COMBAT TANK (SOLUTION)

by Ong Kah Kien

The first step is to identify what is being clued by the 11 given images. The commonality is that each of the images show objects made of a certain alloy, which are created by combining two or more metals for enhanced attributes. This is also clued in the flavortext by the words "combines", "enhanced" and "mix". As confirmation for this step, the alloys have given enumerations, and are in alphabetical order in order of the given images. The table below summarizes the alloys, and the descriptions and remarks for the 11 given images in order:

Alloys	Descriptions and remarks
BRONZE	1881 Athena statue by Johannes Benk atop the Kunsthistorisches Museum in Vienna, Austria. Many modern bronze items, like architectural bronze and Olympic medals, are actually brass (alloyed with zinc instead of tin)
CONSTANTAN	Strain gauge foil resistor, traditionally made of Constantan, because of its high strain sensitivity.
ELECTRUM	Jimmy Carter's 2002 Nobel Peace Prize medal. The modern medals are notably made of Electrum, whereas prior to 1980, they were made of 23K gold.
ELINVAR	Elinvar hairspring from Hamilton pocket watch. Elinvar is used in precision chronometers due to its low thermal expansion, which improved accuracy. Charles Édouard Guillaume won the 1920 Nobel Prize for Physics for discovering the alloys Elinvar and Invar.
GOLOID	1878 Metric Dollar design struck by the United States Mint. The pattern dollar is made of Goloid, patented by Dr. William Wheeler Hubbell as a proposed coinage metal but was eventually rejected.
NISIL	Negative wire of Type N thermocouple (wires are color-coded orange for Type N, and red for the negative wires). Nisil alloy is used in conjunction with Nicrosil for the positive wire.
RED GOLD	1898 Imperial Pelican Fabergé egg made of red gold by Peter Carl Fabergé, who used this alloy for many of his creations and popularized it amongst Russians.
ROSE METAL	Rose-shaped cast of Rose Metal, an alloy discovered by the German chemist Valentin Rose the Elder. (Note: Only this variant spelling will fit the grid)
STELLITE	Dental Stellite, a partial dental prosthesis to replace missing teeth. Stellite, invented by Elwood Haynes, is often used for its strength and light weight.
TALONITE	Cuda Talon knife designed by Rob Simonich. Talonite blades have high corrosion and wear resistance as the alloy has been strengthened by hot rolling.
TERNE	Terne metal roof of historic house in Waterford, Virginia. The high lead and low tin content made terne a cheap plating alloy for roofing, before the lead was replaced by zinc from 2012.

Each of the alloys has a common composition (sometimes for that particular application) of its component metals, which can be correspondingly mapped to each of the pink/red circles alongside, in descending order of percentage. This is clued in the flavortext by the words "composed" and "elements". Since the composition could vary slightly even for the same alloy, the rough percentages for each component metallic element shown in the table below are not important, but only their ordering of relative amounts, which should be unambiguous. Any trace components (less than 3%) are also not reflected as pink/red circles, but by the ellipsis to indicate their omission. As a confirmation for this step, each numbered pink/red circles maps uniquely to a different metallic element.

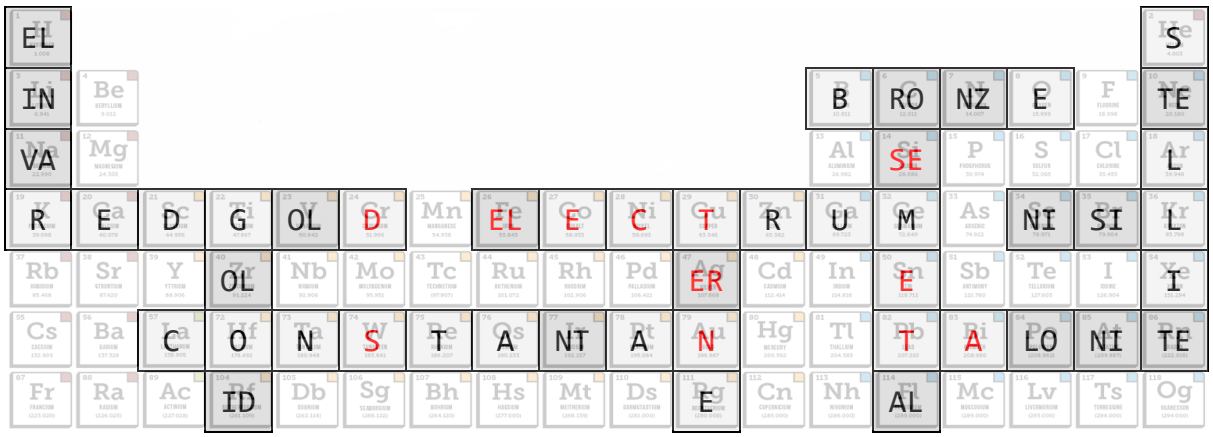
The table below summarizes the alloys, and the mappings of the pink (P1-4) and red (R1-8) circles based on their compositions of metallic elements (with rough percentages) in order of amount:

Alloys	Largest component metallic element	Next largest component metallic element	Least large component metallic element
BRONZE	R2 = COPPER (88)	R3 = TIN (12)	
CONSTANTAN	R2 = COPPER (55)	R5 = NICKEL (45)	
ELECTRUM	P2 = GOLD (75)	P4 = SILVER (25)	
ELINVAR	R5 = NICKEL (52)	R4 = IRON (36)	R8 = CHROMIUM (12)
GOLOID	P4 = SILVER (87.3)	R2 = COPPER (9.1)	P2 = GOLD (3.6)
NISIL	R5 = NICKEL (95)	R7 = SILICON (4.4)	
RED GOLD	P2 = GOLD (75)	R2 = COPPER (25)	
ROSE METAL	R6 = BISMUTH (50)	P3 = LEAD (28)	R3 = TIN (22)
STELLITE	P1 = COBALT (49)	R8 = CHROMIUM (33)	R1 = TUNGSTEN (18)
TALONITE	P1 = COBALT (60)	R8 = CHROMIUM (30)	R1 = TUNGSTEN (4.5)
TERNE	P3 = LEAD (80)	R3 = TIN (20)	

The criss-cross grid at the end of the puzzle has spaces for 11 answers, so the 11 alloys should be fitted into the grid. However, the lengths of the alloy names do not match the available lengths of the answer spaces in the grid. This hints that more than one answer letter may need to fit into some cells in the grid. And indeed some of the cells in the grid are marked with a darker shade. Drawing reference to the symbols for chemical elements (like the metallic elements comprising the alloys), these could take the form of 1 or 2 letters. If 2 letters are fitted into each cell with a darker shade, all the 11 alloys could now fit nicely into the grid. As a confirmation to this aha, occurrences of the same bigrams show up in other darker shade cells as well.

Thematically, the filled grid now somewhat resembles a periodic table, with 1 or 2 letters in each cell, and the overall shape of the grid fits the unique constraints of the period table as well. So the next step is to overlay the grid onto the periodic table, and extract the letters in the grid corresponding to the component metallic elements identified earlier for all the alloys.

The filled criss-cross grid is shown below overlayed with the periodic table, with the letters matching to the component metallic elements highlighted:



The first table below summarizes the mapping of the numbered pink and red circles to the component metallic elements, and the second table summarizes the extracted letters corresponding to each metallic element, in order of the numbered pink and red circles:

	1	2	3	4	5	6	7	8
P	Co	Au	Pb	Ag				
R	W	Cu	Sn	Fe	Ni	Bi	Si	Cr

	1	2	3	4	5	6	7	8
P	E	N	T	ER				
R	S	T	E	EL	C	A	SE	D

This yields the phrase ENTER STEEL CASED, so the thematic answer for this puzzle to enter into the answer checker is **STEEL CASED**.

Constructor's notes:

As mentioned for another puzzle, I always wanted to include in SGPH a good variety of puzzles that touched on different topics/fields which could appeal to solvers with various backgrounds, such as Chemistry, Biology, and Mathematics. The practical constraint being that, as the puzzles are written based on the required answers and hunt theme, it is not always possible to do so. Also, the puzzles generally should not require too in-depth knowledge of a certain topic. For this puzzle title and answer, the notion of tanks and steel cased gave rise to the thematic idea of alloys, which fit a chemistry theme. So using the periodic table, a basic and familiar thing for most solvers, as the extraction method would be apt and thematic. However, it was very challenging to extract from the periodic table based on specific elements (in this case, alloyed metals), which probably explains why no puzzle has done this before. Most puzzles would use some form of shift mechanic to provide flexibility to extract from the periodic table. But fortunately, I managed to find a suitable set of metals and their components for the extraction. I also tried to include more common and well-known alloys where possible, so it was satisfying that I managed to add in some of these in spite of the tight constraints.