Help File – http://WaterTenderApp.com

This app calculates far more than estimating the delivery rate of any water tender based solely on tank size (TS), fill and dump rates, make and break and maneuver time, and distance to a viable water source. It also determines the **minimum number of water tenders** and the **'TOTAL' storage capacity of portable water tanks** necessary to support any incident effectively. All calculations and methodology are upon the directives within ***'Evaluating Tender Performance'*** of the Third Edition of the *International Fire Service Training Administration (IFSTA)* ***'Pumping Apparatus Driver/Operator Handbook,'*** © copyright 2015. Therefore, it is highly recommended that each execution identified in ***Chapter 13 - Water Shuttle Operations*** from Page 440 through 475 be strictly adhered to for personnel safety and efficiency.

We must first obtain and enter the following data that affects every scenario.

Entries required:

1. ***"S"*** for SAE or ***'Customary'*** in US Gallons or ***"M"*** for metric liters. All calculations and display labels and references are automatically adjusted to prevent the risk of any miscalculation(s).
2. **Fire Flow:** Minimum ***Fire Flow*** as estimated by on-scene incident personnel, expressed as US Gallons Per Minute (GPM) or Liters Per Minute (LPM).
3. **Water Tender Tank Capacity:** Note: Only 90% of the maximum certified ***Tank Storage*** **(TS)** capacity is utilized to estimate delivery rates accurately. The 10% difference represents the ***'Residue'*** tank storage of unusable liquid found in all storage tanks, in which the ACTUAL may be more or less accordingly.
4. **Fill Rate:** The certified rate of a water tender is filled from any sufficient water source as expressed in GPM or LPM.
5. **Dump Rate:** The rate the water tender is certified to (gravity) dump its 'usable' product.
    a. **Total 'Handling Time' = Fill Site Time (Tank Storage (TS)/'Fill' Rate) + Dump Site Time (Tank Storage (TS)/'Dump' Rate)**
6. **Dist. (Mi./Km):** Distance measured in **Miles** or **Kilometers** to the nearest viable water source.
7. **Make/Break Time:** The *average* time a driver/operator takes to ***'Maneuver'*** and then ***'Make'*** and then ***'Break'*** all hose connections before FILLING or DUMPING. An assumed equal time is expressed in minutes as a driver/operator prepares to execute all other operations.

The first equation to solve to determine the estimated **'Tender Flow Rate'** is:

0.9 X TS/(Travel Time + Handling Time)

Travel Time is solved as follows.

Customary ("S" in US Gallons)

Travel Time = 0.65 + [1.7 x Distance x 2 (Round-trip)]

Metric ("M" in Metric Liters)

Travel Time = 0.65 + [1.06 x Distance x 2 (Round-trip)]

To mirror IFSTA's calculations as **EXAMPLE 13.4 (Customary)** found on page 467 to prove the accuracy of this phone app, please first consider a **2,500-gallon** water tender with a fill and dump rate at **1,000 GPM**. Next, enter the **travel distance at four (4.0) miles** to the nearest viable water source. Then consider an estimated **1 ½ minutes** to **'*Maneuver*'** and **'*Make*'** and **'*Break*'** all hose connections at the fill and dumpsites. The phone app automatically completes ALL calculations [with 100% accuracy upon instant recalculation upon any new data revision(s)/change(s) that occur] to represent:

'Customary application' **("S" for SAE in US Gallons)**

Travel Time = 0.65 + [(1.7) x Distance (4 mi.) X 2 (Round-trip)] = 14.25 min.

Handling TIme = Fill Site Time + Dump Site Time

Fill Site Time = [1.5 min. *(Make/Break)* + (2,500 gals ÷ 1,000 GPM)] = 4 min.

Dump Site Time = [1.5 min. *(Make/Break)* + (2,500 gals ÷ 1,000 GPM)] = 4 min.

Handling Time = 4 min. + 4 min. = 8 min.

FLOW *(GPM delivered)*:

0.9 X TS / (Travel Time + Handling Time) = 0.9 X 2,500 Gals. / (14.25 min. + 8 min)

2,250 Gals. / 22.25 min = 101 GPM

Again To mirror IFSTA's calculations as **EXAMPLE 13.4 (Metric)** found on page 468 to prove the accuracy of this phone app, please first consider a **10,000-liter** water tender with a fill and dump rate at **4,000 LPM**. Next, enter the **travel distance at eight (8.0) kilometers** to the nearest viable water source. Then consider an estimated **2 minutes** to **'*Maneuver*'** and **'*Make*'** and **'*Break*'** all hose connections at both the fill and dumpsites. The phone app automatically completes ALL calculations [with 100% accuracy upon instant recalculation upon any new data revision(s)/change(s) that occur] to represent:

"METRIC application" **("M" in Liters)**

Travel Time = 0.65 + [(1.06) x Distance (8 km.) X 2 (Round-trip)] = 17.61 min.

Handling TIme = Fill Site Time + Dump Site Time

Fill Site Time = [2 min. + (10,000 ltrs. ÷ 4,000 ltrs.)] = 4.5 min.

Dump Site Time = [2 min. + (10,000 ltrs. ÷ 4,000 ltrs.)] = 4.5 min

Handling Time = 4.5 min. + 4.5 min. = 9 min.

FLOW *(GPM delivered)*:

0.9 X TS / (Travel Time + Handling Time) = 0.9 X 10,000 Ltrs. / (17.61 min. + 9 min)

9,000 Ltrs. / 26.61 min = 338 LPM

Upon the latest calculation formula (REV. 2015) created by the ***International Fire Service Training Administration (IFSTA)***, all mathematical entries instantly solve the estimated ***Fire-Flow*** anticipated on the scene. However, please note this is a mere ***ESTIMATE*** as all entries at this point are only estimates given the most common road surface and incline and weather conditions within any average geographical area at any average time of year.

The ***ACTUAL*** delivery rate can only be achieved by recording the ***ACTUAL*** time at the end of a **FULL COMPLETE CYCLE,** as articulated on **Page 465.** Any (smartphone) timer can be utilized when a Driver/Operator OPENs the DUMP valve and completes one full 'turn-around' cycle upon opening the DUMP valve again at the next delivery. The Driver/Operator then enters the ***ACTUAL*** time to automatically calculate the ***ACTUAL GPM/LPM*** delivered in ***REAL-TIME*** when data is most critical.

The ultimate goal is two-fold:

- To assist command staff in reducing the risk of under-ordering water tender and portable storage tank resources to cause the unintended interruption of water on scene.
- Secondly, prevent the over-ordering of water tenders from preventing the first concern within all neighboring fire districts that have been exhausted and now await the delayed response.
- Thirdly, prevent the overflow from full portable storage tanks (as illustrated) as water tenders impatiently wait to dump their load, especially during winter conditions or on unstable soil.

The Chart - (All examples are SAE *Customary*)

The 'FLOW' chart is created to TOTAL all data from each water tender's estimated or ***ACTUAL*** GPM/LPM delivered on-scene. As a result, operational command staff can quickly determine if adequate water needs are met or if additional resources are required by comparing **150% above the estimated** and anticipated *[i.e., **'Req. Flow'** at **400 GPM** increased to **600 GPM**]* to the ***'ACTUAL Flow'*** *[i.e., **653** GPM].*

The adjacent cell indicates if "***Min. Met?***" as either "**NO!**" with WHITE letters and RED background or "**YES!**" in WHITE letters and GREEN background.

Next is (***Totals:***) of water tender capacities *[Example: **16,500** (Gallons)]* as a running TOTAL of the tank size (TS) capacities of all water tenders listed #1 thru #9. and "***Deliveries per Hour***" [Example: **12.4**]

The following four (4) columns are entered manually and labeled as:

1. "***Tender Ident.***"; pre-numbered as ***Tender #1*** through ***Tender #9***, are editable to identify units by district and number as desired and return to default indicators when reset/power cycled.
2. Water tender Tank Size (TS) "***Capacity***" is manually entered as either "***GALLONS***" or "***LITERS.***"
3. ***ACTUAL*** or ***estimated*** (GPM/LPM) delivery rate is manually entered for each, followed by…
4. ***ACTUAL*** or ***estimated*** roundtrip ***"Travel minutes"*** to determine Deliveries per Hour ***(DPH)***.

As described in the introductory paragraph, the most beneficial feature of this phone app is to effectively estimate the **minimum number of Water Tenders** and the minimum required ***'TOTAL'*** **Portable Tank Storage** capacity to sustain flow and delivery rates necessary to support any incident.

'TOTAL' storage tank capacity is calculated upon the following equation: The number of water tenders assigned [i.e., ***Five (5)*** as entered in the ***'Flow-Chart'***]; by their average delivery flow rates (i.e., ***129 GPM***); by the number of deliveries per hour (i.e., ***12.4***); expressed as ***(5 X 129 GPM X 12.4 = 7,998***

Gallons). This total is then ROUNDED UP to the nearest 500 Gallons to establish a minimum **'TOTAL' portable storage capacity** at **8,000 Gallons**, preferably arranged diagonally as a multiple tank series.

Therefore, this ***'Customary' or SAE*** scenario with **five (5) water tenders** to support **400 GPM** fire-flow… **increased 50% to 600 GPM** requires the minimum portable tank capacity at **8,000 gallons** accordingly.

The '***Metric***' example has ***Four (4)*** **Water Tenders** (with an estimated fire flow at 1,200 LPM is increased 50% to **1,800 LPM);** is then multiplied by the average delivery flow rates (i.e., ***407 LPM***); by the number of deliveries per hour (i.e., ***9.1***); expressed as ***(4 X 407 LPM X 9.1 = 14,815 Liters).*** This total is then ROUNDED UP to the nearest 500 Gallons to establish a minimum **'TOTAL' portable storage capacity** at **15,000-Liters**. Again, preferably arranged diagonally as a multiple tank series.

In all cases, the portable tank capacity is based on the *CURRENT* number of Water Tenders assigned to the incident and thus far. An additional 25% storage capacity can be added to ensure an extra margin of safety. But only if it does not adversely affect neighboring Mutual Aid departments that may address a simultaneous incident requiring the same support to prevent the risk of exhausting their resources also.

As the establishment of all technological advancements results from standing on the shoulders of the giants before us, any feedback is greatly appreciated as we venture into this new territory. Likewise, we graciously welcome the discovery of any additional considerations or adjustments that best reflect operations in the field. All calculations are drafted and executed and open to any modification upon irrefutable laws of physics reinforced by repeated experimentation to ensure the utmost efficiency and resulting highest level of SAFETY we can achieve in the field as possible… and where it truly counts.

Please visit our website to download a ***FREE Trial*** (as available) ***'FlightTest'*** version of our ***Water Tender Shuttle Calculator App*** for up to 90-days after submission on the Apple App Store. Android owners can sign up to be notified when a purchase can be made at the Google Play Store by visiting our website at:

https://WaterTenderApp.com

Our ultimate commitment:

http://ToMakeADifferenceForOthers.org

To ensure:

https://EveryoneGetsHome.org

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