convulsions are UNFIT and not included.*	
Survivors UNFIT to escape (FWD): *Transfer to Table 2A or 2B (as applicable).*	_____ UNFIT to Escape **(4)**
Percent FWD compartment is flooded (rounded to nearest 20%): *Transfer to Tables 3, 4, 7A, 7B & 8.*	_____ % Flooded **(5)**
FWD compartment CO_2 concentration in %SEV as read from ANALOX Monitor or alternate method: *Transfer to Table 4.*	_____ % SEV CO_2 Analox **(6)**
FWD compartment O_2 concentration in %SEV as read from ANALOX Monitor or alternate method: *Transfer to page OP6B-12 & Tables 7A or B.*	_____ % SEV O_2 Analox **(7)**
Number of ExtendAir® Lithium Hydroxide (LiOH) Canisters with ExtendAir® Deployment Kit: (One ExtendAir® DISSUB LiOH Deployment Kit per 60 ExtendAir® LiOH Canisters is required) **(FWD):** *Transfer to Table 5.*	_____ Cans (ExtendAir® LiOH with enough ExtendAir® DISSUB LiOH Deployment Kits) **(8)**
Number of oxygen candles with at least half as many igniters available (FWD): *Transfer to Table 9.*	_____ Cans O_2 Candles **(9)**

OP6B-2 (1)

S9594-AP-SAR-G10 REV 01

Figure 1: Paper Guard Book initial DISSUB scenario input parameters page.

2.3.3 E-Guard

The escape time calculation application (E-Guard, version 0.5.1) was installed on Android-based electronic tablets (Samsung Galaxy Tab A 6; Samsung Electronics, 2016). Users had to input DISSUB scenario information (see Figure 2) and navigate the application to compute escape time values (see Figure 3). All tablets used were set in portrait mode. After generating final escape time outputs, volunteers recorded escape time answers on a separate laminated answer sheet, using a grease pencil. See Appendix D for the answer sheet.

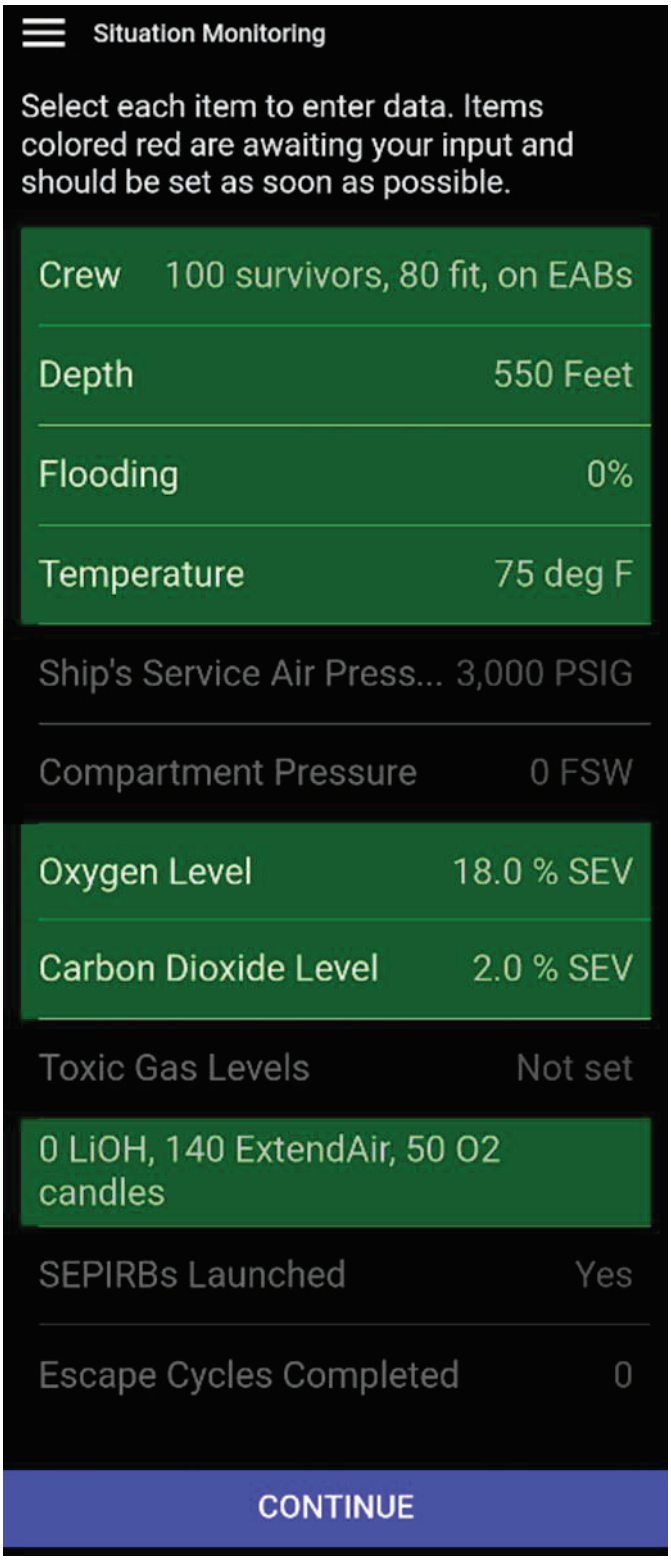
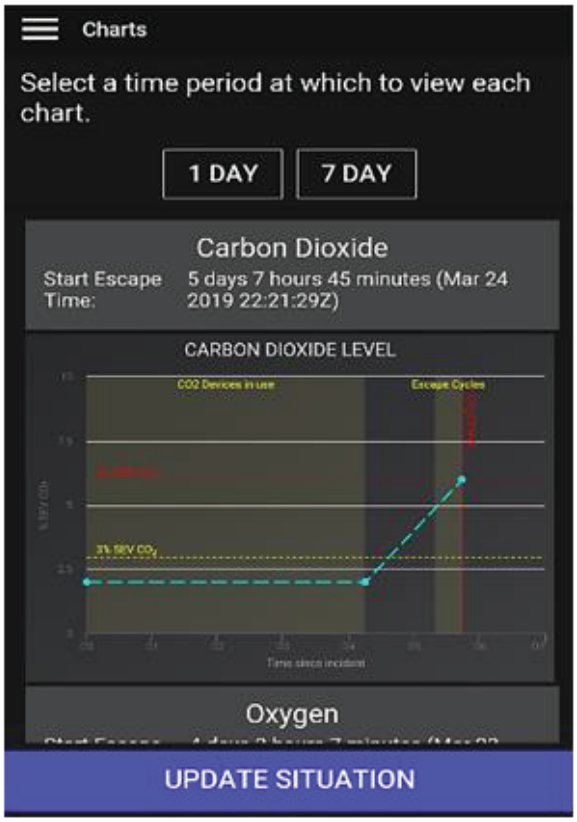


Figure 2: E-Guard initial DISSUB scenario input parameters screen

A



B

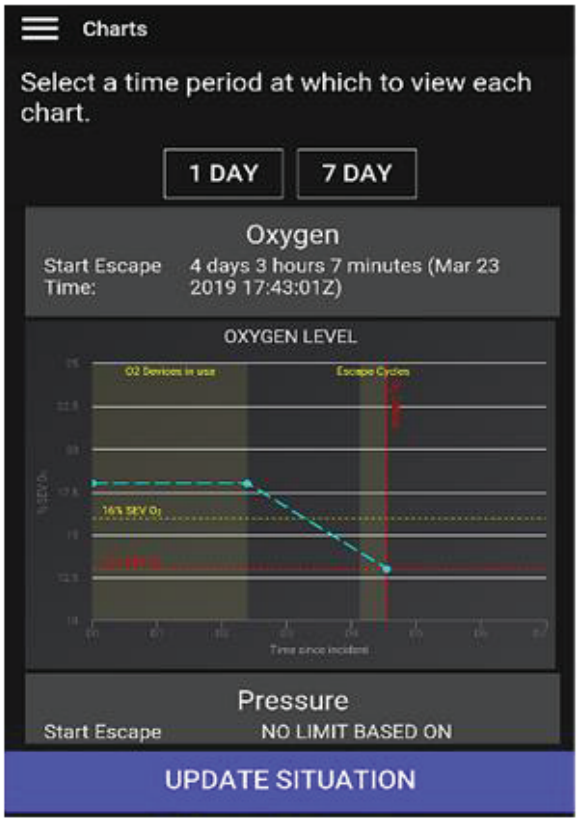


Figure 3: E-Guard-generated start escape times based on carbon dioxide (A) and oxygen (B).

2.3.4 Stress Assessment

The State-Trait Anxiety Inventory for Adults – State (STAI-S; Spielberger, 1983) Short Form was used as an assessment of state-based anxiety and stress to confirm that the training environment imposed stress that was not present during the laboratory assessment. The scale consists of ten Likert-type items designed to assess anxiety experienced in a specific situation.

2.3.5 Subjective Assessment

At the conclusion of each experimental session, volunteers rated the level of ease of their Guard Book platform (1: very confusing – 5: very straightforward), their confidence that they followed all calculation steps correctly (1: not at all confident – 5: very confident), and their confidence that they calculated the correct escape time (1: not at all confident – 5: very confident).

2.3.6 Demographic Questionnaire

Volunteers provided the following demographic information: age, gender, education level, military service and status, and prior DISSUB training (e.g., previously having taken a Submarine Senior Survivor Course, or having used a version of the Guard Book).

2.4 Procedure

Participation involved completion of two experimental sessions: an unstressed session and a stressed session. During each session, volunteers filled out the STAI-S, completed start escape time calculations using their assigned Guard Book platform and the researcher-provided scenario/incident information, and completed all survey measures. Due to operational limitations (i.e., conflicts with regular shipboard duties), four volunteers were unable to return for a second testing session and completed only the stressed (three volunteers) or unstressed (one volunteer) condition. Although every effort was made to counterbalance the order of stress conditions between platforms, dates of Trainer access were limited and constrained volunteers' availability. As a result, 38 volunteers completed the stressed condition first and 7 completed the unstressed condition first. Testing occurred with a minimum of seven days between stress conditions/experimental sessions.

As part of completing escape time calculations, volunteers calculated both CO_2- and O_2-based start escape times—and identified the earliest start escape time—using their assigned Guard Book platform. Escape times were recorded in two formats each: "time until start of escape" (dd:hh:mm) and "date of start of escape" (hh:mm; DD:MM:YYYY).

"Completion time" (mm:ss; the time it took volunteers to complete calculations/identify the earliest start escape time) was measured by investigators using a hand-held stopwatch. Volunteers were instructed to work quickly but to take as much time as needed to reach a correct answer (as in Moslener et al., 2020), and were asked to alert investigators by raising their hands "when [the volunteers] believe[d] [they had] correctly determined the start escape times." Volunteers wrote their investigator-provided completion times at the bottom of their answer sheet.

In the stressed condition, after receiving a safety brief from the Trainer Instructors, volunteers underwent NAVSUBSCOL-directed training in the Wet Damage Control (DC) Trainer, which simulated an active flooding casualty in a submarine Engine Room. The simulated flooding casualty lasted approximately 15 minutes and was managed and overseen by NAVSUBSCOL Instructors to ensure equivalently-stressful experiences across volunteers. During the Trainer scenario, volunteers secured leaks (using tools provided by NAVSUBSCOL staff) while facing hazard events including lighting failures (in which the overhead lights turned off and volunteers had to use flashlights to navigate the space) and sudden pipe bursts (see Figure 4). Immediately upon completion of the Trainer session, and without any warm-up or dry-off period, volunteers were seated in a classroom environment and filled out the STAI-S questionnaire followed by start escape time calculations using their assigned Guard Book platform.

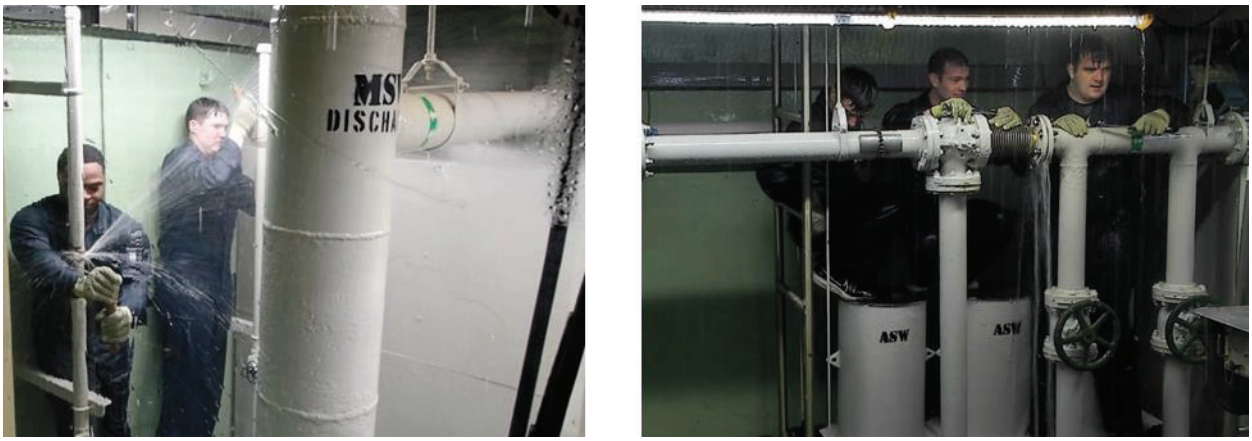


Figure 4: Volunteers in the stressed condition completing a session in the DC Trainer

In the unstressed condition, volunteers reported to a classroom at NSMRL. While seated in a calm, comfortable environment, volunteers filled out the STAI-S and then completed start escape time calculations using their assigned Guard Book platform.

2.5 Data Analysis

All statistical analyses were conducted in R, version 4.2.0. Numerical data (e.g., completion times, STAI-S scores) were modeled using the *lmer* function from the *lme4* package; binary data (e.g., accuracy scores) were modeled using the *lme4 glmer* function. Models were then evaluated using the *Anova* function (type II for models of main effects, type III for models including interactions) from the *car* package. For each variable of interest, the constructed model included interacting fixed effects of Guard Book platform condition and stress condition and random intercepts of subject. Alpha levels of $\alpha = .05$ were used for all analyses.

In addition to analyzing objective performance on the escape time calculations (i.e., the correct earliest start escape time, the calculation completion time), the types of errors that volunteers made were also evaluated for both the E-Guard and paper Guard Book. The errors were categorized into eight groups, or error types: input (typing or writing an incorrect value on the input parameter pages in the Guard Book platforms), instructional (following instructions incorrectly), mathematical (performing arithmetic or mathematic equations incorrectly), table reading (interpreting/recording the table-provided values incorrectly), table rounding (rounding incorrectly on one or more of the table axes), transcription (incorrectly transferring values from one page to another), time conversion (incorrectly converting hours to escape into a date and time to initiate escape), and other (not answering a prompt, or leaving such a lack of information that researchers were unable to determine the cause of the error). As in Moslener et al. (2020), if a volunteer committed more than one type of error, all types were counted; each type of error was only counted once per volunteer. For example, if a volunteer incorrectly copied a value from one page to the next on two occasions, only one transcription error was counted; if a volunteer

incorrectly copied a value from one page to the next and converted from time to date incorrectly, both a transcription error and a time conversion error were counted.

3.0 Results

3.1 Manipulation Check

STAI-S scores were significantly higher in the stressed condition (M = 16.82; SD = 4.99) than in the unstressed condition (M = 13.45, SD = 3.74; $X^2(1) = 11.59$, $p < .001$). This supports that spending time in the DC Trainer successfully introduced a stressful environment.

3.2 Escape Time Performance

E-Guard use significantly improved the accuracy of escape time calculations. 86.4% of volunteers who completed start escape time calculations using the E-Guard correctly determined the "time until start of escape" (i.e., the number of days, hours, and minutes left until escape must begin), compared to only 33.3% of volunteers who completed calculations using the paper Guard Book ($X^2(1) = 6.66$, $p = .01$). No differences emerged in performance accuracy between stress conditions, and no significant interactions were present (all ps > .10).

Interestingly, despite significant performance differences in the accuracy of "time until start of escape" calculations, no significant differences emerged in the accuracy of "date of start of escape" responses (i.e., the day, month, year, hour, and minute of required escape). 50% of volunteers using the E-Guard were correct in their "date of start of escape" responses, and 23.8% of volunteers using the paper Guard Book were correct in their responses ($X^2(1) = 2.11$, $p = .15$). This is likely due to E-Guard users incorrectly entering the date of the casualty event (see Error Type section). When analyses consider only those instances (across all volunteers in both sessions) in which Sailors correctly input the scenario date (i.e., the "Incident Date/Time") of the DISSUB event (26/44 responses for E-Guard; 40/42 responses for paper), E-Guard again had a statistically significantly higher accuracy rate (E-Guard: 88.0% correct; paper: 24.3% correct; $X^2(1) = 13.11$, $p = .0003$). Again, no differences emerged in accuracy between stress conditions, and no significant interactions were present (all ps > .10). See Figure 5 for the comparisons of accuracy on paper Guard Book and E-Guard escape time calculations.

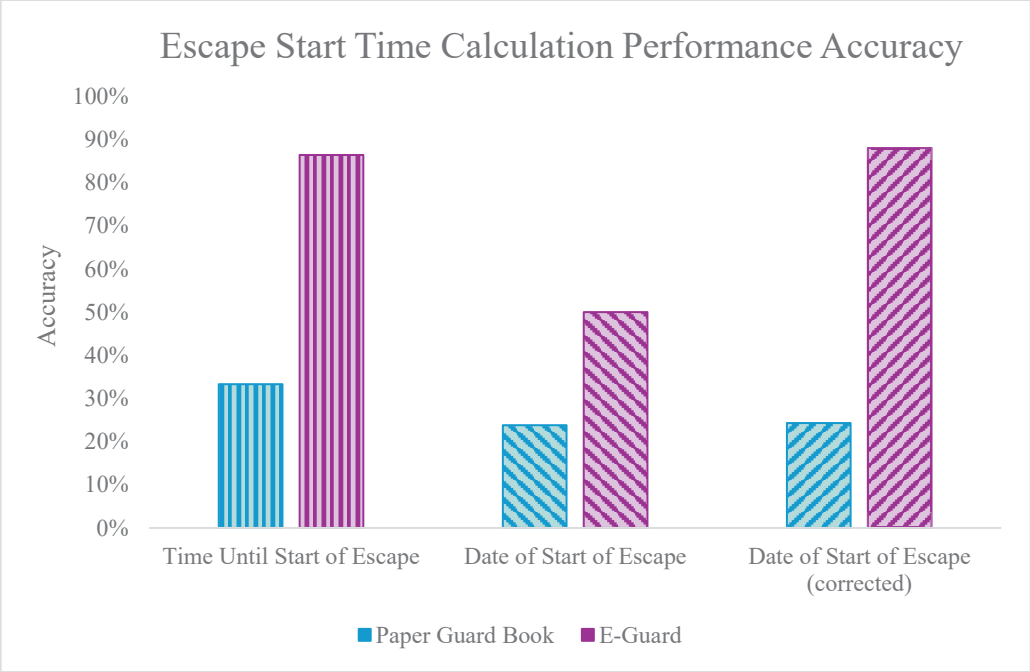


Figure 5: Performance (accuracy) on the paper Guard Book and E-Guard escape time calculations. The accuracies for the responses provided as the earliest start escape times on each answer format ("time until start of escape" and "date of start of escape") are shown. Corrected "date of start of escape" considers only those individuals who entered the correct Incident Date/Time.

Completion times for E-Guard calculations ranged from 3.35 – 13.28 minutes (M = 6.77 min, SD = 2.49 min) and those for paper calculations ranged from 14.10 – 49.07 minutes (M = 29.03 min, SD = 8.93 min; $X^2(1) = 110.88$, $p < .0001$). A main effect of stress condition ($X^2(1) = 9.20$, $p = .002$) emerged, such that completion times were faster in the unstressed condition (M = 16.07 min, SD = 11.32 min) than in the stressed condition (M = 19.14 min, SD = 14.25 min), but no interaction was present ($p > .10$). When considering only those Sailors who reached the correct start escape time, E-Guard performance remained significantly faster ($F = 115.76$, $p < .0001$),[1] with completion times ranging from 3.35 – 13.28 minutes for E-Guard (M = 6.43 min, SD = 2.41 min) and from 15.38 – 43.55 minutes for the paper Guard Book (M = 27.78 min, SD = 8.12 min).

To test for any potential learning effects (attributed to volunteers completing the Guard Book calculations twice), models were constructed with interacting main effects of Guard Book platform condition (paper vs. E-Guard) and session number. Overall, volunteers completed the Guard Book calculations more quickly during their second testing session ($X^2(1) = 75.37$, $p < .0001$), but session number did not significantly impact accuracy of

[1] The mixed-effects model failed to converge, so a general linear model (excluding random effects of subject) was constructed.

"time until escape" ($X^2(1) = 0.14$, $p = .71$) or "date of escape" ($X^2(1) = 0.14$, $p = .71$) calculations.

3.3 Subjective Responses

Overall, Sailors who used the E-Guard were more confident that they had reached the correct start escape time ($X^2(1) = 7.59$, $p = .006$) and were more confident that they had followed the correct steps to get there ($X^2(1) = 4.56$, $p = .03$). Sailors' confidence was predictive of their accuracy in calculating the "date of start of escape" ($X^2(1) = 4.00$, $p = .046$) but not their accuracy in calculating the "time until start of escape" ($X^2(1) = 1.81$, $p = .18$), and was unrelated to Guard Book platform condition (all ps > .05).

3.4 Types of Errors

Analysis of objective performance (i.e., accuracy rates) did not show any statistically significant effects of the stressed vs. unstressed Guard Book completion conditions. Therefore, and to reduce learning effects resulting from completing Guard Book calculations twice (i.e., under both the stressed and unstressed conditions), the analysis of error types considered only each volunteer's first testing session between Guard Book platforms (see Table 1).

Table 1: Error Types Across Guard Book Platforms

Error Type	Paper Guard Book	E-Guard
Input	4	12
Instructional	10	1
Mathematical	1	N/A
Table Reading	9	N/A
Table Rounding	9	N/A
Time Conversion	8	N/A
Transcription	6	2
Other	3	0

3.4.1 Paper Guard Book

Twenty-two volunteers completed the paper Guard Book during Session 1 (18 stressed, 4 unstressed). The most common error type was instructional (20% of errors), which covered a broad range of mistakes to include using an incorrect table, skipping steps, or failing to circle the final answer. Table reading and table rounding errors were the next most common (18% of errors, respectively). Table reading errors most often involved using the incorrect values on the table axes (e.g., selecting 1,300 instead of 13,000). Rounding errors occurred because the values on the table axes do not always match the actual value that the volunteer is working with, so volunteers must round up or down, depending on which table they are using (e.g., if there are 63 survivors fit to escape, the volunteer must round up to 70).

3.4.2 E-Guard

Twenty-three volunteers performed escape time calculations using the E-Guard during Session 1 (20 stressed, 3 unstressed). The most frequently committed error type was an input error (80% of errors), in which volunteers input incorrect scenario values onto the incident date and/or initial parameters screens. There were two instances of transcription errors, attributed to volunteers incorrectly writing information provided by the application onto the answer sheet. Additionally, a single instructional error was present, resulting in a volunteer not indicating the earliest escape time on their answer sheet.

4.0 Discussion

When faced with the need to calculate start escape times using the DISSUB Guard Book, submariners are significantly more accurate and complete the calculations significantly faster when using the tablet-based E-Guard compared to when using the traditional paper version of the Guard Book. This finding held across stress conditions, supporting the use of E-Guard in situations resembling a DISSUB environment, in which mental demands and stress of personnel may be heightened, and mental and physical composure may waver.

As shown in the present study and in Moslener et al. (2020), performance accuracy on the paper Guard Book was low, with only 33.3% of volunteers reaching the correct escape time in the present study and 41.2% of volunteers reaching the correct escape time in Moslener et al. (2020). It is unclear why performance accuracy in the present study was lower than in the prior work. It is possible that, between studies, a difference in volunteers' education levels affected accuracy when using the paper Guard Book. In Moslener et al. (2020), 61% of volunteers held a bachelor's degree or higher, whereas in the current study, only 18% of paper Guard Book volunteers held a at least a bachelor's degree (which is likely more aligned to the makeup of an actual submarine). Additionally, average completion time in the present study was approximately eight minutes faster than the average completion time in Moslener et al. (2020), so it is possible that the present volunteers attempted to complete the calculations more quickly at the expense of accuracy. This may have occurred because calculations were completed in a group setting, and individuals may have felt pressured to work faster as they saw their peers finish the session (despite researcher instruction to prioritize correctly determining start escape times). In any case, the low accuracy rates for paper Guard Book outcomes are concerning and should be mitigated through modifications to existing Guard Book procedures.

An analysis of error types may help guide modifications to future Guard Book iterations. In Moslener et al. (2020), the most common error types were table rounding and time conversion. While these error types persisted in the present study, instructional errors surpassed both to become the most common error type. Instructional errors covered a wide range of mistakes that volunteers made, making it difficult to pinpoint one part of the Guard

Book that can be improved to reduce these errors. Because the start escape time calculations can be difficult, and the instructions may be confusing for individuals completing the calculations for the first time – especially with the instructions requiring users to flip back-and-forth through various pages – user testing should be conducted to ensure that instructions are clear and concise. It may also be beneficial to provide training on general Guard Book use, so that Sailors do not encounter the procedure for the first time in an emergency scenario.

Rounding errors were also prevalent. Since the Moslener et al. (2020) study, the Guard Book was updated to include arrows along each table axis to indicate the correct direction of rounding. While there were fewer rounding errors in the present experiment than seen in Moslener et al. (2020), this error type persisted. It is likely that arrows were either ignored or overlooked, especially when the required rounding direction went against standard rounding rules. Future Guard Book versions should highlight the importance of these arrows to help reduce the number of rounding errors.

Another error type that persisted since Moslener et al.'s study in 2020 was time conversion. The Guard Book calculations result in the total number of hours until escape. Sailors must manually convert this value into the exact date and time of escape, without any instruction on how. Though Moslener et al. (2020) provided a recommended addition to the paper Guard Book that would walk users through this hours-to-date conversion, this has not been implemented in any Guard Book changes. The current study provides additional strong support for changing how the final date of escape is calculated in the paper Guard Book.

Given the low accuracy rates and high rate of errors on the paper Guard Book, alternative solutions to Guard Book calculations are needed. E-Guard improved escape time accuracy and calculation speed, and eliminated many of the most frequently-committed escape time calculation error types of the paper Guard Book. Mathematical, table reading, table rounding, time conversion, and "other" errors were completely eliminated; transcription errors were reduced by two-thirds; and instructional errors were reduced ten-fold. Nevertheless, error types potentially attributed to the application itself (e.g., increased app/input field sensitivity resulting in incorrect or difficult-to-enter inputs), as well as ones potentially attributed to overall human and/or experimental error, persisted during application usage.

Though it is difficult to distinguish or differentiate the exact causes of errors committed during usage of the E-Guard, tablet/application screenshot evidence provides the ability to speculate on how certain errors were made. The most likely contributing factor to E-Guard errors is the user interface (UI)/user experience (UX) of the application. The E-Guard produced a greater number of input errors than the paper Guard Book, a portion of which could be attributed to volunteers inputting the scenario "Incident Date/Time" incorrectly (which occurred in 26 out of 44 E-Guard entries across both experimental sessions). The

Incident Date/Time input consisted of spinner-based date and time selection pickers; the scrolling sensitivity for the pickers may have been too high—with some volunteers even expressing frustration with the input field—making it more difficult to precisely set the Incident Date/Time options on the tablet touchscreen.

Incident Date/Time input errors also may be attributed to confusion with the experimental requirements. Volunteers were required to enter the scenario-provided date and time as the Incident Date/Time to yield the correct escape times; however, some volunteers instead entered the date and time of the experimental session. In a real-world DISSUB scenario, in which the date and time of the DISSUB event is both more evident and more likely to coincide with the date of E-Guard use, this error type is expected to be less prevalent.

Similarly, other errors in which escape time accuracy may have been dependent on volunteers complying with experimental requirements were transcription errors and instructional errors. In some cases, volunteers neglected to write the E-Guard-provided escape time answer(s) correctly on the answer sheet (transcription errors), even though screenshots showed that the application had produced the correct answer. In other cases, volunteers failed to record the escape time answers or indicate the earliest escape time on the answer sheet as instructed (instructional errors); these errors are likely restricted to experimental (as opposed to real-world) settings.

Changes and improvements to the E-Guard are required to ensure that all users can arrive at the correct escape time decisions. These changes include UI/UX considerations, such as implementing an alternate input type for the Incident Date/Time field (e.g., a keypad-based entry method—similar to other existing E-Guard parameter input fields, which did not yield data input errors during the current study) or providing increased in-application clarifications/explanations regarding how to interpret the meaning of certain inputs or escape time outputs.

Feature/factor additions to the application (and subsequent testing) are also necessary for the application to be considered valid, i.e., effective in actual or DISSUB-like scenarios and sufficient/cleared for fleetwide use. Factors including compartment type, ship service air pressure, compartment pressure, toxic gas levels, etc., were not implemented in the current experiment because active development of backend calculations relevant to those factors are ongoing. However, such factors should be considered in DISSUB start escape time decision-making and should be tested once implemented into the E-Guard, prior to the software validation (i.e., an independent verification and validation) required for the application to be eligible for fleetwide use.

Moreover, though the current study's results support the applicability of the E-Guard in mentally and physically stressful environments, the physical practicality and utility of the E-Guard and the deployed tablet (i.e., the hardware) on which it would be hosted have yet to

be tested. Physical and atmospheric hazards, including flooding, gas concentration fluctuations, pressure changes, etc., can all occur during a DISSUB event, and a future study must evaluate how well submariners are able to complete escape time calculations under similar types of conditions (on electronic and paper Guard Book platforms). Moreover, the ability of each platform to physically sustain these conditions must be evaluated (e.g., the Guard Book platforms being able to withstand physical damage from falls or flooding, tablets being able to hold a charge across a multi-day DISSUB period).

Irrespective of improvements made to the E-Guard to minimize the potential for errors, the application cannot serve as a complete/direct replacement to the paper Guard Book. Human error will persist across any version of the Guard Book platform, even on a simplified platform such as the E-Guard. It is necessary for Sailors to be more cognizant, especially during stressful, DISSUB-like scenarios, of the inputs they consider during start escape time calculations. Moreover, tablets are fallible; they may run out of battery charge, become damaged, malfunction, etc. in a DISSUB scenario. Therefore, the E-Guard should be used to supplement, but not fully replace, the paper Guard Book; moreover, changes must be made to the paper Guard Book to improve the low accuracy rates observed in this study and in Moslener et al. (2020).

5.0 Bibliography/References

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Appendix A: Paper Guard Book and E-Guard Performance of the Unstressed Only Sample

In addition to the 45 volunteers who completed the full experimental design, an additional 18 volunteers (3 females) completed both paper and E-Guard calculations under only unstressed conditions. These volunteers ranged in age from 23-39 (M = 29.9 years, SD = 3.0 years) with a mean time of service of 8.2 years (SD = 3.6 years). Two of these volunteers were Enlisted; 16 were Officers. Within-subjects analyses were conducted to compare performance across the two Guard Book types.

The percentage of volunteers arriving at the correct date of escape (E-Guard: 66.7%; paper: 38.9%) and time until escape (E-Guard: 80.0%; paper: 58.8%) did not differ statistically (all ps > .1). Completion times were faster for E-Guard (M = 5.67 min, SD = 1.55 min) than the paper Guard Book (M = 26.16 min, SD = 8.15 min; $X^2(1) = 146.81$, $p < .0001$). This outcome held even when considering only correct responses (E-Guard: M = 5.91 min, SD = 1.64 min; paper: M = 26.92 min, SD = 7.21 min; $X^2(1) = 119.3$, $p < .0001$).

Most paper Guard Book errors were time conversion errors (30.77%), whereas a majority of E-Guard errors were input errors (40.0%). A breakdown of errors is shown in Table A1.

Table A1: Error Types Across Guard Book Platforms in the Unstressed Only Sample

Error Type	Unstressed Only	
	Paper Guard Book	E-Guard
Input	3	4
Instructional	3	2
Mathematical	1	N/A
Table Reading	5	N/A
Table Rounding	4	N/A
Time Conversion	8	N/A
Transcription	1	2
Other	1	2[a]

Note. Classification for paper Guard Book and E-Guard errors for volunteers who completed escape time calculations on both Guard Book platforms (separately), only while unstressed.
[a] One of the "other" errors identified was due to improper installation of the E-Guard software onto the tablet, which was not used in any other experimental trials. Regardless of the app-based error, this volunteer would not have reached the correct escape time answers.

Appendix B: Scenario Sheets

Scenario #1

Starting Time = **1436**

Date = **19-03-2019**

Percent flooded = **0%**

Number of O_2 Candles with ignites = **50**

Total # Survivors = **100**

Percent SEV O_2 Analox = **18%**

Depth = **550 ft**

Number of Unfit to escape = **20**

Temperature = **75° F**

Number of Fit to escape = **80**

Percent SEV CO_2 Analox = **2%**

Number of ExtendAir LiOH cans with Deployment Kits = **140**

EABs in use = **Yes**

Starting Time = **0515**

Date = **13-06-2022**

Percent flooded = **20%**

Number of O_2 Candles with ignites = **80**

Total # Survivors = **160**

Percent SEV O_2 Analox = **26%**

Depth = **550 ft**

Number of Unfit to escape = **65**

Temperature = **75° F**

Number of Fit to escape = **95**

Percent SEV CO_2 Analox = **4%**

Number of ExtendAir LiOH cans with Deployment Kits = **200**

EABs in use = **Yes**

Appendix C: Paper Guard Book Answer Sheet and Calculation Packet

Paper Guard Book Answer Sheet

PID_____

S9594-AP-SAR-G10 REV 01

Scenario _____

OP6B

ASSESS CARBON DIOXIDE & OXYGEN START ESCAPE TIME

PROCEDURES/APPENDICES IMPACTED OR INVOKED

SG.....SENIOR SURVIVOR GUIDE

OP6.....INITIAL ATMOSPHERE ASSESSMENT

EQUIPMENT/TOOLS

NONE

OPERATIONS

_____ **1. Determine start escape times.**

_____ a. Fill-in Table 1 using previously recorded Table 1 (OP6) information or as updated since OP6 completion. Complete step 1 of section 1 (OP6B-3).

_____ b. Perform remaining section 1 steps, for results to avoid **high limit 6% SEV Carbon Dioxide (CO_2)** being exceeded before all escapes are complete; record below:

CO_2 START ESCAPE TIME: _____ _____ / ____
Time (24Hr) (DD - MM / YY)

_____ c. Perform section 2 (OP6B-12) steps, for results to avoid **low limit 13% SEV Oxygen (O_2)** being exceeded before all escapes are complete; record below:

O_2 START ESCAPE TIME: _____ _____ / ____
Time (24Hr) (DD - MM / YY)

_____ d. Circle the earliest START ESCAPE TIME in 1.b or 1.c above.

TABLE 1
DISSUB CONDITIONS DATA

Data Time and Date Table 1 information was gathered: *Transfer to Calculation Box #3 (OP6B-4) and Calculation Box #6 (OP6B-14).*	_____ ____ - ____ / ____ **(1)** **Time (24Hr) (DD - MM / YY)**
---NOTE--- *This Time/Date shall represent only one point-in-time for all Table 1 information.*	
Number of Survivors (FWD): Transfer to Tables 6A, 6B, 6C, 10A, 10B & 10C.	_____ Survivor Total **(2)**
Survivors FIT to escape (FWD): Transfer to Tables 2A, 2B, 3 & 8.	_____ FIT to Escape **(3)**
---NOTE--- *A FIT survivor is defined as having full use of both arms and able to stand upright in the escape trunk while it is being flooded. Personnel unable to perform this task due to injury, nausea or convulsions are UNFIT and not included.*	
Survivors UNFIT to escape (FWD): *Transfer to Table 2A or 2B (as applicable).*	_____ UNFIT to Escape **(4)**
Percent FWD compartment is flooded (rounded to nearest 20%): *Transfer to Tables 3, 4, 7A, 7B & 8.*	_____ % Flooded **(5)**
FWD compartment CO_2 concentration in %SEV as read from Analox Analyzer or alternate method: *Transfer to Table 4.*	_____ % SEV CO_2 Analox **(6)**
FWD compartment O_2 concentration in %SEV as read from Analox Analyzer or alternate method: *Transfer to page OP6B-12 & Tables 7A or B.*	_____ % SEV O_2 Analox **(7)**
Number of ExtendAir® Lithium Hydroxide (LiOH) Canisters with ExtendAir® Deployment Kit: (One ExtendAir® DISSUB LiOH Deployment Kit per 60 ExtendAir® LiOH Canisters is required) **(FWD):** *Transfer to Table 5.*	_____ Cans (ExtendAir® LiOH with enough ExtendAir® DISSUB LiOH Deployment Kits) **(8)**
Number of oxygen candles with at least half as many igniters available (FWD): *Transfer to Table 9.*	_____ Cans (O_2 Candles with enough igniters) **(9)**

SECTION 1
CARBON DIOXIDE TIME TO ESCAPE CALCULATIONS

---NOTE---

Calculations of Section 1 provide an estimated time when escapes should commence to prevent exceeding high limit 6% SEV Carbon Dioxide (CO_2) before all escapes are completed.

☐ **STEP 1:** Transfer Table 1 recorded values into Sections 1 and 2 as indicated in the first column of Table 1.

---NOTE---

When transferring these recorded values to other areas, look for blanks to be filled-in or, 'circle' applicable 'table Left (Column) or Top (Row) axis' quantity that is marked with a corresponding number in parenthesis (e.g., (2) = Survivor Total). If the Table 1 value transferred is not equal to the higher or lower value on the Table it is being transferred into, select the more conservative higher or lower axis value.

☐ **STEP 2:** In Table 2A or 2B (as applicable), circle the intersecting value to the previously circled Table 1 axis values **(3)** and **(4)**. Record the Table 2 intersecting value below. Record this value above Table 5 and Table 9 in the 'Table 2 value' spaces provided above these Tables. Use the Table 2 value to circle its 'equal or greater' value on Table 5 and Table 9 top row axis's.

Table 2 value: _____

☐ **STEP 3:** In Table 3A or 3B (as applicable), circle the intersecting value to the previously circled Table 1 values **(3)** and **(5)**; Record the Table 3 intersecting value in the Calculation Box #1 'Table 3 value' space at right.

☐ **STEP 4:** In Table 4A or 4B (as applicable), circle the intersecting value to the previously circled Table 1 values **(6)** and **(5)**; Record the Table 4 intersecting value in the Calculation Box #1 'Table 4 value' space.

☐ **STEP 5:** If the 'Table 4 value' is equal to or larger than the 'Table 3 value' recorded in Calculation Box #1, Record '0' in the Calculation Box #3 'Table 6 value' space, then skip to step 12. Otherwise, continue to step 6.

☐ **STEP 6:** In Calculation Box #1, ***subtract*** the 'Table 4 value' from the 'Table 3 value' as indicated. Record in Calculation Box #1 and in Calculation Box #2 as the 'CALC Box #1 result'.

CALCULATION BOX #1

Table 3 value: _____
[From Step 3]

Table 4 value: – _____
[From Step 4]

CALC Box #1 result: = _____

(Record this result in Calculation Box #2 as the 'CALC Box #1 result'.)

CALCULATION BOX #2

CALC Box #1 result: _____
[From Step 6]

Table 5 value: + _____
[From Step 7]

CALC Box #2 result: = _____

(Record this result above Table 6 as described by step 9.)

☐ **STEP 7:** In Table 5, circle the intersecting value to the previously circled Table 1 axis value **(8)** and the 'Table 2 value' recorded above Table 5 (by step 2). Record the Table 5 intersecting value in the Calculation Box #2 'Table 5 value' space.

---NOTE---

*Table 5 values in some columns of the top three rows are **NEGATIVE NUMBERS** (as indicated by a preceding dash) and must be recorded with its 'preceding dash' in Calculation Box #2 to represent a negative number.*

☐ **STEP 8:** In Calculation Box #2, **add** the 'Table 5 value' to the 'CALC Box #1 result'.

---NOTE---

*If the 'Table 5 value' was recorded with a preceding dash copied from Table 5, this **NEGATIVE NUMBER** must be **SUBTRACTED** instead of **ADDED** from the 'CALC Box #1 result' in Calculation Box #2.*

☐ **STEP 9:** Record 'CALC Box #2 result' above Table 6A, 6B, or 6C (as applicable) in the 'CALC Box #2 result' space provided.

☐ **STEP 10:** Use 'CALC Box #2 result' to circle its 'equal or lesser' value on the applicable Table 6 top row axis.

☐ **STEP 11:** Determine (& circle) the Table 6 intersecting value for the axis values previously circled (i.e., use Table 1 value **(2)** for far left column axis and 'CALC Box #2 result' for top row axis of Table 6). Record this value in the Calculation Box #3 'Table 6 value' space at right.

☐ **STEP 12:** In Calculation Box #3, use the 'Table 6 value' to convert the 'Data Time/Date values' to a 'CO_2 Start Escape Time'. This is the time/date escapes must start to prevent exceeding high limit 6% SEV CO_2 before all escapes are completed. Record this result on OP6B-1 under 1.b '***CO_2 START ESCAPE TIME***'. This completes OP6B Section 1. Continue to step 13 (Section 2, OP6B-12).

CALCULATION BOX #3

Data Time/Date: [**(1)** From Table 1] _____ ____ - ____ / ____
Time (24Hr) (DD - MM / YY)

Table 6 value: [From Step 11] + _____
Hrs (Stay Time)

CO_2 Start Escape Time: = _____ ____ - ____ / ____
Time (24Hr) (DD - MM / YY)

(Record this result on OP6B-1 under 1.b.)

TABLE 2A (Section 1)

Round Conservatively

TABLE 2A	UNFIT to ESCAPE [(4) From Table 1] (1/ - *For an UNFIT number 90 or greater, use Table 2B.*)																	
FIT to ESCAPE [(3) From Table 1] (Round Conservatively)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85 1/
5	1	4	7	10	13	16	20	23	26	29	32	35	38	41	45	48	51	54
10	5	11	18	24	30	36	43	49	55	61	68	74	80	86	93	99	105	111
15	12	21	31	40	50	59	68	78	87	96	106	115	125	134	143	153	162	171
20	23	35	48	60	73	85	98	110	123	135	148	160	173	185	198	210	223	235
25	36	51	67	83	98	114	130	145	161	176	192	208	223	239	255	270	286	301
30	53	71	90	109	128	146	165	184	203	221	240	259	278	296	315	334	353	371
35	72	94	116	138	160	181	203	225	247	269	291	313	335	356	378	400	422	444
40	95	120	145	170	195	220	245	270	295	320	345	370	395	420	445	470	495	520
45	121	149	177	205	233	261	290	318	346	374	402	430	458	486	515	543	571	599
50	150	181	213	244	275	306	338	369	400	431	463	494	525	556	588	619	650	681
55	182	216	251	285	320	354	388	423	457	491	526	560	595	629	663	698	732	766
60	218	255	293	330	368	405	443	480	518	555	593	630	668	705	743	780	818	855
65	256	296	337	378	418	459	500	540	581	621	662	703	743	784	825	865	906	946
70	298	341	385	429	473	516	560	604	648	691	735	779	823	866	910	954	998	1041
75	342	389	436	483	530	576	623	670	717	764	811	858	905	951	998	1045	1092	1139
80	390	440	490	540	590	640	690	740	790	840	890	940	990	1040	1090	1140	1190	1240
85	441	494	547	600	653	706	760	813	866	919	972	1025	1078	1131	1185	1238	1291	1344
90	495	551	608	664	720	776	833	889	945	1001	1058	1114	1170	1226	1283	1339	1395	1451
95	552	611	671	730	790	849	908	968	1027	1086	1146	1205	1265	1324	1383	1443	1502	1561
100	613	675	738	800	863	925	988	1050	1113	1175	1238	1300	1363	1425	1488	1550	1613	1675
105	676	741	807	873	938	1004	1070	1135	1201	1266	1332	1398	1463	1529	1595	1660	1726	1791
110	743	811	880	949	1018	1086	1155	1224	1293	1361	1430	1499	1568	1636	1705	1774	>1800	>1800
115	812	884	956	1028	1100	1171	1243	1315	1387	1459	1531	1603	1675	1746	>1800	>1800	>1800	>1800
120	885	960	1035	1110	1185	1260	1335	1410	1485	1560	1635	1710	1785	>1800	>1800	>1800	>1800	>1800
125	961	1039	1117	1195	1273	1351	1430	1508	1586	1664	1742	>1800	>1800	>1800	>1800	>1800	>1800	>1800
130	1040	1121	1203	1284	1365	1446	1528	1609	1690	1771	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
135	1122	1206	1291	1375	1460	1544	1628	1713	1797	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
140	1208	1295	1383	1470	1558	1645	1733	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
145	1296	1386	1477	1568	1658	1749	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
150	1388	1481	1575	1669	1763	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
155	1482	1579	1676	1773	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
160	1580	1680	1780	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800

TABLE 2B (Section 1)

Round Conservatively

TABLE 2B	UNFIT to ESCAPE [(4) From Table 1] *continued from Table 2A*														
FIT to ESCAPE [(3) From Table 1]	90	95	100	105	110	115	120	125	130	135	140	145	150	155	160
5	57	60	63	66	70	73	76	79	82	85	88	91	95	98	101
10	118	124	130	136	143	149	155	161	168	174	180	186	193	199	205
15	181	190	200	209	218	228	237	246	256	265	275	284	293	303	312
20	248	260	273	285	298	310	323	335	348	360	373	385	398	410	423
25	317	333	348	364	380	395	411	426	442	458	473	489	505	520	536
30	390	409	428	446	465	484	503	521	540	559	578	596	615	634	653
35	466	488	510	531	553	575	597	619	641	663	685	706	728	750	772
40	545	570	595	620	645	670	695	720	745	770	795	820	845	870	895
45	627	655	683	711	740	768	796	824	852	880	908	936	965	993	1021
50	713	744	775	806	838	869	900	931	963	994	1025	1056	1088	1119	1150
55	801	835	870	904	938	973	1007	1041	1076	1110	1145	1179	1213	1248	1282
60	893	930	968	1005	1043	1080	1118	1155	1193	1230	1268	1305	1343	1380	1418
65	987	1028	1068	1109	1150	1190	1231	1271	1312	1353	1393	1434	1475	1515	1556
70	1085	1129	1173	1216	1260	1304	1348	1391	1435	1479	1523	1566	1610	1654	1698
75	1186	1233	1280	1326	1373	1420	1467	1514	1561	1608	1655	1701	1748	1795	>1800
80	1290	1340	1390	1440	1490	1540	1590	1640	1690	1740	1790	>1800	>1800	>1800	>1800
85	1397	1450	1503	1556	1610	1663	1716	1769	>1800	>1800	>1800	>1800	>1800	>1800	>1800
90	1508	1564	1620	1676	1733	1789	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
95	1621	1680	1740	1799	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800
100	1738	1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800	>1800

Round Conservatively

TABLE 3 & TABLE 4 (Section 1)

Round Conservatively

Round Conservatively

TABLE 3A

FIT to ESCAPE [(3) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From TABLE 1]				
	0	20	40	60	80
5	5316	4227	3137	2048	959
10	5299	4209	3120	2031	941
15	5272	4183	3094	2004	915
20	5255	4165	3076	1987	897
25	5228	4139	3050	1960	871
30	5211	4121	3032	1943	853
35	5185	4095	3006	1916	827
40	5167	4078	2988	1899	809
45	5141	4051	2962	1872	783
50	5123	4034	2944	1855	765
55	5097	4007	2918	1828	739
60	5079	3990	2900	1811	721
65	5053	3963	2874	1784	695
70	5035	3946	2856	1767	678
75	5009	3919	2830	1741	651
80	4991	3902	2812	1723	634
85	4965	3875	2786	1697	607

TABLE 3B

FIT to ESCAPE [(3) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From TABLE 1]				
	0	20	40	60	80
90	4947	3858	2768	1679	590
95	4921	3831	2742	1653	563
100	4903	3814	2725	1635	546
105	4877	3788	2698	1609	519
110	4859	3770	2681	1591	502
115	4833	3744	2654	1565	475
120	4815	3726	2637	1547	458
125	4789	3700	2610	1521	431
130	4772	3682	2593	1503	414
135	4745	3656	2566	1477	388
140	4728	3638	2549	1459	370
145	4701	3612	2522	1433	344
150	4684	3594	2505	1415	326
155	4657	3568	2478	1389	300
160	4640	3550	2461	1371	282

TABLE 4A

COMPARTMENT CO_2 CONCENTRATION (% SEV) [(6) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From TABLE 1]				
	0	20	40	60	80
0.00	0	0	0	0	0
0.20	182	145	109	73	36
0.40	363	291	218	145	73
0.60	545	436	327	218	109
0.80	726	581	436	291	145
1.00	908	726	545	363	182
1.20	1089	872	654	436	218
1.40	1271	1017	763	508	254
1.60	1453	1162	872	581	291
1.80	1634	1307	980	654	327
2.00	1816	1453	1089	726	363
2.20	1997	1598	1198	799	399
2.40	2179	1743	1307	872	436
2.60	2360	1888	1416	944	472
2.80	2542	2034	1525	1017	508
3.00	2724	2179	1634	1089	545
3.20	2905	2324	1743	1162	581

TABLE 4B

COMPARTMENT CO_2 CONCENTRATION (% SEV) [(6) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From TABLE 1]				
	0	20	40	60	80
3.40	3087	2469	1852	1235	617
3.60	3268	2615	1961	1307	654
3.80	3450	2760	2070	1380	690
4.00	3631	2905	2179	1453	726
4.20	3813	3050	2288	1525	763
4.40	3994	3196	2397	1598	799
4.60	4176	3341	2506	1670	835
4.80	4358	3486	2615	1743	872
5.00	4539	3631	2724	1816	908
5.20	4721	3777	2832	1888	944
5.40	4902	3922	2941	1961	980
5.60	5084	4067	3050	2034	1017
5.80	5265	4212	3159	2106	1053
6.00	5447	4358	3268	2179	1089

TABLE 5 (Section 1)

Table 2 value: _____ (From Step 2, Use for Table 5 top row axis. Round to the next higher axis value if Table 2 value is in between below axis values.)

Round Conservatively

Round Conservatively

TABLE 5	TABLE 2 VALUE (From above fill-in value – via Step 2)																				
EXTENDAIR® LiOH CANISTERS [(8) From Table 1]	25	50	75	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
0	*-25*	*-50*	*-75*	*-100*	*-200*	*-300*	*-400*	*-500*	*-600*	*-700*	*-800*	*-900*	*-1000*	*-1100*	*-1200*	*-1300*	*-1400*	*-1600*	*-1700*	*-1800*	*-1800*
10	705	680	655	630	530	430	330	230	130	30	*-70*	*-170*	*-270*	*-370*	*-470*	*-570*	*-670*	*-870*	*-970*	*-1070*	*-1070*
20	1435	1410	1385	1360	1260	1160	1060	960	860	760	660	560	460	360	260	160	60	*-140*	*-240*	*-340*	*-340*
30	2165	2140	2115	2090	1990	1890	1790	1690	1590	1490	1390	1290	1190	1090	990	890	790	590	490	390	390
40	2895	2870	2845	2820	2720	2620	2520	2420	2320	2220	2120	2020	1920	1820	1720	1620	1520	1320	1220	1120	1120
50	3625	3600	3575	3550	3450	3350	3250	3150	3050	2950	2850	2750	2650	2550	2450	2350	2250	2050	1950	1850	1850
60	4355	4330	4305	4280	4180	4080	3980	3880	3780	3680	3580	3480	3380	3280	3180	3080	2980	2780	2680	2580	2580
70	5085	5060	5035	5010	4910	4810	4710	4610	4510	4410	4310	4210	4110	4010	3910	3810	3710	3510	3410	3310	3310
80	5815	5790	5765	5740	5640	5540	5440	5340	5240	5140	5040	4940	4840	4740	4640	4540	4440	4240	4140	4040	4040
90	6545	6520	6495	6470	6370	6270	6170	6070	5970	5870	5770	5670	5570	5470	5370	5270	5170	4970	4870	4770	4770
100	7275	7250	7225	7200	7100	7000	6900	6800	6700	6600	6500	6400	6300	6200	6100	6000	5900	5700	5600	5500	5500
110	8005	7980	7955	7930	7830	7730	7630	7530	7430	7330	7230	7130	7030	6930	6830	6730	6630	6430	6330	6230	6230
120	8735	8710	8685	8660	8560	8460	8360	8260	8160	8060	7960	7860	7760	7660	7560	7460	7360	7160	7060	6960	6960
130	9465	9440	9415	9390	9290	9190	9090	8990	8890	8790	8690	8590	8490	8390	8290	8190	8090	7890	7790	7690	7690
140	10195	10170	10145	10120	10020	9920	9820	9720	9620	9520	9420	9320	9220	9120	9020	8920	8820	8620	8520	8420	8420
150	10925	10900	10875	10850	10750	10650	10550	10450	10350	10250	10150	10050	9950	9850	9750	9650	9550	9350	9250	9150	9150
160	11655	11630	11605	11580	11480	11380	11280	11180	11080	10980	10880	10780	10680	10580	10480	10380	10280	10080	9980	9880	9880
170	12385	12360	12335	12310	12210	12110	12010	11910	11810	11710	11610	11510	11410	11310	11210	11110	11010	10810	10710	10610	10610
180	13115	13090	13065	13040	12940	12840	12740	12640	12540	12440	12340	12240	12140	12040	11940	11840	11740	11540	11440	11340	11340
190	13845	13820	13795	13770	13670	13570	13470	13370	13270	13170	13070	12970	12870	12770	12670	12570	12470	12270	12170	12070	12070
200	14575	14550	14525	14500	14400	14300	14200	14100	14000	13900	13800	13700	13600	13500	13400	13300	13200	13000	12900	12800	12800
210	15305	15280	15255	15230	15130	15030	14930	14830	14730	14630	14530	14430	14330	14230	14130	14030	13930	13730	13630	13530	13530
220	16035	16010	15985	15960	15860	15760	15660	15560	15460	15360	15260	15160	15060	14960	14860	14760	14660	14460	14360	14260	14260
230	16765	16740	16715	16690	16590	16490	16390	16290	16190	16090	15990	15890	15790	15690	15590	15490	15390	15190	15090	14990	14990
240	17495	17470	17445	17420	17320	17220	17120	17020	16920	16820	16720	16620	16520	16420	16320	16220	16120	15920	15820	15720	15720
250	18225	18200	18175	18150	18050	17950	17850	17750	17650	17550	17450	17350	17250	17150	17050	16950	16850	16650	16550	16450	16450
260	18955	18930	18905	18880	18780	18680	18580	18480	18380	18280	18180	18080	17980	17880	17780	17680	17580	17480	17380	17280	17180
270	19685	19660	19635	19610	19510	19410	19310	19210	19110	19010	18910	18810	18710	18610	18510	18410	18310	18210	18110	18010	17910
280	20415	20390	20365	20340	20240	20140	20040	19940	19840	19740	19640	19540	19440	19340	19240	19140	19040	18940	18840	18740	18640

TABLE 6A (Section 1)

PRE-ESCAPE 'CO₂' STAY TIME (Hrs)

CALC Box #2 result: _____ (From Step 9, use for Table 6A top row axis, if applicable. For a CALC Box #2 result 5,250 or greater, use Table 6B.)

Round Conservatively

Round Conservatively

TABLE 6A	CALC BOX #2 RESULT [From above fill-in value – via Step 9]																											
SURVIVOR TOTAL [(2) from Table 1]	0	50	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000
5	0	10	20	40	60	80	100	120	140	160	180	200	250	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
10	0	5	10	20	30	40	50	60	70	80	90	100	125	150	175	200	225	250	275	300	>300	>300	>300	>300	>300	>300	>300	>300
15	0	3	7	13	20	27	33	40	47	53	60	67	83	100	117	133	150	167	183	200	217	233	250	267	283	300	>300	>300
20	0	3	5	10	15	20	25	30	35	40	45	50	63	75	88	100	113	125	138	150	163	175	188	200	213	225	238	250
25	0	2	4	8	12	16	20	24	28	32	36	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
30	0	2	3	7	10	13	17	20	23	27	30	33	42	50	58	67	75	83	92	100	108	117	125	133	142	150	158	167
35	0	1	3	6	9	11	14	17	20	23	26	29	36	43	50	57	64	71	79	86	93	100	107	114	121	129	136	143
40	0	1	3	5	8	10	13	15	18	20	23	25	31	38	44	50	56	63	69	75	81	88	94	100	106	113	119	125
45	0	1	2	4	7	9	11	13	16	18	20	22	28	33	39	44	50	56	61	67	72	78	83	89	94	100	106	111
50	0	1	2	4	6	8	10	12	14	16	18	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
55	0	1	2	4	5	7	9	11	13	15	16	18	23	27	32	36	41	45	50	55	59	64	68	73	77	82	86	91
60	0	1	2	3	5	7	8	10	12	13	15	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83
65	0	1	2	3	5	6	8	9	11	12	14	15	19	23	27	31	35	38	42	46	50	54	58	62	65	69	73	77
70	0	1	1	3	4	6	7	9	10	11	13	14	18	21	25	29	32	36	39	43	46	50	54	57	61	64	68	71
75	0	1	1	3	4	5	7	8	9	11	12	13	17	20	23	27	30	33	37	40	43	47	50	53	57	60	63	67
80	0	1	1	3	4	5	6	8	9	10	11	13	16	19	22	25	28	31	34	38	41	44	47	50	53	56	59	63
85	0	1	1	2	4	5	6	7	8	9	11	12	15	18	21	24	26	29	32	35	38	41	44	47	50	53	56	59
90	0	1	1	2	3	4	6	7	8	9	10	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50	53	56
95	0	1	1	2	3	4	5	6	7	8	9	11	13	16	18	21	24	26	29	32	34	37	39	42	45	47	50	53
100	0	1	1	2	3	4	5	6	7	8	9	10	13	15	18	20	23	25	28	30	33	35	38	40	43	45	48	50
105	0	0	1	2	3	4	5	6	7	8	9	10	12	14	17	19	21	24	26	29	31	33	36	38	40	43	45	48
110	0	0	1	2	3	4	5	5	6	7	8	9	11	14	16	18	20	23	25	27	30	32	34	36	39	41	43	45
115	0	0	1	2	3	3	4	5	6	7	8	9	11	13	15	17	20	22	24	26	28	30	33	35	37	39	41	43
120	0	0	1	2	3	3	4	5	6	7	8	8	10	13	15	17	19	21	23	25	27	29	31	33	35	38	40	42
125	0	0	1	2	2	3	4	5	6	6	7	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
130	0	0	1	2	2	3	4	5	5	6	7	8	10	12	13	15	17	19	21	23	25	27	29	31	33	35	37	38
135	0	0	1	1	2	3	4	4	5	6	7	7	9	11	13	15	17	19	20	22	24	26	28	30	31	33	35	37
140	0	0	1	1	2	3	4	4	5	6	6	7	9	11	13	14	16	18	20	21	23	25	27	29	30	32	34	36
145	0	0	1	1	2	3	3	4	5	6	6	7	9	10	12	14	16	17	19	21	22	24	26	28	29	31	33	34
150	0	0	1	1	2	3	3	4	5	5	6	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	32	33
155	0	0	1	1	2	3	3	4	5	5	6	6	8	10	11	13	15	16	18	19	21	23	24	26	27	29	31	32
160	0	0	1	1	2	3	3	4	4	5	6	6	8	9	11	13	14	16	17	19	20	22	23	25	27	28	30	31

TABLE 6B (Section 1)

PRE-ESCAPE 'CO₂' STAY TIME (Hrs)

CALC Box #2 result: _____ (From Step 9, use for Table 6B top row axis, if applicable. For a CALC Box #2 result 13,000 or greater, use Table 6C.)

Round Conservatively

Round Conservatively

TABLE 6B	CALC BOX #2 RESULT [From above fill-in value – via Step 9]																								
SURVIVOR TOTAL [(2) from Table 1]	5250	5500	5750	6000	6250	6500	6750	7000	7250	7500	7750	8000	8250	8500	8750	9000	9250	9500	9750	10000	10500	11000	11500	12000	12500
5	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
10	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
15	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
20	263	275	288	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
25	210	220	230	240	250	260	270	280	290	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
30	175	183	192	200	208	217	225	233	242	250	258	267	275	283	292	300	>300	>300	>300	>300	>300	>300	>300	>300	>300
35	150	157	164	171	179	186	193	200	207	214	221	229	236	243	250	257	264	271	279	286	300	>300	>300	>300	>300
40	131	138	144	150	156	163	169	175	181	188	194	200	206	213	219	225	231	238	244	250	263	275	288	300	>300
45	117	122	128	133	139	144	150	156	161	167	172	178	183	189	194	200	206	211	217	222	233	244	256	267	278
50	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	210	220	230	240	250
55	95	100	105	109	114	118	123	127	132	136	141	145	150	155	159	164	168	173	177	182	191	200	209	218	227
60	88	92	96	100	104	108	113	117	121	125	129	133	138	142	146	150	154	158	163	167	175	183	192	200	208
65	81	85	88	92	96	100	104	108	112	115	119	123	127	131	135	138	142	146	150	154	162	169	177	185	192
70	75	79	82	86	89	93	96	100	104	107	111	114	118	121	125	129	132	136	139	143	150	157	164	171	179
75	70	73	77	80	83	87	90	93	97	100	103	107	110	113	117	120	123	127	130	133	140	147	153	160	167
80	66	69	72	75	78	81	84	88	91	94	97	100	103	106	109	113	116	119	122	125	131	138	144	150	156
85	62	65	68	71	74	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	124	129	135	141	147
90	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100	103	106	108	111	117	122	128	133	139
95	55	58	61	63	66	68	71	74	76	79	82	84	87	89	92	95	97	100	103	105	111	116	121	126	132
100	53	55	58	60	63	65	68	70	73	75	78	80	83	85	88	90	93	95	98	100	105	110	115	120	125
105	50	52	55	57	60	62	64	67	69	71	74	76	79	81	83	86	88	90	93	95	100	105	110	114	119
110	48	50	52	55	57	59	61	64	66	68	70	73	75	77	80	82	84	86	89	91	95	100	105	109	114
115	46	48	50	52	54	57	59	61	63	65	67	70	72	74	76	78	80	83	85	87	91	96	100	104	109
120	44	46	48	50	52	54	56	58	60	63	65	67	69	71	73	75	77	79	81	83	88	92	96	100	104
125	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	84	88	92	96	100
130	40	42	44	46	48	50	52	54	56	58	60	62	63	65	67	69	71	73	75	77	81	85	88	92	96
135	39	41	43	44	46	48	50	52	54	56	57	59	61	63	65	67	69	70	72	74	78	81	85	89	93
140	38	39	41	43	45	46	48	50	52	54	55	57	59	61	63	64	66	68	70	71	75	79	82	86	89
145	36	38	40	41	43	45	47	48	50	52	53	55	57	59	60	62	64	66	67	69	72	76	79	83	86
150	35	37	38	40	42	43	45	47	48	50	52	53	55	57	58	60	62	63	65	67	70	73	77	80	83
155	34	35	37	39	40	42	44	45	47	48	50	52	53	55	56	58	60	61	63	65	68	71	74	77	81
160	33	34	36	38	39	41	42	44	45	47	48	50	52	53	55	56	58	59	61	63	66	69	72	75	78

TABLE 6C (Section 1)

PRE-ESCAPE 'CO₂' STAY TIME (Hrs)

CALC Box #2 result: _____ (From Step 9, use for Table 6C top row axis, if applicable).

Round Conservatively

Round Conservatively

TABLE 6C — SURVIVOR TOTAL [(2) from Table 1]	CALC BOX #2 RESULT [From above fill-in value – via Step 9] *(K = x(1,000); e.g., 13K = 13,000 and 13.5K = 13,500)*																								
	13K	13.5K	14K	14.5K	15K	15.5K	16K	16.5K	17K	17.5K	18K	18.5K	19K	19.5K	20K	20.5K	21K	21.5K	22K	22.5K	23K	23.5K	24K	24.5K	25K
5	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
10	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
15	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
20	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
25	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
30	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
35	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
40	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
45	289	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
50	260	270	280	290	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
55	236	245	255	264	273	282	291	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
60	217	225	233	242	250	258	267	275	283	292	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
65	200	208	215	223	231	238	246	254	262	269	277	285	292	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
70	186	193	200	207	214	221	229	236	243	250	257	264	271	279	286	293	300	>300	>300	>300	>300	>300	>300	>300	>300
75	173	180	187	193	200	207	213	220	227	233	240	247	253	260	267	273	280	287	293	300	>300	>300	>300	>300	>300
80	163	169	175	181	188	194	200	206	213	219	225	231	238	244	250	256	263	269	275	281	288	294	300	>300	>300
85	153	159	165	171	176	182	188	194	200	206	212	218	224	229	235	241	247	253	259	265	271	276	282	288	294
90	144	150	156	161	167	172	178	183	189	194	200	206	211	217	222	228	233	239	244	250	256	261	267	272	278
95	137	142	147	153	158	163	168	174	179	184	189	195	200	205	211	216	221	226	232	237	242	247	253	258	263
100	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240	245	250
105	124	129	133	138	143	148	152	157	162	167	171	176	181	186	190	195	200	205	210	214	219	224	229	233	238
110	118	123	127	132	136	141	145	150	155	159	164	168	173	177	182	186	191	195	200	205	209	214	218	223	227
115	113	117	122	126	130	135	139	143	148	152	157	161	165	170	174	178	183	187	191	196	200	204	209	213	217
120	108	113	117	121	125	129	133	138	142	146	150	154	158	163	167	171	175	179	183	188	192	196	200	204	208
125	104	108	112	116	120	124	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188	192	196	200
130	100	104	108	112	115	119	123	127	131	135	138	142	146	150	154	158	162	165	169	173	177	181	185	188	192
135	96	100	104	107	111	115	119	122	126	130	133	137	141	144	148	152	156	159	163	167	170	174	178	181	185
140	93	96	100	104	107	111	114	118	121	125	129	132	136	139	143	146	150	154	157	161	164	168	171	175	179
145	90	93	97	100	103	107	110	114	117	121	124	128	131	134	138	141	145	148	152	155	159	162	166	169	172
150	87	90	93	97	100	103	107	110	113	117	120	123	127	130	133	137	140	143	147	150	153	157	160	163	167
155	84	87	90	94	97	100	103	106	110	113	116	119	123	126	129	132	135	139	142	145	148	152	155	158	161
160	81	84	88	91	94	97	100	103	106	109	113	116	119	122	125	128	131	134	138	141	144	147	150	153	156

SECTION 2
OXYGEN TIME TO ESCAPE CALCULATIONS

---NOTE---

Calculations of Section 2 provide an estimated time when escapes should commence to prevent exceeding low limit 13% SEV Oxygen before all escapes are completed.

☐ **STEP 13:** Record the FWD Compartment O_2 concentration from Table 1 value **(7)** in the below box.

FWD Compartment O_2 concentration [(7) From Table 1]: _____ % SEV O_2

☐ **STEP 14:** If above FWD compartment O_2 concentration is 26% SEV or less, continue to step 15. If FWD compartment O_2 concentration is greater than 26% SEV, skip to step 16.

☐ **STEP 15:** In Table 7A, circle the intersecting value to the previously circled Table 1 axis values **(7)** and **(5)**. Record the Table 7A intersecting value in the Calculation Box #4 'Table 7 value' space at right. Skip to step 17.

☐ **STEP 16:** In Table 7B, circle the intersecting value to the previously circled Table 1 axis values **(7)** and **(5)**. Record the Table 7B intersecting value in the Calculation Box #4 'Table 7 value' space at right. Continue to step 17.

☐ **STEP 17:** In Table 8, circle the intersecting value to the previously circled Table 1 values **(3)** and **(5)**. Record the Table 8 intersecting value in the Calculation Box #4 'Table 8 value' space.

CALCULATION BOX #4

Table 7 value: _____
[From Steps 15 or 16]

Table 8 value: – _____
[From Step 17]

CALC Box #4 result: = _____

(Record this result in Calculation Box #5 on next page as the 'CALC Box #4 result'.)

☐ **STEP 18:** In Calculation Box #4, ***subtract*** the 'Table 8 value' from the 'Table 7 value' as indicated. Record in Calculation Box #4 and in Calculation Box #5 (next page) as the 'CALC Box #4 result'.

☐ **STEP 19:** In Table 9, circle the intersecting value to the previously circled Table 1 value **(9)** and the 'Table 2 value' recorded above Table 9 (by step 2 in Section 1). Record the Table 9 intersecting value in the Calculation Box #5 'Table 9 value' space below.

---NOTE---

*Table 9 values in some columns of the top two rows are **NEGATIVE NUMBERS** (as indicated by a preceding dash) and must be recorded with its 'preceding dash' in Calculation Box #5 to represent a negative number.*

☐ **STEP 20:** In Calculation Box #5, ***add*** the 'Table 9 value' to the 'CALC Box #4 result' to get a 'CALC Box #5 result'.

---NOTE---

*If the 'Table 9 value' was recorded with a preceding dash copied from Table 9, this **NEGATIVE NUMBER** must be **SUBTRACTED** instead of **ADDED** from the 'CALC Box #4 result' in Calculation Box #5.*

☐ **STEP 21:** Record 'CALC Box #5 result' above Table 10A, 10B, or 10C (as applicable) in the 'CALC Box #5 result' space provided.

☐ **STEP 22:** Use 'CALC Box #5 result' to circle its 'equal or lesser' value on the applicable Table 10 top row axis.

CALCULATION BOX #5

CALC Box #4 result: _____
[From Step 18]

Table 9 value: + _____
[From Step 19]

CALC Box #5 result: = _____

(Record this result* above Table 10 *as the 'CALC Box #5 result'.)

☐ **STEP 23:** Determine (& circle) the Table 10 intersecting value for the axis values previously circled. (i.e., use Table 1 value **(2)** for far left column axis & 'CALC Box #5 result' for top row axis of Table 10.) Record this value in the Calculation Box #6 'Table 10 value' space below.

☐ **STEP 24:** In Calculation Box #6, use the 'Table 10 value' to convert the 'Data Time/Date values' to an 'O_2 Start Escape Time'. This is the time/date escapes must start to prevent exceeding low limit 13% SEV O_2 before all escapes are completed. Record this result on OP6B-1 under 1.c ***'O_2 START ESCAPE TIME'***. This completes OP6B.

CALCULATION BOX #6

Data Time/Date: [**(1)** From Table 1] _____ ____ - ____ / ____
Time (24Hr) (DD - MM / YY)

Table 10 value [From Step 23] + _____
Hrs (Stay Time)

O_2 Start Escape Time: = _____ ____ - ____ / ____
Time (24Hr) (DD - MM / YY)

(Record this result on OP6B-1 under 1.c.)

TABLE 7A, TABLE 7B, & TABLE 8 (Section 2)

Round Conservatively →

Round Conservatively ↑

TABLE 7A

OXYGEN CONCENTRATION (% SEV) [(7) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From Table 1]				
	0	20	40	60	80
13.0	10242	8194	6145	4097	2048
13.5	10636	8509	6382	4255	2127
14.0	11030	8824	6618	4412	2206
14.5	11424	9139	6855	4570	2285
15.0	11818	9455	7091	4727	2364
15.5	12212	9770	7327	4885	2442
16.0	12606	10085	7564	5042	2521
16.5	13000	10400	7800	5200	2600
17.0	13394	10715	8036	5358	2679
17.5	13788	11030	8273	5515	2758
18.0	14182	11346	8509	5673	2836
18.5	14576	11661	8745	5830	2915
19.0	14970	11976	8982	5988	2994
19.5	15364	12291	9218	6145	3073
20.0	15758	12606	9455	6303	3152
20.5	16152	12921	9691	6461	3230
21.0	16546	13236	9927	6618	3309
21.5	16939	13552	10164	6776	3388
22.0	17333	13867	10400	6933	3467
22.5	17727	14182	10636	7091	3545
23.0	18121	14497	10873	7249	3624
23.5	18515	14812	11109	7406	3703
24.0	18909	15127	11346	7564	3782
24.5	19303	15443	11582	7721	3861
25.0	19697	15758	11818	7879	3939
25.5	20091	16073	12055	8036	4018
26.0	20485	16388	12291	8194	4097

Round Conservatively →

Round Conservatively ↑

TABLE 7B

OXYGEN CONCENTRATION (% SEV) [(7) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From Table 1]				
	0	20	40	60	80
26.5	20879	16703	12527	8352	4176
27.0	21273	17018	12764	8509	4255
27.5	21667	17333	13000	8667	4333
28.0	22061	17649	13236	8824	4412
28.5	22455	17964	13473	8982	4491
29.0	22849	18279	13709	9139	4570
29.5	23243	18594	13946	9297	4649
30.0	23636	18909	14182	9455	4727
30.5	24030	19224	14418	9612	4806
31.0	24424	19539	14655	9770	4885
31.5	24818	19855	14891	9927	4964
32.0	25212	20170	15127	10085	5042
32.5	25606	20485	15364	10242	5121
33.0	26000	20800	15600	10400	5200
33.5	26394	21115	15836	10558	5279
34.0	26788	21430	16073	10715	5358
34.5	27182	21746	16309	10873	5436
35.0	27576	22061	16546	11030	5515
35.5	27970	22376	16782	11188	5594
36.0	28364	22691	17018	11346	5673
36.5	28758	23006	17255	11503	5752
37.0	29152	23321	17491	11661	5830
37.5	29546	23636	17727	11818	5909
38.0	29940	23952	17964	11976	5988
38.5	30333	24267	18200	12133	6067
39.0	30727	24582	18436	12291	6145
39.5	31121	24897	18673	12449	6224
40.0	31515	25212	18909	12606	6303

Round Conservatively →

Round Conservatively ↓

TABLE 8

FIT to ESCAPE [(3) From Table 1]	PERCENT (%) COMPARTMENT FLOODED [(5) From Table 1]				
	0	20	40	60	80
5	9997	7948	5900	3851	1803
10	9964	7915	5867	3818	1770
15	9914	7866	5817	3769	1720
20	9881	7833	5784	3736	1687
25	9831	7783	5734	3686	1637
30	9798	7750	5701	3653	1604
35	9749	7700	5652	3603	1555
40	9716	7667	5619	3570	1522
45	9666	7618	5569	3521	1472
50	9633	7585	5536	3488	1439
55	9584	7535	5487	3438	1390
60	9551	7502	5454	3405	1357
65	9501	7452	5404	3356	1307
70	9468	7419	5371	3322	1274
75	9418	7370	5321	3273	1224
80	9385	7337	5288	3240	1191
85	9336	7287	5239	3190	1142
90	9303	7254	5206	3157	1109
95	9253	7205	5156	3108	1059
100	9220	7172	5123	3075	1026
105	9171	7122	5074	3025	977
110	9137	7089	5040	2992	944
115	9088	7039	4991	2942	894
120	9055	7006	4958	2909	861
125	9005	6957	4908	2860	811
130	8972	6924	4875	2827	778
135	8923	6874	4826	2777	729
140	8890	6841	4793	2744	696
145	8840	6792	4743	2695	646
150	8807	6759	4710	2662	613
155	8757	6709	4660	2612	563
160	8724	6676	4627	2579	530

Table 2 value: _____ (From Step 2, Use for Table 5 top row axis. Round to the next higher axis value if Table 2 value is in between below axis values.)**TABLE 9 (Section 2)**

Round Conservatively

TABLE 9	TABLE 2 VALUE (From above fill-in value – via Step 2)																				
OXYGEN CANDLES [(9) from Table 1]	25	50	75	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800
0	*-25*	*-50*	*-75*	*-100*	*-200*	*-300*	*-400*	*-500*	*-600*	*-700*	*-750*	*-800*	*-900*	*-1100*	*-1200*	*-1300*	*-1400*	*-1500*	*-1600*	*-1700*	*-1800*
10	1125	1100	1075	1050	950	850	750	650	550	450	400	350	250	50	*-50*	*-150*	*-250*	*-350*	*-450*	*-550*	*-650*
20	2275	2250	2225	2200	2100	2000	1900	1800	1700	1600	1550	1500	1400	1200	1100	1000	900	800	700	600	500
30	3425	3400	3375	3350	3250	3150	3050	2950	2850	2750	2700	2650	2550	2350	2250	2150	2050	1950	1850	1750	1650
40	4575	4550	4525	4500	4400	4300	4200	4100	4000	3900	3850	3800	3700	3500	3400	3300	3200	3100	3000	2900	2800
50	5725	5700	5675	5650	5550	5450	5350	5250	5150	5050	5000	4950	4850	4650	4550	4450	4350	4250	4150	4050	3950
60	6875	6850	6825	6800	6700	6600	6500	6400	6300	6200	6150	6100	6000	5800	5700	5600	5500	5400	5300	5200	5100
70	8025	8000	7975	7950	7850	7750	7650	7550	7450	7350	7300	7250	7150	6950	6850	6750	6650	6550	6450	6350	6250
80	9175	9150	9125	9100	9000	8900	8800	8700	8600	8500	8450	8400	8300	8100	8000	7900	7800	7700	7600	7500	7400
90	10325	10300	10275	10250	10150	10050	9950	9850	9750	9650	9600	9550	9450	9250	9150	9050	8950	8850	8750	8650	8550
100	11475	11450	11425	11400	11300	11200	11100	11000	10900	10800	10750	10700	10600	10400	10300	10200	10100	10000	9900	9800	9700
110	12625	12600	12575	12550	12450	12350	12250	12150	12050	11950	11900	11850	11750	11550	11450	11350	11250	11150	11050	10950	10850
120	13775	13750	13725	13700	13600	13500	13400	13300	13200	13100	13050	13000	12900	12700	12600	12500	12400	12300	12200	12100	12000
130	14925	14900	14875	14850	14750	14650	14550	14450	14350	14250	14200	14150	14050	13850	13750	13650	13550	13450	13350	13250	13150
140	16075	16050	16025	16000	15900	15800	15700	15600	15500	15400	15350	15300	15200	15000	14900	14800	14700	14600	14500	14400	14300
150	17225	17200	17175	17150	17050	16950	16850	16750	16650	16550	16500	16450	16350	16150	16050	15950	15850	15750	15650	15550	15450
160	18375	18350	18325	18300	18200	18100	18000	17900	17800	17700	17650	17600	17500	17300	17200	17100	17000	16900	16800	16700	16600
170	19525	19500	19475	19450	19350	19250	19150	19050	18950	18850	18800	18750	18650	18450	18350	18250	18150	18050	17950	17850	17750
180	20675	20650	20625	20600	20500	20400	20300	20200	20100	20000	19950	19900	19800	19600	19500	19400	19300	19200	19100	19000	18900
190	21825	21800	21775	21750	21650	21550	21450	21350	21250	21150	21050	20950	20850	20750	20650	20550	20450	20350	20250	20150	20050
200	22975	22950	22925	22900	22800	22700	22600	22500	22400	22300	22200	22100	22000	21900	21800	21700	21600	21500	21400	21300	21200
210	24125	24100	24075	24050	23950	23850	23750	23650	23550	23450	23350	23250	23150	23050	22950	22850	22750	22650	22550	22450	22350
220	25275	25250	25225	25200	25100	25000	24900	24800	24700	24600	24500	24400	24300	24200	24100	24000	23900	23800	23700	23600	23500
230	26425	26400	26375	26350	26250	26150	26050	25950	25850	25750	25650	25550	25450	25350	25250	25150	25050	24950	24850	24750	24650
240	27575	27550	27525	27500	27400	27300	27200	27100	27000	26900	26800	26700	26600	26500	26400	26300	26200	26100	26000	25900	25800
250	28725	28700	28675	28650	28550	28450	28350	28250	28150	28050	27950	27850	27750	27650	27550	27450	27350	27250	27150	27050	26950
260	29875	29850	29825	29800	29700	29600	29500	29400	29300	29200	29100	29000	28900	28800	28700	28600	28500	28400	28300	28200	28100
270	31025	31000	30975	30950	30850	30750	30650	30550	30450	30350	30250	30150	30050	29950	29850	29750	29650	29550	29450	29350	29250
280	32175	32150	32125	32100	32000	31900	31800	31700	31600	31500	31400	31300	31200	31100	31000	30900	30800	30700	30600	30500	30400
290	33325	33300	33275	33250	33150	33050	32950	32850	32750	32650	32550	32450	32350	32250	32150	32050	31950	31850	31750	31650	31550
300	34475	34450	34425	34400	34300	34200	34100	34000	33900	33800	33700	33600	33500	33400	33300	33200	33100	33000	32900	32800	32700
310	35625	35600	35575	35550	35450	35350	35250	35150	35050	34950	34850	34750	34650	34550	34450	34350	34250	34150	34050	33950	33850
320	36775	36750	36725	36700	36600	36500	36400	36300	36200	36100	36000	35900	35800	35700	35600	35500	35400	35300	35200	35100	35000
330	37925	37900	37875	37850	37750	37650	37550	37450	37350	37250	37150	37050	36950	36850	36750	36650	36550	36450	36350	36250	36150
340	39075	39050	39025	39000	38900	38800	38700	38600	38500	38400	38300	38200	38100	38000	37900	37800	37700	37600	37500	37400	37300
350	40225	40200	40175	40150	40050	39950	39850	39750	39650	39550	39450	39350	39250	39150	39050	38950	38850	38750	38650	38550	38450
360	41375	41350	41325	41300	41200	41100	41000	40900	40800	40700	40600	40500	40400	40300	40200	40100	40000	39900	39800	39700	39600
370	42525	42500	42475	42450	42350	42250	42150	42050	41950	41850	41750	41650	41550	41450	41350	41250	41150	41050	40950	40850	40750

Round Conservatively

TABLE 10A (Section 2)

PRE-ESCAPE 'O_2' STAY TIME (Hrs)

CALC Box #5 result: _____ (From Step 21, use for Table 10A top row axis, if applicable. For a CALC Box #5 result 5,250 or greater, use Table 10B.)

Round Conservatively

Round Conservatively

TABLE 10A	CALC BOX #5 RESULT [From above fill-in value – via Step 21]																											
SURVIVOR TOTAL [(2) from Table 1]	0	50	100	200	300	400	500	600	700	800	900	1000	1250	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000
5	0	10	20	40	60	80	100	120	140	160	180	200	250	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
10	0	5	10	20	30	40	50	60	70	80	90	100	125	150	175	200	225	250	275	300	>300	>300	>300	>300	>300	>300	>300	>300
15	0	3	7	13	20	27	33	40	47	53	60	67	83	100	117	133	150	167	183	200	217	233	250	267	283	300	>300	>300
20	0	3	5	10	15	20	25	30	35	40	45	50	63	75	88	100	113	125	138	150	163	175	188	200	213	225	238	250
25	0	2	4	8	12	16	20	24	28	32	36	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
30	0	2	3	7	10	13	17	20	23	27	30	33	42	50	58	67	75	83	92	100	108	117	125	133	142	150	158	167
35	0	1	3	6	9	11	14	17	20	23	26	29	36	43	50	57	64	71	79	86	93	100	107	114	121	129	136	143
40	0	1	3	5	8	10	13	15	18	20	23	25	31	38	44	50	56	63	69	75	81	88	94	100	106	113	119	125
45	0	1	2	4	7	9	11	13	16	18	20	22	28	33	39	44	50	56	61	67	72	78	83	89	94	100	106	111
50	0	1	2	4	6	8	10	12	14	16	18	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
55	0	1	2	4	5	7	9	11	13	15	16	18	23	27	32	36	41	45	50	55	59	64	68	73	77	82	86	91
60	0	1	2	3	5	7	8	10	12	13	15	17	21	25	29	33	38	42	46	50	54	58	63	67	71	75	79	83
65	0	1	2	3	5	6	8	9	11	12	14	15	19	23	27	31	35	38	42	46	50	54	58	62	65	69	73	77
70	0	1	1	3	4	6	7	9	10	11	13	14	18	21	25	29	32	36	39	43	46	50	54	57	61	64	68	71
75	0	1	1	3	4	5	7	8	9	11	12	13	17	20	23	27	30	33	37	40	43	47	50	53	57	60	63	67
80	0	1	1	3	4	5	6	8	9	10	11	13	16	19	22	25	28	31	34	38	41	44	47	50	53	56	59	63
85	0	1	1	2	4	5	6	7	8	9	11	12	15	18	21	24	26	29	32	35	38	41	44	47	50	53	56	59
90	0	1	1	2	3	4	6	7	8	9	10	11	14	17	19	22	25	28	31	33	36	39	42	44	47	50	53	56
95	0	1	1	2	3	4	5	6	7	8	9	11	13	16	18	21	24	26	29	32	34	37	39	42	45	47	50	53
100	0	1	1	2	3	4	5	6	7	8	9	10	13	15	18	20	23	25	28	30	33	35	38	40	43	45	48	50
105	0	0	1	2	3	4	5	6	7	8	9	10	12	14	17	19	21	24	26	29	31	33	36	38	40	43	45	48
110	0	0	1	2	3	4	5	5	6	7	8	9	11	14	16	18	20	23	25	27	30	32	34	36	39	41	43	45
115	0	0	1	2	3	3	4	5	6	7	8	9	11	13	15	17	20	22	24	26	28	30	33	35	37	39	41	43
120	0	0	1	2	3	3	4	5	6	7	8	8	10	13	15	17	19	21	23	25	27	29	31	33	35	38	40	42
125	0	0	1	2	2	3	4	5	6	6	7	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
130	0	0	1	2	2	3	4	5	5	6	7	8	10	12	13	15	17	19	21	23	25	27	29	31	33	35	37	38
135	0	0	1	1	2	3	4	4	5	6	7	7	9	11	13	15	17	19	20	22	24	26	28	30	31	33	35	37
140	0	0	1	1	2	3	4	4	5	6	6	7	9	11	13	14	16	18	20	21	23	25	27	29	30	32	34	36
145	0	0	1	1	2	3	3	4	5	6	6	7	9	10	12	14	16	17	19	21	22	24	26	28	29	31	33	34
150	0	0	1	1	2	3	3	4	5	5	6	7	8	10	12	13	15	17	18	20	22	23	25	27	28	30	32	33
155	0	0	1	1	2	3	3	4	5	5	6	6	8	10	11	13	15	16	18	19	21	23	24	26	27	29	31	32
160	0	0	1	1	2	3	3	4	4	5	6	6	8	9	11	13	14	16	17	19	20	22	23	25	27	28	30	31

TABLE 10B (Section 2)

PRE-ESCAPE 'O_2' STAY TIME (Hrs)

CALC Box #5 result: _____ (From Step 21, use for Table 10B top row axis, if applicable. For a CALC Box #5 result 13,000 or greater, use Table 10C.)

Round Conservatively

Round Conservatively

TABLE 10B	CALC BOX #5 RESULT [From above fill-in value – via Step 21]																								
SURVIVOR TOTAL [(2) from Table 1]	5250	5500	5750	6000	6250	6500	6750	7000	7250	7500	7750	8000	8250	8500	8750	9000	9250	9500	9750	10000	10500	11000	11500	12000	12500
5	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
10	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
15	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
20	263	275	288	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
25	210	220	230	240	250	260	270	280	290	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
30	175	183	192	200	208	217	225	233	242	250	258	267	275	283	292	300	>300	>300	>300	>300	>300	>300	>300	>300	>300
35	150	157	164	171	179	186	193	200	207	214	221	229	236	243	250	257	264	271	279	286	300	>300	>300	>300	>300
40	131	138	144	150	156	163	169	175	181	188	194	200	206	213	219	225	231	238	244	250	263	275	288	300	>300
45	117	122	128	133	139	144	150	156	161	167	172	178	183	189	194	200	206	211	217	222	233	244	256	267	278
50	105	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	210	220	230	240	250
55	95	100	105	109	114	118	123	127	132	136	141	145	150	155	159	164	168	173	177	182	191	200	209	218	227
60	88	92	96	100	104	108	113	117	121	125	129	133	138	142	146	150	154	158	163	167	175	183	192	200	208
65	81	85	88	92	96	100	104	108	112	115	119	123	127	131	135	138	142	146	150	154	162	169	177	185	192
70	75	79	82	86	89	93	96	100	104	107	111	114	118	121	125	129	132	136	139	143	150	157	164	171	179
75	70	73	77	80	83	87	90	93	97	100	103	107	110	113	117	120	123	127	130	133	140	147	153	160	167
80	66	69	72	75	78	81	84	88	91	94	97	100	103	106	109	113	116	119	122	125	131	138	144	150	156
85	62	65	68	71	74	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	124	129	135	141	147
90	58	61	64	67	69	72	75	78	81	83	86	89	92	94	97	100	103	106	108	111	117	122	128	133	139
95	55	58	61	63	66	68	71	74	76	79	82	84	87	89	92	95	97	100	103	105	111	116	121	126	132
100	53	55	58	60	63	65	68	70	73	75	78	80	83	85	88	90	93	95	98	100	105	110	115	120	125
105	50	52	55	57	60	62	64	67	69	71	74	76	79	81	83	86	88	90	93	95	100	105	110	114	119
110	48	50	52	55	57	59	61	64	66	68	70	73	75	77	80	82	84	86	89	91	95	100	105	109	114
115	46	48	50	52	54	57	59	61	63	65	67	70	72	74	76	78	80	83	85	87	91	96	100	104	109
120	44	46	48	50	52	54	56	58	60	63	65	67	69	71	73	75	77	79	81	83	88	92	96	100	104
125	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	84	88	92	96	100
130	40	42	44	46	48	50	52	54	56	58	60	62	63	65	67	69	71	73	75	77	81	85	88	92	96
135	39	41	43	44	46	48	50	52	54	56	57	59	61	63	65	67	69	70	72	74	78	81	85	89	93
140	38	39	41	43	45	46	48	50	52	54	55	57	59	61	63	64	66	68	70	71	75	79	82	86	89
145	36	38	40	41	43	45	47	48	50	52	53	55	57	59	60	62	64	66	67	69	72	76	79	83	86
150	35	37	38	40	42	43	45	47	48	50	52	53	55	57	58	60	62	63	65	67	70	73	77	80	83
155	34	35	37	39	40	42	44	45	47	48	50	52	53	55	56	58	60	61	63	65	68	71	74	77	81
160	33	34	36	38	39	41	42	44	45	47	48	50	52	53	55	56	58	59	61	63	66	69	72	75	78

TABLE 10C (Section 2)

PRE-ESCAPE 'O₂' STAY TIME (Hrs)

CALC Box #5 result: _____ (From Step 21, use for Table 10C top row axis, if applicable).

Round Conservatively

Round Conservatively

TABLE 10C — SURVIVOR TOTAL [(2) from Table 1]	CALC BOX #5 RESULT [From above fill-in value – via Step 21] (K = x(1,000); e.g., 13K = 13,000 and 13.5K = 13,500)																								
	13K	13.5K	14K	14.5K	15K	15.5K	16K	16.5K	17K	17.5K	18K	18.5K	19K	19.5K	20K	20.5K	21K	21.5K	22K	22.5K	23K	23.5K	24K	24.5K	25K
5	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
10	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
15	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
20	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
25	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
30	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
35	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
40	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
45	289	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
50	260	270	280	290	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
55	236	245	255	264	273	282	291	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
60	217	225	233	242	250	258	267	275	283	292	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
65	200	208	215	223	231	238	246	254	262	269	277	285	292	300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300	>300
70	186	193	200	207	214	221	229	236	243	250	257	264	271	279	286	293	300	>300	>300	>300	>300	>300	>300	>300	>300
75	173	180	187	193	200	207	213	220	227	233	240	247	253	260	267	273	280	287	293	300	>300	>300	>300	>300	>300
80	163	169	175	181	188	194	200	206	213	219	225	231	238	244	250	256	263	269	275	281	288	294	300	>300	>300
85	153	159	165	171	176	182	188	194	200	206	212	218	224	229	235	241	247	253	259	265	271	276	282	288	294
90	144	150	156	161	167	172	178	183	189	194	200	206	211	217	222	228	233	239	244	250	256	261	267	272	278
95	137	142	147	153	158	163	168	174	179	184	189	195	200	205	211	216	221	226	232	237	242	247	253	258	263
100	130	135	140	145	150	155	160	165	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240	245	250
105	124	129	133	138	143	148	152	157	162	167	171	176	181	186	190	195	200	205	210	214	219	224	229	233	238
110	118	123	127	132	136	141	145	150	155	159	164	168	173	177	182	186	191	195	200	205	209	214	218	223	227
115	113	117	122	126	130	135	139	143	148	152	157	161	165	170	174	178	183	187	191	196	200	204	209	213	217
120	108	113	117	121	125	129	133	138	142	146	150	154	158	163	167	171	175	179	183	188	192	196	200	204	208
125	104	108	112	116	120	124	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188	192	196	200
130	100	104	108	112	115	119	123	127	131	135	138	142	146	150	154	158	162	165	169	173	177	181	185	188	192
135	96	100	104	107	111	115	119	122	126	130	133	137	141	144	148	152	156	159	163	167	170	174	178	181	185
140	93	96	100	104	107	111	114	118	121	125	129	132	136	139	143	146	150	154	157	161	164	168	171	175	179
145	90	93	97	100	103	107	110	114	117	121	124	128	131	134	138	141	145	148	152	155	159	162	166	169	172
150	87	90	93	97	100	103	107	110	113	117	120	123	127	130	133	137	140	143	147	150	153	157	160	163	167
155	84	87	90	94	97	100	103	106	110	113	116	119	123	126	129	132	135	139	142	145	148	152	155	158	161
160	81	84	88	91	94	97	100	103	106	109	113	116	119	122	125	128	131	134	138	141	144	147	150	153	156

Appendix D: E-Guard Answer Sheet

PID _____

Electronic eGUARD answer sheet

Scenario_____

OP6B
ASSESS CARBON DIOXIDE & OXYGEN START ESCAPE TIME

1. Record CO2 Start Escape Time from electronic Guard Book
2. Convert Escape Time to Date and Time
3. Record O2 Start Escape Time from electronic Guard Book
4. Convert Escape Time to Date and Time
5. Circle earliest Escape time
6. Record the time from the stopwatch in the RED box

CO_2 START ESCAPE TIME: _____ **in days and hours**

_____ ____-____/____ **date and time**
Time (24Hr) (DD - MM / YY)

O_2 START ESCAPE TIME: _____ **in days and hours**

_____ ____-____/____ **date and time**
Time (24Hr) (DD - MM / YY)

Circle earliest Escape time