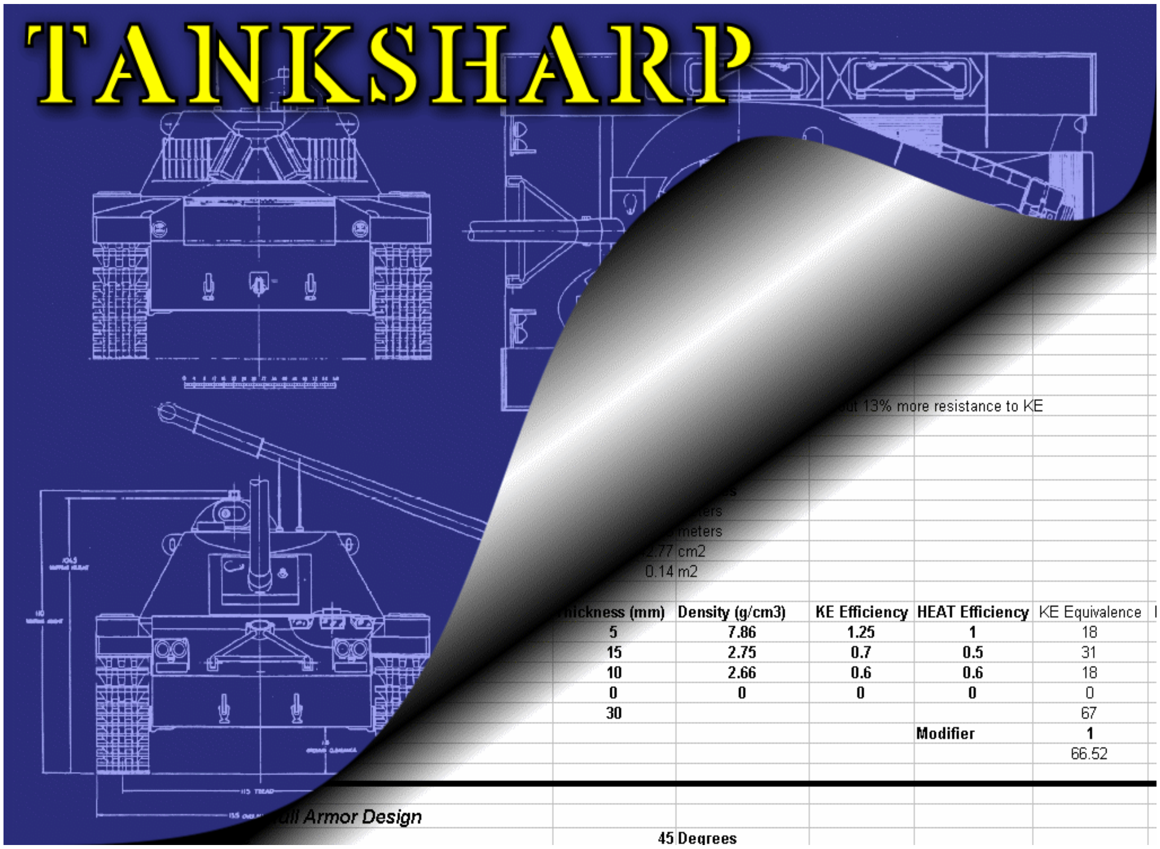

Tanksharp

v0.3 Manual

By

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(Contact me at ryancrierie@yahoo.com if you have any questions or suggestions)

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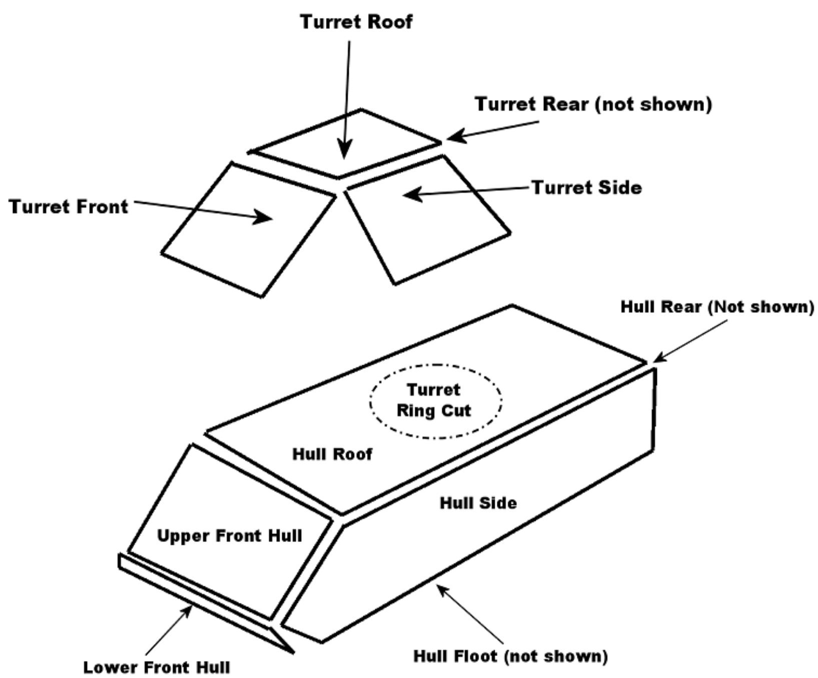
1. Introduction

Thank you for downloading and trying out my rough attempt to create something very similar to James Ross-Gowan and Ian Ross-Gowan's Springsharp, but for tanks instead of warships. Obviously, for a first version, it is going to be crude, but hopefully it can be used as a base for something by people who are more technically inclined and have more information than I can find.

Tanksharp v0.2 was created using Open Office 2.2.0.

The current dimensional model used in v0.2 for finding the weight of armor is:



I realize that this is very much an incomplete model; since it does not:

- Allow for Side or Rear Hull Sloping.
- Allow Curved Armor (such as Cast RHA Gun Mantlets).
- There is "missing" armor on the turret whose weight is not accounted for if you slope all four sides; because I did not have the knowledge or skill to figure out the calculations required to do that (I only passed basic High School Algebra a looong time ago). I decided to allow complete sloping of all four sides on the turret, since the area that goes "missing" is very little compared to what would go "missing" with it applied to the hull.

Much of my data comes from several sources:

- *Jane's Armour and Artillery Upgrades 1995-1996*
- www.tank-net.org
- Paul Lakowski's *Armor Technology* primer.
- Alliant Tech System (ATK)'s page on their AFV armament options here

2. Changelog

- 0.1 - Initial release of Tanksharp (29 May 2007)
- 0.2 - Reworked Cannon/Gun section to improve ammunition section for more realism and to allow caseless/telescoped/bagged and liquid propellant/railgun ammo.
- 0.2 - Reworked Frontal Hull Armor to now weight the average according to how big each plate is; e.g. if your upper front hull plate has an area of 2m2, it will get counted more in the averaging calculations than a lower front hull plate of 1m2.
- 0.2 - Doubled the number of layers available for frontal hull and turret armor to 8 layers, to help simulate the more exotic layerings you might find.
- 0.2 - Sheets now have the changeable cells color coded in green for easier use.
- 0.3 - Revised resistance specs according to new information from Bojan at Tank-Net; added specs for perforated armor in the manual, and clarified some resistance specifications.

3. What do we want the tank to do? (And setting limits)

First, before we start playing around with the spreadsheet, we need to figure out what we want this vehicle to do, and what our limitations as a designer are.

- Do we have a cost limitation?
- Do we have a weight limitation?
- Do we have a minimal standard for protection we have to meet?
- Do we need to have a large number of vehicle components standardized across multiple vehicles?
- Do we have a combination of several factors that all must be met?

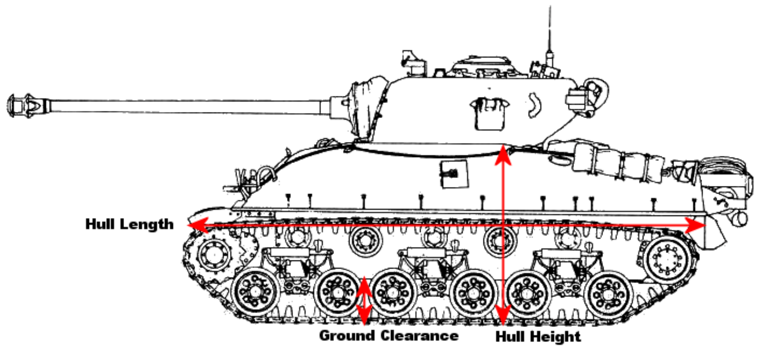
It is quite easy to make a vehicle with unlimited funding and unlimited weight limits; it is not so when you are given limitations due to fiscal or policy reasons (e.g. the weight of the vehicle has to be at or under 35 tons, because that is the maximum weight that can be dealt with by our existing wreckers in service with our armored force; and no, we're not buying a new set of wreckers for you.)

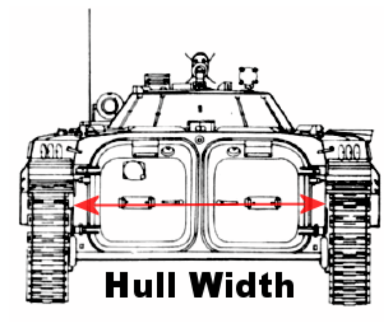
Also, most of the time as a designer, you will not be allowed to have the luxury of having a transmission, engine, and suspension system custom designed for your vehicle alone; either for economic reasons, or for logistics reasons (we have standardized all of our force on such and such transmissions for efficiency).

Giving yourself limitations makes for a much more interesting design process, which teaches you about how vehicles are all trade-offs between various capabilities.

4. Hull Design Explained

Any field that can be changed will be in **bold** typeface, to make finding things easier.

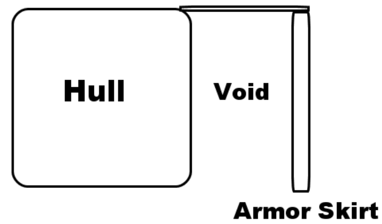




Vehicle Hull Length	Length of the vehicle's hull.
Vehicle Hull Width	Width of the vehicle's hull, not it's overall length (which increases due to track skirts and sponsons)
Vehicle Hull Height	Height of the vehicle's hull from it's roof to top.
Vehicle Ground Clearance	Clearance between the ground and the vehicle.
Glacis Height Percentage	The height that the glacis elbow between the upper and lower plates is at. Fifty Percent means that it will be at half of the **Vehicle Hull Height**.

Overall Slope	Slope in degrees from vertical of this section of the hull.
Thickness (mm)	Thickness of that layer of armor in millimeters.
Density (g/cm3)	Density of that layer's armor material in grams per cubic centimeter.
KE Efficiency	Efficiency of this layer's armor material against kinetic threats (Armour Piercing Discarding Sabot Fin Stabilized). For example, 50mm of armor material with a KE Efficiency of 1.25 would have an effectiveness of 62.5mm of material.
HEAT Efficiency	Efficiency of this layer's armor material against chemical energy threats (High Explosive Anti-Tank). For example, 50mm of armor material with a HEAT Efficiency of 1.25 would have an effectiveness of 62.5mm of material.
Modifier	This is there to modify the total effectiveness of your armor layer against KE threats. For example, if you encase a ceramic material in soft steel, overall KE resistance rises by 1.12 (Lakowsi, *Armor Basics*, pg 10)

Side Hull Armor: Unlike the other hull armor angles, this one has two extra layers of armor; **Armored Skirt** and **Void Between Hull and Skirt** to allow representation of side armor skirts and the mostly empty volume created by the width of either the track(s) or tire(s).



Normally, the Void Layer should have the following properties:

Thickness (mm)	Density (g/cm3)	KE Efficiency	HEAT Efficiency
Length between hull and Armored Skirt	0.0013 (that of air)	0	0.25

Number of Crew In Hull	Number of Crew who have their stations in the hull.
Number of Passengers In Hull	Number of Passengers who are carried in the hull.

NOTE: It is assumed that each crewman or passenger takes up 0.75 cubic meters of space; and requires 180 kilograms of mass for himself, and then another 180 kilograms of mass for seats, water, food, and various support systems, like vision blocks, etc.

LIGHT WEAPONS: This is how many light weapons that have their mounts in the hull or are carried on top of the hull in a pintle mount. If there is a bow mounted 7.62mm Machine Gun, then that would count as One (1) **7.62mm MG.** See the **Appendixes** for a listing of weapon weights and volume used by the spreadsheet.

LIGHT WEAPONS STOWED AMMUNITION: This is how many rounds of ammunition are stowed within the hull itself for the above weapons. See the **Appendixes** for a listing of ammunition weights and volumes used by the spreadsheet.

CANNON/GUN TYPE(S) ONE AND TWO: These are any large caliber weapons above HMG Calibre which are carried on the hull itself, usually in a semi-fixed mount, like the WWII StuG III, or like the Swedish S-Tank's fixed mount.

Number Carried	How many of this kind of weapon are carried. A twin 20mm mount would be two, for example.
Size of Weapon	How big the shell fired by it is in millimeters.
Calibre of Weapon	How long the barrel is in calibers. Used for calculating overall weapon weight.
Is this an automatic weapon:	Either TRUE or FALSE. Used to calculate the breech weight of the weapon.
Barrel Material Density:	How heavy the material used to make the gun barrel is. Affects overall weapon weight.

Simulating Stowed Ammunition for Turreted Weapons: If you want to simulate carrying additional rounds for a turreted weapon within the hull; simply enter the size of the weapon and how many rounds are carried; but make the **Number Carried** entry zero (0).

Rounds Carried for Weapon:	How many rounds are stowed within the hull for the weapon.
Is this a Fixed Case Weapon?	TRUE or FALSE. If your weapon fires a conventional metallic cartridge then TRUE. If however, it uses bagged propellant, or is a telescoped/caseless/railgun round, then enter FALSE.
Density of Round	How dense the round is. 1.2 g/cm3 is a nice round general figure.
Is this a LP or Railgun weapon?	TRUE or FALSE.

HULL INTERNAL VOLUME LEFT FREE: How much space is available inside the vehicle in cubic meters after all the various doodads are factored in. As you might imagine, negative numbers mean that you can't possibly fit everything in; which means you will need to make some tradeoffs in what you want, or increase the vehicle size, while an absurdly low number means that the vehicle is very cramped, the crew can't move about easily, and is literally a death trap if a good solid penetration occurs with a decent calibre weapon.

5. Turret Design Explained

Turret Ring Diameter	Diameter of Turret Ring in centimeters.
Turret Width	Width of Turret in Meters.
Turret Height	Height of Turret in Meters.
Turret Length	Length of Turret in Meters.
Number of Crew In Turret	How many crewmembers have their combat stations in the turret; if it is a two man turret like the M2 Bradley turret, this number is two (2). Unmanned turrets are naturally zero (0)

Turret Slope and Armor Layering is handled the same as with the **Hull Design** sheet.

Light Weapons, Light Weapons Stowed Ammunition, and **Cannon/Gun Type(s) One and Two** are handled the same way as with the **Hull Design** sheet.

6. Add On Armors A and B Explained

These two pages are handled the same way hull and turret armor layering are on their respective sheets. They allow you to design add-on applique armor for your vehicle to increase it's resistance to various weapons.

7. Propulsion Explained

HP/Ton Ratio Desired	What is the Horsepower/Ton Ratio you want from your vehicle?
Minimum Engine Output Needed	Calculates the horsepower you need to achieve the **HP/Ton Ratio desired** above based on current vehicle combat weight.
Engine Output Desired	How much POWAARRR do you want your engine to have?
Engine Power/Volume Ratio	How space efficient your engine is. (See **Appendixes** for lists)
Engine Power/Weight Ratio	How weight efficient your engine is. (See **Appendixes** for lists)
Specific Fuel Consumption	How fast your engine drinks fuel in grams per kilowatt produced per hour.
Gallons of Fuel	How many gallons of fuel your vehicle carries.
Fuel Density	Density of your fuel. (See **Appendixes** for lists)
Fuel Volume (kg/m3)	Volume of your fuel. (See **Appendixes** for lists)

APU Power Output	How many kW you want your Auxilary Power Unit (APU) to output.
APU Power/Weight Ratio	How weight efficient your APU is. (See **Appendixes** for lists)

The APU is used when vehicles are in stationary positions to save fuel by turning off their main powerplants and using the much more efficient APU for electrical power to drive the turret motors, gunnery computer, communications systems, and thermal sights.

Energy Storage Needed	How many megajoules (MJ) you need to store in the capacitor for electromagnetic weapons and other future-tech goodies.
Capacitor Energy Density	The mass efficiency of your capacitor design.

Normally, you can leave the capacitor fields blank, because the only use for it is in near-future 20xx vehicles armed with electromagnetic guns, or "railguns", which require a much higher energy output to fire than even a gas turbine can supply.

Transmission Mass Ratio	How efficient your transmission is masswise in handling the output from an engine.
Minimum Transmission Weight Needed	How heavy your transmission has to be *at the minimum* to handle the engine output you want.
Manual Transmission Weight Input	How heavy do you want your transmission to be?
Maximum Vehicle Weight	How much vehicle weight your transmission can handle before it burns out or becomes a maintenance nightmare.

Maximum Vehicle Weight Envisioned	The maximum possible weight of your vehicle combat loaded with any future or planned applique armor packages.
Suspension Ratio	Vehicle weight supported per kilogram of suspension.

Road Wheel Material Density	Density of the material that your road wheels are made up of. Steel and Aluminum are popular.
Rows of Road Wheels	How many rows of road wheels per track. Light vehicles can get away with one row, but heavy vehicles need two rows.

Ground Pressure Desired	The ground pressure you want for your vehicle in pounds per square inch
Ground Track Area Needed	How much area in cubic centimeters your track must have in ground track area in order to achive the desired ground pressure.
Track Width	Track Width in millimeters that your vehicle has.
Track Weight	Weight of your track type in kilograms per cubic meter.
Track Area Modifier	See List to Right of Spreadsheet to pick the one appropriate for your track.

8. Print Sheet Explained

This takes all the information we've put in on the varous pages and integrates it into a very easy cohesive page which can then be printed out and perused at our leisure.

On it, you can see how the various protection levels affect your vehicles' ground pressure, top speed, and propulsive systems.

At the bottom is a listing of your protection levels, which I believe you can figure out.

Appendixes

Armor Types

Armor Type	density (g/cm3)	TE (KE)	TE (HEAT)	Cost	Notes
Mild Steel	7.86	0.8	Unknown	Unknown	no limitations
Rolled RHA	7.86	1	1	Unknown	no limitations
Cast RHA	7.860	0.91	Unknown	Unknown	no limitations
SHS or HY-120 Steels	7.86	1.23	Unknown	Unknown	max thickness of several cm
Perforated RHA Plate	2.75 or 3.93	0.7	Unknown	Unknown	Unknown
Aluminum 5xxx Series	2.66	0.6	Unknown	Unknown	resists corrosion
Ti-6Al-4V	4.50	0.85	Unknown	Unknown	
Honeycombed Aluminum	2.75?	0.7	Unknown	Unknown	
Water	1	0.15	0.45	Unknown	
Steltexolite (Fiberglass type armor)	1.76	0.5	1.1	Unknown	
Alumina based Ceramics	3.58	0.9	2	Unknown	
Rubber Based Non Explosive Reactive Armor	8.75	0.44	0.34	Unknown	Must Be Thick
Chobham	2.22	0.61	1.07	Unknown	Must Be Thick
Air	0.0013	0	0.25	FREE	Found in Void Spaces
90s French Explosive Reactive Armor	2.96	0.25	2.67	Unknown	Must be 75mm thick

Fuel Consumption Table

Type of Engine	grams per KwH
Perkins Condor Diesel (modern)	220
AGT 1500 Gas turbine	300

Engine Power Density Table

Engine Type	kilowatts per kilogram
Ford GAA (M4A3 Sherman)	0.52
1970s Diesels	0.54
Fuel Cells (Present Day)	0.85
Fuel Cells (Mid-Term Future)	0.98
MTU 890 Series Diesel (1990s)	1.15
LV-50-2 Gas Turbine (FCS)	1.68

Engine Power Volume Efficiency Table

Engine Type	horsepower per m3
WWII Era 1944-45 Maybach	166
1970s Diesels	364.11

Fuel Data Table

Fuel Type	Area (kg/m3)	Density (lb/gallon)
JET A	817.5	6.75
Gasoline	737.22	6.27
Diesel	885	7.03

Track Systems Data Table

Track Type	Weight (kg/m2)	Modifier
80-100 Ton Vehicle Conventional	261	0.91
50-70 Ton Vehicle Conventional	180	0.64
30-40 Ton Vehicle Conventional	124	0.45
13-20 Ton Vehicle Conventional	65	0.31
80-100 Ton Vehicle Band	89.31	0.39
50-70 Ton Vehicle Band	61.53	0.27
30-40 Ton Vehicle Band	42.39	0.19
13-20 Ton Vehicle Band	22.22	0.13

Capacitor Data Table

Type	kJ/kg
Modern Capacitor	122
Possible Future?	244

Transmission Data Table

Type	kg/kw
T-72 Transmission	2.84
Electric?	4?

Suspension Data Table

Type	kg/susp/kg
Modern In Arm Suspension System	27.97

Ammunition Table

Ammunition Type	Weight	Volume (m3)
Man Portable ATGM	39.46 kg (includes launcher tube and batteries for launcher)	0.5
5.56mm Cartridge	12 grams (Plus 7.71 kg ammo box every 840 rds)	0.0037 (for each 840 round can)
7.62mm Cartridge	25 grams (Plus 7.71 kg ammo box every 400 rds)	0.0037 (for each 400 round can)
12.7mm Cartridge	120 grams (Plus 7.71 kg ammo box every 100 rds)	0.0037 (for each 100 round can)

Resistance Levels (KE)

Resistant to	Means
5.56 (generic short rifle rounds)	10mm penetration @ 500m
7.62 (generic full size rifle rounds)	17mm penetration @ 500m
12.7mm (Generic .50 BMG)	22mm penetration @ 500m
20x110mm Hispano	29mm penetration @ 500m
Soviet 30x 210mm M53 (BMP-2)	50mm penetration @ 1 kilometer
40mm L70 M56 AP	66mm penetration @ 1kilometer
US 25mm (M242 Bushmaster)	80mm penetration @1 kilometer
40mm L70 APFSDS	130mm penetration @ 1 kilometer
Early 105mm and modern 76mm	250mm penetration @ 1 kilometer
1986 Era 120mm	450mm penetration @ 1 kilometer
Modern Era 120mm	800mm penetration @ 1 kilometer

Resistance Levels (HEAT)

Resistant to	Means
Bazooka	100mm
Super Bazooka	200mm
RPG-7V	330mm
RPG-7VL	500mm
TOW	600mm
ITOW	700mm
TOW 2	800mm
TOW 2A	1000mm