Special Supplement 3
Missiles in

Traveller

Science-Fiction Adventure
in the Far Future

Missiles in Traveller

The space combat rules of **Traveller** provide for missile racks and missiles as weaponry for starships and spacecraft. Presented here are additional rules about missiles. The intention is to provide a greater usefulness for such weapons in both space combat and role-playing situations.

Missile installations for basic starship designs include four components— the *turret,* the *missile racks,* the *fire control equipment,* and the *missiles* themselves. Each of these components has its own contribution to make to space combat, but only missiles are the subject of this special supplement.

Missile Parameters: Missiles can vary widely in their capabilities as well as in their physical descriptions. It is possible for missiles to be small enough to fit in the hand, or large enough to rival small craft. A standard has been established, however, which allows interchangeability of many different types of missiles and an ease of procurement as well.

Standard missiles must be able to fit into a standardized shipping/launch container. The launch container is fitted directly to the launch rack and the missile is fired from it. The container includes integral test circuitry, provides protection from extremes of temperature and weather, and is isolated from the corrosive effects of atmosphere and moisture.

The standard container is a cylinder with interior dimensions of one meter long and 15 centimeters in diameter. Sealed for safety and security, the containers can be opened and the contents examined, removed or exchanged—an important feature when components are to be custom assembled for specific missile types.

Missile mass varies with the specific type of missile and is the sum of the masses of the missile's components. For convenience, missile mass is used to determine space limitations on missiles. A standard container will hold any missile of 50 kilograms or less; missiles in excess of 50 kilograms are unable to fit in standard missile containers, and thus in standard missile launch racks.

Missile containers each mass 5 kilograms, and are disposed of when the missile is expended.

Missiles which exceed 50 kilograms must be handled in launch bays available under the *High Guard* construction system; they cannot be launched from ordinary turret missile launch racks.

Scale: These rules are written for the standard starship combat scales in **Traveller,** and use those scales. Time is measured in turns of 1,000 seconds (or 16.66 minutes). Distance is measured with 100 millimeters equalling 10,000 kilometers. One G of acceleration for one turn moves an object 100 millimeters.

Tech Levels: The various components of missiles have their tech levels noted in the text. These tech levels are the *standard tech level for* that component and determine on what worlds these components may be manufactured. The primary effect of tech level is on cost.

The credit cost of a component at its standard tech level is shown in the text. At two less than the standard tech level, the cost is 200% of the base price. At one less than the standard tech level, the cost is 150% of the base price. At one greater than the standard tech level, the cost is 90% of base price. At two or more greater than the standard tech level, the cost is 80% of the base price. Components cannot be manufactured if local tech level is three less than standard tech level.

Non-industrial worlds, for various reasons, cannot manufacture missile components and they are not available on such worlds.

Law Levels: Most missile components are available for purchase at the starport of any world capable of producing them. Some components (specifically warheads) may not be available due to local law level restrictions.

TYPES OF MISSILES

Many different kinds of missiles are possible, but all make use of four basic types of components: a *propulsion system,* a *guidance system,* a *detonation system,* and a *warhead.* A missile is constructed by assembling one of each of the components together. If the resulting missile is less than 50 kilograms, then it can fit in a standard launch rack.

It is always possible to rearrange missile components to produce new types of missiles if they are needed. One gunner can assemble one missile from components (including by disassembling other missiles) in one turn and still be able to fire his turrets weapons during that turn.

Missile Identification: Any missile constructed using the procedures in these rules can be identified by indicating its performance, its propulsion, its guidance, and its detonation systems, its warhead, its mass, and its cost. Each of these components is more fully explained below. If a component is not produced at its standard tech level, then its tech level should be indicated in parentheses.

For example, a typical missile is a 5G5 limited burn, radio sensing, proximity detonator, high explosive warhead missile (all produced at their standard tech level) costing Cr16,200 and massing 50 kg. This price does not take into account tech level effects. At TL9, this missile costs Cr15,960; at TL7, it costs Cr31,100.

Propulsion Systems: The propulsion system for a missile moves it toward its target. Movement of the missile within game scale is accomplished by the propulsion system (finer movement control is assumed to be accomplished by smaller course control thrusters which are part of the system).

The capabilities of a propulsion system depend on how the missile is constructed and how much money was spent in producing it. There are three basic propulsion systems: continuous burn, limited burn, and discretionary burn. Each has its own benefits in utility, efficiency, and price.

Propulsion systems are defined by two numbers, commonly separated by a capital G. The first number is the maximum number of Gs which the missile is capable of in a turn; the second is the number of G-burns of fuel the missile can make. For example, a 1G1 propulsion system can accelerate a maximum of 1G per turn, and is capable of burning fuel to achieve 1G once. A 6G6 system can accelerate to a maximum of 6G per turn, and has enough fuel to reach 6G once. A 3G12 system can accelerate to a maximum of 3G in one turn, and has fuel to allow reaching 3G for four turns. This same missile could accelerate at 1G for 12 turns, or 2G for 6 turns.

A selection of basic propulsion systems have been computed for mass and price and are presented in the charts section. Other systems are also possible.

Continuous Burn propulsion systems are solid fuel motors which operate at maximum efficiency when ignited and until their fuel is exhausted. They cannot be turned off once started. They are, however, relatively cheap, and technologically easy to manufacture.

A continuous burn missile must *always* use its maximum acceleration in each turn until its fuel is exhausted. For example, a 3G6 continuous burn missile must accelerate 300 millimeters in its first turn and 300 millimeters in its second turn; thereafter, its fuel is exhausted. Continuous burn systems cannot alter course; they continue on the course given them when fired.

The casing for a continuous burn propulsion system is constucted to withstand the G forces the missile will encounter. It weighs 1 kilogram per G the missile is rated for, and costs Cr100 per kilogram. Fuel weighs 1 kilogram times burns; fuel costs Cr100 per kilogram.

Continuous burn propulsion systems have a standard tech level of 8.

Limited Bum propulsion systems are solid fuel motors which have the fuel segregated into increments, permitting the motors to be turned off and restarted. They are more expensive and still have limitations in their operation.

Limited burn missiles may be launched at less than maximum acceleration, but that acceleration may not be increased or decreased as the missile moves. Its course change potential is one-half the difference between its maximum G rating and its current G rating with fractions rounded down. It may alter its course by its course change potential (times 100 millimeters) in each turn. Fuel for course changes is expended at 2 burns for 1G of change. For example, a 6G12 continuous burn missile could be launched at 4G and would have the ability to change course at 1G (using 2 burns of fuel to do so); it could be launched at 1G and would have the ability to change course at 2G (using 4 burns to do so).

The casing for a limited burn missile weighs 5 kilograms plus 1 kilogram per G the system is rated for. The casing costs Cr200 per kilogram. Fuel for the limited burn missile weighs 1 kilogram per burns (for example, a 4G4 missile has fuel weighing 4 kilograms). Fuel costs Cr100 per kilogram.

Limited burn propulsion systems have a standard tech level of 9.

Discretionary Bum propulsion systems are liquid fuel motors which can vary fuel feed across a wide range, thus allowing fast or slow accelerations as circumstances require.

A discretionary propulsion system allows the missile to maneuver at or below the limits of its propulsion system once launched. Its maneuvers are just like those of a ship or small craft of equal capability.

Discretionary burn propulsion systems casings weigh 10 kilograms plus G in kilograms, and cost Cr2,000 plus G^2 times 100. Fuel weighs 0.4 kilograms per burn; it costs Cr400 per kilogram.

Discretionary burn propulsion systems have a standard tech level of 10.

No System: It is also possible to outfit a missile without a propulsion system. The missile cannot move by itself (although it does take the vector of the ship that launches it), and is a form of drifting mine. Such a missile requires no fuel, but still requires a casing (which serves as a foundation on which the other components are attached). The casing weighs 1 kilogram and costs Cr100. It has a standard tech level of 5.

Varying Payloads: The propulsion systems shown here are designed to power a 50 kilogram missile. If, once the missile has been assembled, its mass is greater than, or less than, 50 kilograms, then its actual performance will be different.

Determine the ratio of design mass (50 kilograms) and actual mass and multiply it times the missile performance in Gs.

The number of burns available for the missile must be similarly recomputed. Multiply the number of burns in the performance rating by the ratio of design to performance. Use of this ratio may increase or reduce missile performance.

For example, a missile with a 2G10 propulsion system is assembled, and with its warhead, detonation, guidance systems is found to mass 40 kilograms. The ratio 50:40 (reduced to 10:8, or 120%) is multiplied by the G rating of the missile, to produce a new G rating of 2.4; the number of burns is similarly recomputed by multiplying 120% times 10, to produce a new rating of 12.

Guidance Systems: Guidance systems provide the controlling pulses which carry a missile to its target.

Guidance systems are composed for two components: a *controller* and a *sensor* assembly.

Controllers provide course adjustments and correction signals to the propulsion system. The controller can function with any propulsion system. Controllers mass 3 kilograms and cost Cr300. Standard tech level is 9.

The sensor assembly provides input to the controller. It detects information and provides it to the controller.

Radio Receiver: The most versatile of the sensors is the radio receiver. It may be used for a variety of seeking methods which include external guidance, active homing, and passive homing. A radio receiver masses 1 kilogram and costs Cr400. Standard tech level is 8.

With external guidance, the missile is directed by radio waves from the launching ship. The radio sensor receives guidance signals from the launching ship and forwards them to the controller, which then directs the propulsion system.

With passive homing, the radio receiver senses radio emissions from the target and uses them to guide the missile to it.

With active homing, the launching ship broadcasts radio (or radar) and the radio receiver on the missile senses reflections of them from the target and allows the missile to home on them.

Infrared Sensor: The infrared sensor allows the controller to react to heat emissions from the target and to home in on them. An infrared sensor masses 1 kilogram and costs Cr800. Standard tech level is 9.

Mass Sensor: The mass sensor allows the controller to react to the mass of the target and to home in on it. A mass sensor masses 1 kilogram and costs Cr1,000. Standard tech level is 10.

Neutrino Sensor: The neutrino sensor allows the controller to react to neutrino emissions from the target's power plant and to home in on them. A neutrino detector masses 4 kilograms and costs Cr1,000. Standard tech level is 11.

In practice, all of the sensors work in concert when the missile is operating in the homing mode. The controller reacts to all sensor input and guides the missile to the location where the preponderance of evidence shows the target to be.

Other sensors are possible and can be produced, but they are not standard installations. For example, an occultation sensor can be set to memorize local star fields and to react when a target passes in front of the memorized field. Or, an emission sensor can be set to detect ionized particles, gases, or pollutants emitted by potential targets. Inertial sensors can determine and calculate movement by the missile and allow the controller to move the missile to a specific pre-selected location, there to explode or to wait for a target.

Detonation Systems: Detonation systems are a specialized (and distinct) part of the guidance system which determines when to explode the missile's warhead.

Detonation systems determine when the warhead will explode and under what circumstances. Basic detonation systems are *contact, proximity, intelligent,* and *command.*

Contact Detonators trigger the warhead when the missile actually rams or collides with the target. They are indiscriminating, and so function whether or not the ship they hit is the intended target. A missile which explodes in contact with its target inflicts double the normal number of hits. Each masses one kilogram. A contact detonator requires impact with the target rather than simply intercept it. Base Price: Cr100. TL5.

Proximity Detonators trigger the warhead when the missile intercepts the target; impact is not required. They can be countered by ECM (Electronic Counter Measures) programs in the target ship's computer. Base Price: Cr500. TL6. Mass: 1kg.

Intelligent Detonators utilize electronic circuits to recognize patterns, circumstances, and strategies of the target, and to counteract them. While not sentient, they are sophisticated and can overcome ECM by the target. Base Price: Cr1,000. TL8. Mass: 1kg.

Command Detonators trigger the warhead on a signal from the launching ship. The missiles they are installed on must have a radio sensor. When the missile intercepts its target, the controlling gunner may detonate the warhead in proximity to the target and inflict the standard number of hits. If the missile impacts the target, the warhead may be detonated in contact, inflicting double the standard number of hits. Command detonators are detonated out of range of damage by successful ECM. Command detonators are subject to range attenuation due to radio communications lag: if more than three meters (one light-second) from the launching ship, throw 2+ for the missile to respond to the detonation command; DM - 1 per light-second distance, DM - 3 if attempting to detonate in contact. If unsuccessful, the detonation command may be re-sent in the next game turn. Base Price: Cr200. TL7. Mass: 1kg.

Warheads: Warheads contain the payload for the missile; they are generally an explosive charge. In some cases, the payload may be non-explosive, or even non-weapon in nature.

Warheads vary by size and type of explosive. Five basic types of explosive are available: *high explosive, focussed force explosive, nuclear, enhanced radiation,* and *fusion.*

High Explosive is simple chemical explosive. It creates an blast effect which works best when in contact with the target. Chemical blast explosive warheads are produced in a 10 kilogram basic size. Larger charges can be produced by assembling more than one charge in a missile. The chemical explosive warhead produces 2 hits. Base Price: Cr500. TL6.

Focussed Force Explosive is high explosive which directs the blast toward the target, thus reducing wasted blast effect. It is an evolution of shaped charge technology. Focussed force explosive is produced in 10, 20, and 30 kilogram charges; because of the nature of the focussed force process, separate charges cannot be combined in a missile assembly. The focussed force warhead produces 4 hits per ten kilograms of explosive. Base Price: Cr1,000 for 10 kilogram charge, Cr2,000 for 20 kilogram charge, and Cr3,000 for 30 kilogram charge. TL9.

Nuclear Explosive produces blast through nuclear fission. Some radiation effects are also produced. Nuclear warheads mass 30 kilograms, but can be acquired in various yields ranging from 0.1 kiloton to 10 kilotons. A nuclear warhead produces 10 hits per 0.1 kiloton of yield, and also produces 2 radiation hits per 0.1 kiloton of yield. Base Price: Cr1,000,000 per kiloton yield. TL8.

Enhanced Radiation warheads produce minimal blast but greater amounts of radiation. Enhanced radiation warheads mass 20 kilograms, but can produce equivalent yields of 0.1 kiloton to 10 kilotons. An enhanced radiation warhead produces 8 hits on the radiation table per 0.1 kiloton of yield. If detonated in contact with the target, it will produce 5 hits per 0.1 kiloton of yield; if not in contact, there are no ordinary hits produced. Base Price: Cr1,000,000 per kiloton yield. TL9.

Fusion Warheads release great amounts of energy through hydrogen fusion. Those below standard tech level require a fission trigger (0.1 kiloton yield) while those at standard tech level and above achieve fusion by other means. They inflict 10 damage hits and 2 radiation hits per 0.1 kiloton of yield. Below standard tech level, there is a minimum yield of 0.2 kilotons. Base Price: Cr1,000,000 per kiloton yield (at tech level 8 there is a Cr100,000 surcharge for the fission trigger; at TL9, there is a Cr90,000 surcharge for the fission trigger). TL10. Mass: 20 kilograms (40 kilograms if below tech level 10).

MISSILE STORAGE

Each standard missile rack can hold one missile ready to fire and two additional missiles ready for future game turns. The role of the gunner in the turret is to aim and fire the weaponry in the turret; once the missile racks and ready missiles are exhausted, the gunner must reload them with new missiles. A gunner can load new missiles into the racks and still operate the weaponry in a game turn.

The standard turret has room to store an additional 12 missiles in it. Once these missiles have been used, the turret must be restocked with missiles carried elsewhere in the ship (usually in the cargo hold).

Restocking a turret with missiles is accomplished during the game turn interphase. If the gunner participates in restocking, he may not operate weaponry in the turret in the next game turn. It is possible for non-gunner crewmembers who are not otherwise engaged to perform restocking instead. One person can restock a turret in one game turn.

MISSILE MOVEMENT

Missiles move using the same vector movement system that is used for ships. The procedures are the same except that the player must monitor the available fuel for the missile, and it may not maneuver once it exhausts that fuel supply.

Continuous burn missiles begin at maximum acceleration and continue to operate at maximum acceleration until fuel is exhausted. They may not maneuver if their target moves or changes course. Consequently, continuous burn missiles are most effective if fired against targets which can be intercepted during the first phase of movement. For example, a 6G6 missile can intercept a target within 600 millimeters of its launch point during its first turn of movement. Chances of interception in subsequent turns are much less.

Limited burn missiles may be launched at less than maximum acceleration, but that acceleration may not be increased or decreased as the missile moves. They may change course within certain limits, allowing interception of some maneuvering targets. Limit burn missiles are a compromise between the low cost of continuous burn missiles and the efficiency of discretionary burn missiles.

Discretionary burn missiles function in the same manner as spacecraft, but their fuel consumption must be monitored.

Unpowered missiles may not maneuver, although their courses are affected by gravity. They do have a vector given them by their launching ship, and they continue to move using that vector.

Effects of Gravity: Gravity functions constantly and affects the courses of missiles in the normal manner.

Interception: A missile intercepts a target if it passes within 25 millimeters of that target. Within 25 millimeters of the target is close enough to activate proximity detonators and for any warhead to affect the target.

Because of the scale being used, the distance of 25 millimeters from the target is measured from a single point on the target which is located at the head of its vector arrow.

Referee's Note: For reasons of scale and convenience of play, the distance of 25 millimeters has been selected to indicate a distance at which a missile intercepts a target. In actuality, the sophisticated systems aboard the missile would produce interceptions at ranges of several hundred meters.

Impact: Actually impacting a target (as opposed to intercepting) requires maneuverability on the part of the missile. Any powered missile will impact the target on the first turn of movement; initial guidance by the launch racks is sufficient in this case. In subsequent turns, continuous burn missiles can intercept, but will not impact. Limited burn and discretionary burn missiles can impact if they are able to plot a vector which passes through the target.

Range Band Movement: If the range band movement system for space craft is being used instead of the vector movement system, then missile movement must be adjusted to correspond to that system. Missile movement is determined by acceleration possible, and fuel is expended when the missile accelerates.

Continuous burn missiles cannot hit if they do not intercept on the first turn of movement.

Limited burn missiles cannot hit if they do not intercept on the first three turns of movement. On turns of movement after the first, throw 4+ for the missile to intercept the target and allow DM+ remaining fuel on the throw.

Discretionary burn missiles are maneuvered in exactly the same manner as ships.

MISSILE COMBAT EFFECTS

Missiles which intercept the target in the movement phase and which then survive anti-missile fire and ECM can detonate. When a missile detonates, it inflicts hits on the target based on its detonator system, its warhead, its velocity vector, and its distance.

Warheads: The specific warhead type determines the base number of hits which a missile can inflict on the target. This number can be increased or decreased through the influence of other factors.

The base hit numbers for warheads are given in the missile components table.

Detonators: Detonators determine when and how effectively a warhead explodes. Contact detonators function only when the missile hits the target; they double the base number of hits. Proximity detonators function when the missile intercepts the target but before contact occurs; they do not alter the base number of hits. Intelligent detonators function the same as proximity detonators, but are not affected by ECM. Command detonators are triggered by the gunner and may operate as either proximity or contact detonators; command detonators are reduced in effectiveness by distance.

Velocity Vector: If a missile contacts its target and the sum of the vectors of the missile and the target is greater than 300 millimeters, then one extra hit on the hit location table is allowed for each 300 millimeters of vector length. Ignore fractions remaining when dividing the vector by 300 millimeters.

Counter Measures: A target may adopt counter-measures against a particular type of missile.

Passive radio homing missiles cannot be launched against a target which is not broadcasting radio. A target is assumed to be not broadcasting radio if it has not fired active radio homing missiles, has not fired missiles equipped with command detonators, is not communicating by radio with other ships or bases, is not externally guiding missiles, and is not using radar. Missiles fired against a ship which then ceases such operations continue on their last plotted vector.

Heat seeking (IR homing) missiles of less than base tech level will shift their target to any hotter object which presents itself, including the local star.

Neutrino seeking missiles cannot track craft without power plants such as missiles, or ships which have turned off their power plants.

Mass seeking missiles sometimes cannot differentiate between a mass and background masses. At less than standard tech level, a mass seeking missile will be unable to intercept a target which is located on a world or planet. At standard tech level or less, a mass seeking missile will be unable to intercept a target located on a nickel-iron asteroid at least three times larger than the target. At higher than standard tech level, a mass seeking missile can properly differentiate and lock onto a target, regardless of background.

Inflicting Damage: For each hit which a missile produces, roll once on the hit location table. Most warheads use the basic hit location table. Nuclear warheads inflict hits on both the basic hits table and the radiation damage table. Radiation warheads inflict hits on the radiation damage table.

The damage (or hit) tables from **Traveller** are used. In addition, a radiation damage table is presented in the chart set to allow implementation of radiation hits. Radiation affects only crew, computers, and weaponry. The sudden burst of radiation can cause crew casualties, incapacitate a computer, or incapacitate weaponry circuits making the weapons inoperable. If a ship's computer has a fiber optic backup system (explained in *High Guard),* then the computer is immune to radiation hits.

ECM: Electronic Counter Measures programs may fool or disorient a missile, forcing it to explode prematurely, or without effect, or to fail to explode. ECM requires an ECM program running in the target ship's computer and can affect any missile which intercepts the ship. ECM takes place during the laser return fire phase and before the missile has an opportunity to detonate.

ECM affects any missile which is operating with a radio sensor. Throw 9+ for the ECM to be successful. If successful, most missiles will fail to explode, and instead continue on their course; they are incapacitated and cannot be guided or used further by their launching ship.

An ECM incapacitated missile may still do damage to the target. Any ECM incapacitated missile which has sufficient velocity vector to qualify for hits (if vector is at least 300 millimeters long) will still inflict those hits if the target is hit. Any ECM incapacitated missile which is on its first turn of movement will still impact the target.

Any contact detonator will still function if the target is contacted. Proximity, intelligent, and command detonated warheads will explode at sufficient range from the target to assure no target damage is done.

Sand Effects: Any missile which passes through sand may be incapacitated by that sand. For each 25 millimeters of sand that a missile passes through, throw 12+ for the missile to be incapacitated by it. If incapacitated, the missile ceases to function.

NON-MILITARY MISSILES

Missiles can be assembled with payloads that do not serve a strictly military function. Examples of such missiles include illumination or signal missiles, message torpedoes, and remote sensor drones.

Illumination missiles are fitted with a bright flare warhead (usually chemical in nature), a radio sensor, and a command detonation system. The purpose is to create a bright visual signal for some purpose— communication with a planetary surface, momentary illumination of a location, or even as a diversion. Illumination missiles which illuminate in the radio or the infrared spectrum are also possible; they use special illumination payloads at the same cost and mass as the ordinary type.

An illumination payload is capable of producing an extremely bright light for the period of one game turn. The process destroys the missile. The payload masses 10 kilograms and has a base price of Cr1,000. Standard tech level is 6.

Message Torpedoes carry physical messages, materials, equipment, or samples from one location to another. Their payload section is a compartment which holds the items securely. They also carry a radio sensor and a controller.

A message torpedo payload masses 10 kilograms and costs Cr100 at tech level 5.

Remote Sensor Drones carry sensor equipment for remote operations. The specific sensor equipment must be placed in a custom produced payload assembly. The assembly costs Cr500 plus the cost of the instrumentation and can be produced at the tech level of the instrumentation.

BUDGETING

Because missiles are expended when fired, they must be replaced as soon as possible if a ship is to be fully prepared for every possible contingency. Two specific methods of handling this situation are possible.

The most direct method is to purchase missile components and to maintain a record of all components purchased. When missiles are fired, they are taken from this inventory list and marked as expended. When components are acquired, they are added to this list.

A less specific method is to maintain a running credit balance in a missile component assembly account. The referee can assume that player characters may draw any appropriate standard component assembly from the account when and where needed. Restocking the account can take place at any starport where components can be purchased. If this method is used, all missile components expended should be considered at standard price and tech level. Restocking can only take place at worlds which meet standard tech level requirements. In addition, the fund cannot be converted to cash again except at a 50% discount (to account for trying to sell less than new missile components).

FIRE WHEN READY

These missile rules provide additional material for the referee and the players to produce missiles that meet their needs in **Traveller** campaigns. These rules add complexity, but they also add flavor to almost any **Traveller** space combat situation.

In addition, they add a further degree of information for the players who are role-playing with their characters in the course of a space battle by indicating procedures and considerations which come into force for the individuals involved in ship to ship combat.

REFERENCES

The following are inportant references for use in conjunction with this special supplement.

Starter **Traveller** (GDW: 1983).

Starships, **Traveller** Book 2 (GDW: 1981).

The **Traveller** *Book (GDW: 1982).*

High Guard, **Traveller** Book 5 (GDW: 1980).

Trillion Credit Squadron, **Traveller** Adventure 5 (GDW: 1981).

Traveller
Special Supplement 3 — Missiles

This special supplement was designed by Marc W. Miller.

GAME TURN SEQUENCE

Intruder Player Turn—

A. Intruder Movement. The intruder moves his ships using the movement and gravity rules. Missiles and sand launched in previous game turns also move.

B. Intruder Laser Fire. The intruder may fire his ship's laser weaponry at enemy targets. Only laser weaponry may fire in this phase.

C. *Native* Laser Return Fire. The native may return fire with his laser weaponry at enemy ships which have fired on him, provided his return fire computer program is running during this phase, and in accordance with the computer program and combat rules. Anti-missile laser fire may be performed in this phase if the appropriate computer program is running. ECM programming operates and may destroy close enemy missiles. Missiles passing through sand may be incapacitated.

D. Intruder Ordnance Launch. Precise missile types (indicating specific assemblies included in the missile) are designated prior to launch. Missiles are launched on specific missions against designated targets by the intruder, subject to the applicable rules. Sand is launched. Missile racks and sandcasters are reloaded if necessary and missiles or sand are available. Missiles which intercepted targets detonate, with blast and/or radiation effects. Lifeboats and ship's vehicles are launched.

E. Intruder Computer Reprogramming. The intruder may remove computer programs from his on-board computer and input others in anticipation of later needs.

Native Player Turn—

A. Native Movement. The native moves his ships using the movement and gravity rules. Missiles and sand launched in previous game turns also move.

B. Native Laser Fire. The native may fire his ship's laser weaponry at enemy targets. Only laser weaponry may fire in this phase.

C. *Intruder* Laser Return Fire. The intruder may return fire with his laser weaponry at enemy ships which have fired on him, provided his return fire computer program is running during this phase, and in accordance with the computer program and combat rules. Anti-missile laser fire may be performed in this phase if the appropriate computer program is running. ECM programming operates and may destroy close enemy missiles. Missiles passing through sand may be incapacitated.

D. Native Ordnance Launch. Precise missile types (indicating specific assemblies included in the missile) are designated prior to launch. Missiles are launched on specific missions against designated targets by the native, subject to the applicable rules. Sand is launched. Missile racks and sandcasters are reloaded if necessary and missiles or sand are available. Missiles which intercepted targets detonate with blast and/or radiation effects. Lifeboats and ship's vehicles are launched.

E. Native Computer Reprogramming. The native may remove computer programs from his on-board computer and input others in anticipation of later needs.

Game Turn Interphase—

The end of one game turn is marked. All non-player items such as planets, worlds, and satellites move in accordance with the rules. Turrets may be restocked with missiles and sand moved from cargo storage locations by the gunner or by other crewmembers. Other miscellaneous activity may also be necessary. The game then proceeds to the movement and combat of the next game turn.

CONTINUOUS BURN PROPULSION SYSTEM

Burns	1G		2G		3G		4G		5G		6G	
1	2	200	4	600	6	1,200	8	2,000	10	3,000	12	4,200
2	3	300	6	1,000	9	2,100	12	3,600	15	5,500	18	7,800
3	4	400	8	1,400	12	3,000	16	5,200	20	8,000	24	11,400
4	5	500	10	1,800	15	3,900	20	6,800	25	10,500	30	15,000
5	6	600	12	2,200	18	4,800	24	8,400	30	13,000	36	18,600
6	7	700	14	2,600	21	5,700	28	10,000	35	15,500	42	22,200
7	8	800	16	3,000	24	6,600	32	11,600	40	18,000	48	25,800
8	9	900	18	3,400	27	7,500	36	13,200	45	20,500	54	29,400
9	10	1,000	20	3,800	30	8,400	40	14,800	50	23,000	60	33,000
10	11	1,100	22	4,200	33	9,300	44	16,400	55	25,500	66	36,600
11	12	1,200	24	4,600	36	10,200	48	18,000	60	28,000	72	40,200
12	13	1,300	26	5,000	39	11,100	52	19,600	65	30,500	78	43,800

LIMITED BURN PROPULSION SYSTEM

Burns	1G		2G		3G		4G		5G		6G	
1	7	1,300	9	1,800	11	2,500	13	3,400	15	4,500	17	5,800
2	8	1,400	11	2,200	14	3,400	17	5,000	20	7,000	23	9,400
3	9	1,500	13	2,600	17	4,300	21	6,600	25	9,500	29	13,000
4	10	1,600	15	3,000	20	5,200	25	8,200	30	12,000	35	16,600
5	11	1,700	17	3,400	23	6,100	29	9,800	35	14,500	41	20,200
6	12	1,800	19	3,800	26	7,000	33	11,400	40	17,000	47	23,800
7	13	1,900	21	4,200	29	7,900	37	13,000	45	19,500	53	27,400
8	14	2,000	23	4,600	32	8,800	41	14,600	50	22,000	59	31,000
9	15	2,100	25	5,000	35	9,700	45	16,200	55	24,500	65	34,600
10	16	2,200	27	5,400	38	10,600	49	17,800	60	27,000	71	38,200
11	17	2,300	29	5,800	41	11,500	53	19,400	65	29,500	77	41,800
12	18	2,400	31	6,200	44	12,400	57	21,000	70	32,000	83	45,400

DISCRETIONARY BURN PROPULSION SYSTEM

Burns	1G		2G		3G		4G		5G		6G	
1	12	2,260	13	2,720	15	3,380	16	4,240	17	5,300	19	6,560
2	12	2,420	14	3,040	16	3,860	18	4,880	19	6,100	21	7,520
3	13	2,580	15	3,360	17	4,340	19	5,520	21	6,900	24	8,480
4	13	2,740	16	3,680	18	4,820	21	6,160	23	7,700	26	9,440
5	13	2,900	16	4,000	19	5,300	22	6,800	25	8,500	28	10,400
6	14	3,060	17	4,320	21	5,780	24	7,440	27	9,300	31	11,360
7	14	3,220	18	4,640	22	6,260	26	8,080	29	10,100	33	12,320
8	15	3,380	19	4,960	23	6,740	27	8,720	31	10,900	36	13,280
9	15	3,540	20	5,280	24	7,220	29	9,360	33	11,700	38	14,240
10	15	3,700	20	5,600	25	7,700	30	10,000	35	12,500	40	15,200
11	16	3,860	21	5,920	27	8,180	32	10,640	37	13,300	43	16,160
12	16	4,020	22	6,240	28	8,660	34	11,280	39	14,100	45	17,120

In each column, the left number is mass of the missile propulsion assembly in kilograms; the right number is the cost of the propulsion assembly in credits.

The prices shown are base prices at standard tech level.

SCALE

Time: Each game turn is 1,000 seconds (about 16.6 minutes).

Space: One millimeter equals 100 kilometers; 1:100,000,000. Three meters equal one light-second.

Thrust: 1G vector equals 100 millimeters. 1,000 seconds of acceleration at 1G produces a velocity change of 10,000 kilometers (or 100mm in scale).

Units: Individual starships, non-starships, small craft and missiles.

TECH LEVEL EFFECTS

Tech Level	*Price*
Standard TL-3	not available
Standard TL-2	200% of base price
Standard TL-1	1 50% of base price
Standard TL	base price
Standard TL+1	90% of base price
Standard TL+2+	80% of base price

Non-industrial worlds cannot produce missile components and they are not available.

LAW LEVELS

Law levels have no effect except for warheads. Nuclear, fusion, and enhanced radiation warheads are illegal at law levels 4+; all warheads are illegal at law levels 8+.

PROPULSION RATING SYSTEM

Missile propulsion systems are rated by their acceleration potential and their endurance using two numbers separated by a G (for example, 5G5).

The first number is the maximum G acceleration possible for the missile. The second number is the number of burns possible for the missile, expressed so that one burn will accelerate the missile at 1G for one turn.

Example: 5G5 indicates the missile can reach a maximum 5G acceleration, and which has enough burns to do so for one turn.

MISSILE COMPONENT ASSEMBLIES

Component Type	*Mass*	*TL*	*Credits*
Controller	3kg	9	300
Radio Sensor	1kg	8	400
Infrared Sensor	1kg	9	800
Mass Sensor	1kg	10	1,000
Neutrino Sensor	4kg	11	1,000
Contact Detonator	1kg	5	100
Proximity Detonator	1kg	6	500
Intelligent Detonator	1kg	8	1,000
Cmd Detonator	1kg	6	200
High Explosive	10kg	6	500
Force Focussing	10kg	9	1,000
Force Focussing	20kg	9	2,000
Force Focussing	30kg	9	3,000
Nuclear Warhead	30kg	8	*
Enhanced Radiation	20kg	9	#
Fusion Warhead	20kg	10	§

*Fission, Fusion, and Enhanced Radiation warheads may be acquired in yields of 0.1 to 10 kilotons at a cost of MCr1 per 0.1 kiloton.

PROPULSION SYSTEM COSTS

The formulae below compute credit cost and mass for propulsion systems.

Casing **Continuous Burn** *Fuel*

$M_C=G$ $M_F=B$

$C_C=100M_C$ $C_F=100GM_F$

Casing **Limited Burn** *Fuel*

$M_C=5+G$ $M_F=B$

$C_C=300M_C$ $C_F=200GM_F$

Casing **Discretionary Burn** *Fuel*

$M_C=10+G$ $M_F=0.4B$

$C_C=2000+100G^2$ $C_F=400M_F$

Casing **No Propulsion** *Fuel*

$M_C=1$ $M_F=0$

$C_C=100$ $C_F=0$

G: Gravities acceleration. B: Burns of fuel. C_F: Fuel Cost in credits. C_C: Casing Cost in credits. M_C: Casing Mass in kilograms. M_F: Fuel Mass in kilograms. Payload will vary missile performance.

INTERCEPTION

A missile intercepts its target if it passes within 25 millimeters of the target.

ECM EFFECTS

Throw 9+ for an operating ECM program to affect an intercepting radio sensor missile during the Laser Return Fire Phase.

Intelligent detonators are immune.

Command and proximity detonators explode harmlessly.

Ccontact detonators still function.

Missiles on their first turn of movement still impact the target. Velocity hits can still occur.

SAND EFFECTS

For each 25 millimeters of sand which a missile passes through, throw 12+ for the missile to become incapacitated. An incapacitated missile ceases to function.

VELOCITY COMBAT EFFECTS

If the sum of the vectors of the missile and the target exceeds 300 millimeters in length then one extra hit is allowed for each 300 millimeters of vector length. Ignore fractions when dividing the vector by 300 millimeters.

RADIATION DAMAGE

Two Dice	*Starship*	*Non-Starship*	*Small Craft*
2	Crew	Crew	Crew
3	Crew	Crew	Crew
4	Computer	Crew	Crew
5	Computer	Computer	Crew
6	Computer	Computer	Crew
7	No Effect	Computer	Crew
8	Computer	Computer	Computer
9	Crew	Crew	Computer
10	Turret	Turret	Turret
11	Turret	Turret	Turret
12	Turret	Turret	Turret

Fiber Optic computers are immune to computer hits on this table.

Missiles are hit on the small craft column with DM -3 (crew hits are treated as sensor destroyed; computer hits are treated as controller destroyed; weapon hits are treated as warhead detonated).

Crew Hits inflict 4D hits on one crew member determined randomly.

MISSILE IDENTIFICATION

Identify each missile by stating its performance, its components (and their tech levels if non-standard), and its mass and cost.

Performance, propulsion, guidance and detonation systems, warhead, mass, and cost.

COMBAT EFFECTS

Warheads produce hits; detonators may alter hits produced; velocity produces hits.

High Explosive: 2 hits per 10 kilograms.

Focussed Force: 4 hits per 10 kilograms.

Nuclear Explosive: 10 hits per 0.1 kiloton yield, plus 2 radiation hits per 0.1 kiloton yield.

Enhanced Radiation: 8 radiation hits per 0.1 kiloton yield. 5 hits per 0.1 kiloton yield if in contact with the target.

Fusion Warhead: 10 hits per 0.1 kiloton yield, plus 2 radiation hits per 0.1 kiloton yield.

Contact Detonator: Doubles hits produced by warhead.

Proximity Detonator: No effect on hits.

Intelligent Detonator: No effect on hits.

Command Detonator: Doubles hits produced by warhead detonated in contact.

This special supplement amplifies and elaborates certain facets of missiles and their use in ***Traveller®*** *. It originally appeared as a pull-out section in the* Journal of the Travellers' Aid Society® *issue number 21.*