

**BATTLETECH**



# INTERSTELLAR OPERATIONS

Open Beta: Solar System Generation



**CATALYST**  
game labs™



# PRIMARY SOLAR STATS TABLE

Spectral Class	Charge Time (hrs)	Transit Time (days)	Safe Jump Distance (km)	Mass Mstar/Msun	Luminosity Lstar/Lsun	Radius Rstar/Rsun	Temp (K)	Lifetime (Million Years)	Habitability Modifier
M9V	210	1.96	75,004,186	0.10	0.00415	0.20	2,000.00	5,524,271.73	-3
M8V	209	2.09	82,196,817	0.10	0.00353	0.24	2,167.00	1,641,124.84	-3
M7V	208	2.22	90,202,821	0.10	0.00369	0.28	2,333.00	839,223.62	-3
M6V	207	2.34	99,120,198	0.20	0.0045	0.32	2,500.00	494,825.15	-2
M5V	206	2.45	109,082,750	0.20	0.00624	0.36	2,667.00	290,112.63	-2
M4V	205	2.56	120,212,270	0.30	0.0106	0.39	2,833.00	202,860.21	-2
M3V	204	2.67	132,669,349	0.30	0.0178	0.41	3,000.00	148,355.18	-2
M2V	203	2.86	146,630,886	0.40	0.0321	0.47	3,167.00	112,341.70	-1
M1V	202	2.96	162,304,787	0.50	0.0618	0.51	3,333.00	87,473.55	-1
M0V	201	3.14	179,917,035	0.50	0.125	0.55	3,500.00	69,679.56	-1
K9V	200	3.31	199,737,005	0.50	0.144	0.55	3,640.00	56,568.54	-2
K8V	199	3.47	222,081,144	0.60	0.155	0.55	3,780.00	48,900.17	-2
K7V	198	3.70	247,343,861	0.60	0.187	0.55	3,920.00	42,611.81	-3
K6V	197	3.91	275,861,999	0.60	0.211	0.56	4,060.00	35,860.96	-2
K5V	196	4.12	308,167,706	0.70	0.266	0.57	4,200.00	31,743.05	-2
K4V	195	4.31	344,841,863	0.70	0.31	0.60	4,340.00	27,215.29	-1
K3V	194	4.62	386,486,041	0.70	0.335	0.65	4,480.00	24,392.42	0
K2V	193	4.85	433,890,326	0.70	0.401	0.71	4,620.00	21,963.06	0
K1V	192	5.18	487,899,662	0.80	0.443	0.80	4,760.00	19,859.40	0
K0V	191	5.48	549,564,113	0.80	0.543	0.91	4,900.00	18,027.37	0
G9V	190	5.82	620,061,930	0.80	0.57	0.92	5,010.00	16,423.49	0
G8V	189	6.19	700,990,216	0.80	0.65	0.93	5,120.00	15,012.49	0
G7V	188	6.57	793,654,769	0.90	0.68	0.94	5,230.00	13,765.54	0
G6V	187	7.01	900,260,278	0.90	0.79	0.95	5,340.00	13,013.49	0
G5V	186	7.47	1,023,057,406	0.90	0.84	0.96	5,450.00	11,989.27	0
G4V	185	7.96	1,164,589,626	0.90	0.98	0.97	5,560.00	11,074.44	0
G3V	184	8.53	1,328,301,833	1.00	1.15	0.99	5,670.00	10,518.04	0
G2V	183	9.12	1,517,879,732	1.00	1.23	1.02	5,780.00	10,000.00	0
G1V	182	9.75	1,737,804,380	1.00	1.46	1.19	5,890.00	9,287.67	0
G0V	181	10.43	1,993,326,049	1.10	1.72	1.25	6,000.00	8,851.70	0
F9V	180	11.19	2,290,901,666	1.10	2.03	1.30	6,140.00	8,443.85	0
F8V	179	12.01	2,638,513,835	1.20	2.41	1.35	6,280.00	6,753.60	0
F7V	178	12.89	3,044,526,612	1.30	2.62	1.35	6,420.00	5,394.80	-1
F6V	177	13.87	3,520,358,039	1.30	3.13	1.41	6,560.00	4,469.95	-1
F5V	176	14.94	4,079,039,960	1.40	3.75	1.48	6,700.00	3,752.72	-1
F4V	175	16.10	4,736,187,040	1.40	4.50	1.56	6,840.00	3,136.95	-2
F3V	174	17.36	5,510,895,632	1.50	4.94	1.57	6,980.00	2,693.29	-2
F2V	173	18.75	6,426,026,992	1.50	5.95	1.65	7,120.00	2,332.75	-3
F1V	172	20.26	7,509,968,038	1.60	6.56	1.67	7,260.00	2,009.63	-3
F0V	171	21.94	8,782,563,721	1.60	7.94	1.77	7,400.00	1,767.77	-4
A9V	170	23.75	10,324,169,238	1.70	8.85	1.75	7,650.00	1,510.26	-4
A8V	169	25.77	12,147,011,068	1.80	10.90	1.81	7,900.00	1,288.06	-5
A7V	168	27.98	14,324,662,716	1.80	12.20	1.81	8,150.00	1,097.64	-5
A6V	167	32.76	16,931,308,504	1.80	15.10	1.89	8,400.00	944.42	-6
A5V	166	33.12	20,061,644,606	1.90	17.00	1.89	8,650.00	804.68	-6
A4V	165	36.09	23,844,066,419	2.10	23.20	2.09	8,900.00	686.35	-6
A3V	164	39.38	28,381,605,649	2.40	28.90	2.20	9,150.00	586.27	-7
A2V	163	43.02	33,849,108,637	2.50	39.40	2.44	9,400.00	501.68	-7
A1V	162	47.06	40,498,150,645	2.70	49.20	2.59	9,650.00	427.13	-7
A0V	161	51.54	48,582,277,772	2.90	67.40	2.88	9,900.00	364.78	-8
B9V	160	56.53	58,430,461,862	3.40	119.00	2.73	11,710.00	312.5	-8
B8V	159	62.07	70,474,451,635	3.80	211.00	2.73	13,520.00	178.89	-8
B7V	158	68.25	85,203,218,902	4.50	404.00	2.94	15,330.00	113.4	-8
B6V	157	75.15	103,286,041,300	5.20	692.00	3.07	17,140.00	77.14	-9
B5V	156	82.86	125,563,499,718	5.90	1,160.00	3.26	18,950.00	55.24	-9
B4V	155	91.48	153,067,686,150	6.70	2,290.00	3.82	20,760.00	31.62	-9
B3V	154	101.15	187,115,967,958	7.60	4,890.00	4.71	22,570.00	20.05	-9
B2V	153	112.00	229,405,969,325	10.90	9,360.00	5.59	24,380.00	13.64	-10
B1V	152	124.19	282,066,836,091	14.20	19,400.00	6.97	26,190.00	8.39	-10
B0V	151	137.91	347,840,984,769	17.5	36,200.00	8.34	28,000.00	5.59	-10



## PRIMARY SOLAR STATS TABLE

Spectral Class	Inner Life Zone Edge			Outer Life Zone Edge		
	Distance from star (km/AU)		Avg Temp (K)	Distance from star (km/AU)		Avg Temp (K)
M9V	2,319,138	0.016	306.22	4,638,276	0.031	275.40
M8V	3,208,345	0.022	309.01	6,594,932	0.044	274.13
M7V	4,373,667	0.029	307.77	8,929,569	0.060	273.95
M6V	5,735,514	0.038	307.88	11,772,898	0.079	273.32
M5V	7,346,411	0.049	307.81	15,048,294	0.101	273.55
M4V	8,957,198	0.060	308.21	18,377,700	0.123	273.67
M3V	10,606,623	0.071	307.52	21,613,496	0.145	274.00
M2V	13,437,355	0.090	308.81	27,680,951	0.186	273.66
M1V	16,407,340	0.110	306.37	33,187,574	0.223	273.99
M0V	19,622,213	0.132	305.51	39,244,426	0.263	274.76
K9V	21,060,769	0.141	306.69	42,690,748	0.287	273.98
K8V	22,440,922	0.151	308.54	46,062,946	0.309	273.90
K7V	24,000,141	0.161	309.39	49,297,586	0.331	274.57
K6V	26,182,800	0.176	309.57	53,743,641	0.361	274.83
K5V	28,624,229	0.192	309.01	58,795,714	0.395	274.23
K4V	32,571,422	0.219	307.11	65,978,008	0.443	274.45
K3V	37,332,074	0.251	308.21	76,400,524	0.513	274.02
K2V	43,693,947	0.293	307.05	89,287,631	0.599	273.20
K1V	51,915,431	0.348	308.07	105,827,610	0.710	274.44
K0V	63,003,696	0.423	307.03	128,218,049	0.861	273.74
G9V	66,581,180	0.447	307.05	135,419,349	0.909	273.84
G8V	70,141,642	0.471	307.38	142,701,962	0.958	274.09
G7V	74,433,863	0.50	306.43	150,108,291	1.01	274.45
G6V	77,425,112	0.52	308.40	158,854,972	1.07	273.84
G5V	82,535,447	0.55	306.45	167,822,075	1.13	273.34
G4V	86,213,444	0.58	307.49	175,399,766	1.18	274.19
G3V	91,688,535	0.62	307.18	186,594,212	1.25	273.87
G2V	98,151,248	0.66	307.21	199,629,657	1.34	273.98
G1V	119,622,155	0.80	306.29	242,869,224	1.63	273.40
G0V	129,837,283	0.87	306.94	263,609,029	1.77	273.98
F9V	141,053,288	0.95	307.33	286,380,918	1.92	274.33
F8V	153,689,329	1.03	306.87	312,035,911	2.09	273.92
F7V	160,245,499	1.08	307.23	325,346,923	2.18	274.24
F6V	175,148,880	1.18	306.88	355,605,301	2.39	273.92
F5V	191,712,676	1.29	306.92	389,234,826	2.61	273.97
F4V	210,010,714	1.41	307.36	426,385,389	2.86	274.36
F3V	220,038,497	1.48	307.40	446,744,826	3.00	274.39
F2V	241,486,956	1.62	306.85	490,291,699	3.29	273.90
F1V	253,563,720	1.70	307.19	514,811,189	3.46	274.20
F0V	278,962,256	1.87	307.32	566,377,913	3.80	274.33
A9V	294,514,601	1.98	307.45	597,953,886	4.01	274.44
A8V	326,849,966	2.19	306.51	663,604,476	4.45	273.60
A7V	345,792,134	2.32	307.43	702,062,818	4.71	274.42
A6V	384,701,313	2.58	306.97	781,060,241	5.24	274.01
A5V	408,187,457	2.74	306.88	828,744,231	5.56	273.93
A4V	476,847,145	3.20	307.20	968,144,204	6.50	274.22
A3V	532,211,330	3.57	306.72	1,080,550,276	7.25	273.79
A2V	621,417,251	4.2	307.10	1,261,665,328	8.5	274.13
A1V	694,412,846	4.7	307.27	1,409,868,505	9.5	274.28
A0V	812,765,280	5.5	307.26	1,650,159,810	11.1	274.26
B9V	1,079,962,499	7.2	306.96	2,192,651,135	14.7	274.00
B8V	1,438,058,066	9.7	307.13	2,919,693,648	19.6	274.15
B7V	1,989,875,373	13.4	307.22	4,040,050,000	27.1	274.24
B6V	2,604,283,395	17.5	306.82	5,287,484,468	35.5	273.88
B5V	3,371,818,500	22.6	307.21	6,845,813,319	45.9	274.22
B4V	4,737,540,501	31.8	307.35	9,618,642,836	64.6	274.35
B3V	6,922,924,960	46.5	306.94	14,055,635,525	94.3	273.98
B2V	9,577,962,205	64.3	307.08	19,446,165,689	130.5	274.11
B1V	13,789,104,394	92.5	307.00	27,996,060,437	187.9	274.03
B0V	18,836,034,615	126.4	307.18	38,242,858,157	256.7	274.20

### Legend

**Spectral Class:** Spectral class (all main sequence); an internet search on "stellar classification" will explain these codes.

**Charge Time (hrs):** Length of time in hours required for a JumpShip to recharge by solar sail at the proximity limit (including standard jump points) of the star system.

**Transit Time (days):** Length of time in days required for a vessel to transit from the standard jump points to the middle of the life zone using the standard flight profile of 1G acceleration to midpoint, followed by 1G braking to the destination. For most stars, flight times to the inner and outer edges of the life zone will vary only minimally. (See Transit Times, pp. 258-259, *Strategic Operations*.)

**Safe Jump Distance (km):** This marks the proximity limit of the star, as measured in kilometers from the star's core. The standard (zenith/nadir) jump points are at the north and south "poles" of the proximity limit sphere.

**Temperature of Star (K):** The surface temperature of the star in degrees Kelvin. (Kelvin uses the same degrees as Celsius, but sets 0K at absolute zero, which is about -273°C.)

**Mass (Sol=1):** Mass of the star as a multiple of Sol's mass.

**Luminosity (Sol=1):** Overall luminosity of the star (all frequencies: visible, UV, IR, and others) as a multiple of Sol's luminosity.

**Radius:** Radius of the star as a multiple of Sol's radius.

**Lifespan:** This is how long the star will survive on the main sequence. This figure has a significant impact on the habitability modifier for planets, as it generally takes billions of years for a planet to reach a stage suitable for terrestrial-style life (without artificial intervention). A star that leaves the main sequence rapidly (less than 2-3 billion years) is unsuited for a naturally habitable planet, and giant phases are too turbulent to sustain even terraformed planets for long.

**Habitability Modifier:** This modifier is used in the dice rolls to determine if a planet in the star's life zone can support Terran-type life. If the entry is "not hab." (not habitable), that means the star will not support naturally habitable planets. If the star's lifespan is over 200 million years, it may have planets that can be terraformed, but stars with lifespans of less than 6 billion years are less likely to be naturally habitable. The unusual "spike" in Habitability Modifier penalties in the cooler K-type stars is due to high UV levels at the ground resulting from increasing UV-A/B light output compared to cooler stars but low UV-C output (UV-C creates UV-shielding ozone in habitable atmospheres).

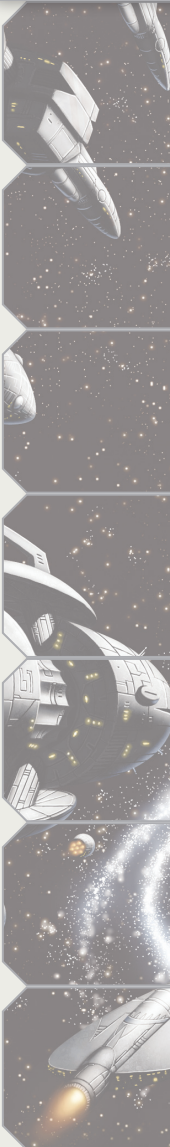
**Life Zone Inner Edge:** This is the innermost distance from the star that could host a habitable planet, given certain assumptions about Bond Albedo (0.4) and a low greenhouse factor, and acceptance of a high average surface temperature.

**Life Zone Maximum:** This is the outermost distance from the star that could host a habitable planet. It assumes a relatively dark planet with a strong greenhouse effect (possibly requiring toxic levels of CO<sub>2</sub>), and temperatures below even the worst Ice Ages of Terra.

**Distance from star (km):** The distance from the star for the edge of the life zone (minimum or maximum).

**Avg. Temp (K):** Average temperature of the planet in degrees Kelvin. This is averaged from the poles to the equator. For comparison, Terra's average is currently about 287 K (14°C). Terra's noted peak during the Paleocene-Eocene Thermal Maximum, when the Arctic Ocean saw tropical conditions, had a planetary average of about 294 K (21°C). During the most recent Terran Ice Age, the global average was about 279 K (6°C).

### SOLAR SYSTEM GENERATION





# SOLAR SYSTEM GENERATION

The following charts and discussion provide gamemasters with guidelines for producing more detailed star systems, planets, and even inhabited worlds. They are not meant as firm rules, but simply guidelines for GMs and players who do not feel like creating systems from scratch.

These guidelines are distinctly unrealistic in some ways to support fun gaming, though care has been taken to include current astronomical theory where possible. Notes in each step generally explain where deviations from realism take place so that players interested in a more realistic—or less realistic—approach to system and planetary generation can modify the results or create their own system from scratch. In particular, the provided dice rolling tends to produce star systems lacking habitable planets, so players should feel free to override the dice rolls if they want a habitable planet or specific star system layout.

In the following guidelines, if reference is made to “current knowledge” or “modern astronomers” or the like, that refers to circa 2013 astronomy and astrophysics.

A blank basic star system construction sheet at the end of the chapter may be used as templates for filling out the important details of a planet.

Finally, there is a fair amount of math in this chapter, but it is intended as a guideline only. The math is presented for players who want the detail it offers. Unlike an algebra or calculus test, this chapter will not ask you to extract any variables from even the worst of its equations. You should find everything you need to quickly plug into equations and in most cases you’ll have the option of bypassing the math by using a real-world example or making an arbitrary selection.

Quick-Start Rules: Players looking for the quick-start version of these rules, see Basic World Building, p. 140 of *A Time of War Companion*.

## THE PRIMARY

The defining feature of a star system is the star, the system primary. This star affects planetary formation and determines the possibility of having habitable planets. Players should therefore determine the system primary first.

### Star Type

Roll 2D6 and consult the desired Star Type column: Realistic, Life-Friendly, or Hot Stars.

The Realistic column is weighted to approximate the real distribution of stars in the galaxy, which heavily favors M-type stars (76 percent of stars). Type A, B and O stars, representing about 1 in 160, 1 in 800 and 1 in 3,000,000 of all stars, respectively, are too rare to be generated randomly from this column and so are left to players’ arbitrary decisions or the use of the Hot Stars column.

The Life-Friendly column generates stars currently thought to favor terrestrial-type life and planets.

The Hot Stars column generates very rare hot stars, like class A and class B stars, though these may not be suitable for hosting a star system. Because class O stars are so rare and are not supported by existing system transit and JumpShip rules, they are left as a special option (see *Options*, p. XX).

## PRIMARY GENERATION TABLE

Roll 2D6	Star Type (Realistic)	Star Type (Life-Friendly)	Star Type (Hot Stars)	Stellar Subtype	
				Roll 1D6	Subtype
2	F	M	B	1	1
3	M	M	B	2	2
4	G	M	A	3	4
5	K	K	A	4	6
6	M	K	A	5	8
7	M	G	A	6	0
8	M	G	A		
9	M	F	A		
10	M	F	A		
11	M	F	B		
12	F*	F	F		

\*Or roll on the Hot Stars column, at the player’s option.

All stars generated in this table are, by default, class V (main sequence) stars, as described in All the Pretty Colors (see p. XX).

Once selected, details of the star can be found in the Primary Stats Table (see p. XX).

### Stellar Subtype

As discussed under All the Pretty Colors (p. XX), there are additional components to the stellar classification after the letter. To generate the 0 to 9 subtype, roll 1D6 and refer to the Subtype column of the Primary Generation Table, which provides a reasonable distribution of subtypes. Players should note that it is easy to substitute other types of dice for generating a number between 0 and 9 if they have dice other than D6’s on hand, like a D10 or D20. Also note that simple summations of dice (e.g., 2D4 or 2D6) do not generate an even distribution of results. For example, 2D6 is six times as likely to give a 7 as a 2.

*Chuck just got done reading Edgar Rice Burroughs’ Venus series, so he wants a star system where he can put an Amtor Mk II. (He’d be happy to use Venus in the Sol system, which was terraformed by the Terran Alliance, but ComStar’s neglect has ruined the planet and the whole system is infested with WoBblies. Chuck feels it’s better to make his own star system than bother with Sol.) While Chuck has firm ideas about Amtor Mk II, he’s less picky about the rest of the system and decides to roll randomly. To improve the chances of Amtor Mk II ending up in a habitable star system, Chuck uses the Life-Friendly column. He rolls 2D6 and gets a 10: an F-class star.*

*He then moves to figure out the subtype of Amtor Mk II’s star. Since Chuck has his gaming dice on hand, he throws a D10, getting a 3. Amtor Mk II’s star is an F3.*

*Chuck doesn’t want the headache of putting Amtor Mk II around a giant star, so he’s happy to accept the default size classification of main sequence dwarf. He notes the star is an F3V, a hot, short-lived star that just might last long enough to produce a habitable planet. Maybe. If it doesn’t work out, Chuck can arbitrarily change the star to something that suits his needs.*



## ALL THE PRETTY COLORS



The rules for generating the primary are based on standard stellar classifications, as used by modern astronomers. The basic stellar classification is a quick way of describing a star's key characteristics: surface temperature and color (which is based on temperature), and size. From left to right, a stellar classification (for example, G2V) consists of a letter roughly describing the star's temperature, a number serving as a "decimal place" for the letter that more precisely defines the temperature, and a Roman numeral defining the star's size. A full treatment of stellar classifications can be found in astronomical reference books or on the internet.

The stellar classes used in these guidelines are: O, B, A, F, G, K, and M. Specialty designations like D, L, T, and Y classes are a level of detail beyond the scope of this book. In order, M represents the "reddest," coolest normal stars; Ks are warmer orange-ish stars; Gs are yellow stars; Fs are yellow-white stars; As are white or bluish-white; Bs are blue; and Os are deep blue (with most of their output actually in the ultraviolet range.) The colors are related to temperature: cool stars are a deep red. As stars become hotter, their color shifts through orange, yellow, white, and eventually to blue shades.

After selecting the basic type, the other part of stellar classification widely used in *BattleTech* (especially the JumpShip recharging and system transit rules) is a suffix of 0-9 applied to O, B, A, F, G, K and M-type stars. This is a "decimal place" for the notation that helps gauge where a star is within its color classification. This is used because not all stars of a given type are created equal. For example, Tau Ceti (New Earth in *BattleTech*) is a yellow, G-type star, but it is noticeably cooler and dimmer than Earth's G-type star, Sol. To make these distinctions, 0 is set at the hot end

of a spectral class while 9 is the cool end. Sol is a G2 star, meaning it verges on the whitish F-class, while Tau Ceti is a G8 star, almost an orange-ish K-type star.

*BattleTech* has mostly overlooked a third element of stellar classification, a Roman numeral that describes the size of a star (and, roughly, its stage in the stellar lifecycle). This value is important because, for example, Betelgeuse and GJ 1046 are both (approximately) M2 stars, but Betelgeuse is a super giant while GJ 1046 is a dwarf star. These Roman numerals range from VI (sub-dwarf) to V (main sequence dwarf), with IV, III, and II referring to increasingly large giant stars. Classes Ia and Ib refer to super giant stars. (Outside the scope of these rules is the VII luminosity class, which only applies to the white dwarf stellar class.) While planetary atlases in various *BattleTech* publications do occasionally provide the size of the star, the system transit and recharge rules overlook this aspect. By default, the transit and recharge rules refer to a class V main sequence star, and thus these guidelines also refer only to class V stars as well. Players should feel free to use non-main sequence stars for their systems, but this will alter transit and recharge times to values outside of the scope of existing transit and recharge rules. The impact of larger luminosity classes is discussed under Optional Rules, "Hot, Hot, Hot!" (see p. XX).

Combined, these guidelines provide three-value stellar classifications. Betelgeuse's full classification is M2Ia while GJ 1046 is M2V, Sol is G2V and Tau Ceti is G8V.

Players should also note that some variation still exists within specific classifications. For example, Sol and Alpha Centauri-A (the brightest of the three Alpha Centauri stars) are both G2V, but Alpha Centauri A is somewhat more massive and brighter than Sol.

### SOLAR SYSTEM GENERATION



## THE PLANETS

The following steps provide guidance on populating a star system with planets, asteroids, and other objects.

### Step 1: Generating Number of Orbits

To determine how many orbital slots a system has, roll 2D6 and add 3. The resulting number is the number of orbital slots the system has. The slots are not necessarily occupied by planets; determining what is in a slot is Step 3, Filling Orbital Slots.

*Chuck hadn't thought much about the rest of the star system occupied by Amtor Mk II, so he is content to use the guidelines' suggestion of rolling 2D6+3 to find out how many orbits are in the system. He rolls a 5, meaning there are 8 orbits he needs to concern himself with (5 + 3 = 8).*

This is an arbitrary value for the number of orbital slots. There simply is not an adequate observational database to say if 5 to 15 slots will address common, real star system arrangements or not. However, 5 to 15 slots should produce systems suitable for gaming purposes.

### Step 2: Placing Orbits

Distribution of the orbits of objects around a star can be an enormously complicated process, and a system's layout may change over time (millions of years) due to a variety of reasons. Some of these issues are discussed under Optional Rules (Realistic Planetary Placement), and the topic is evolving rapidly as observations of extra-solar planets improve and increase. In the absence of a succinct and realistic guideline for distributing planets, these guidelines use a modified Titius-Bode relationship.

To find the location of an orbital slot around a star (in terms of AU from the star) multiply the value in the Orbital Placement Table by the mass of the star (in multiples of Sol's mass). Slot 1 is the innermost orbit; slot 2 is the next orbit out, and so on. Continue outward for as many orbits as were calculated in Step 1. It is worth noting at this stage which orbits fall within the life zone of the star, as defined on the Primary Stats Table (see p. XX.)

These orbits are assumed to be circular or nearly so ("low eccentricity"). For more elliptical planetary orbits, see Options, p. XX.



## ORBITAL PLACEMENT TABLE

Slot #	Base Location (AU)	Slot #	Base Location (AU)
1	0.4	9	38.8
2	0.7	10	77.2
3	1.0	11	154
4	1.6	12	307.6
5	2.8	13	614.8
6	5.2	14	1229.2
7	10	15	2458
8	19.6		

Chuck quickly jots down the positions of the 8 orbital slots. Since the radii of the orbital slots are multiplied by the mass of the primary (he'll need to name the star soon...), he checks the Primary Stats table and finds that an F3V is 1.5 times as massive as Sol. Slot 1 is thus an orbit  $0.4\text{AU} \times 1.5 = 0.6\text{AU}$  in radius. Slot 2 is 1.05AU, slot 3 is 1.5AU, slot 4 is 2.4AU, slot 5 is 4.2AU, slot 6 is 7.8AU, slot 7 is 15AU, and slot 8 is 29.4AU.

Chuck notes from the Primary Stats Table that the star's life zone ranges from about 220 to 446 million kilometers. Since an AU is (approximately) 150 million kilometers, that means the range is 1.47 to 2.97AU. Orbits 3 and 4 are inside the life zone.

**Transit Times:** Once the orbital slots for a system are determined in terms of AU, it is relatively simple to convert these values to kilometers or meters to estimate transit times from the standard jump points to any planet, or between any two planets. The equations and supporting explanations players will need are found in *Strategic Operations*, under System Transit on p. 259 and in the Proximity Distance Table under Hyperspace Travel on page 86.

Transits from a zenith or nadir point to a planet in the life zone may use the Transit Time column of the Primary Stats Table (see p. XX.) Transit times for planets outside the life zone (or players who want a very accurate value for transit to a planet in the life zone) need to use a little geometry, specifically the Pythagorean Theorem. The transit distance from a zenith or nadir point to the planet is the hypotenuse of a right triangle formed by the jump point, star, and planet. The Proximity Point Distance Table on p. 86 of *Strategic Operations* gives the distance from the jump point to the star (distance A). Step 2 above, Placing Orbits, gives the distance from the star to the planet's orbit (distance B). Distances A and B must be converted to meters (multiplying distances in kilometers by 1,000 and multiplying distances in AU by 150,000,000,000). Then the distance from the jump point to the planet is calculated using the equation:

$$\text{Transit Distance} = \sqrt{[(\text{Distance A})^2 + (\text{Distance B})^2]}$$

Transit times may then be found using the Time equation on p. 259 of *Strategic Operations*. This process assumes the orbits are fairly circular, but elliptical orbits are relatively easy to handle. Players who have created planets with elliptical orbits simply

use the actual distance from the star to the destination planet at the time the transiting vessel(s) would arrive there, rather than an average distance value, for Distance B in the Transit Distance Equation. The Planet Construction Sheet provides a column for transit times from jump points to a planet, if players are interested in this detail.

Transits between two planets are a bit trickier because planets move with respect to each other, but it is convenient to approximate planet separation as the average between maximum and minimum. This average separation is approximately the distance from the outer of the two planets to the star. Players need only use the distance of the outer planet's orbital slot from its primary and convert that to meters, which may then be used in the Time equation on p. 259 of *Strategic Operations*. Minimum separation flights are also easy to calculate; the transit distance is simply the difference between the inner planet's and outer planet's distances from the primary. Maximum separation flights start by adding the distances of the inner and outer planet from the primary, and multiply that value by 20 percent to represent a "dogleg" around the sun (a straight flight between planets at maximum separation would otherwise involve a flight through the star.)

Finally, transits from a planet to the nearest edge of the Proximity Limit are relatively easy to calculate. Subtract the planet's orbital slot distance from the star from the distance given in the Proximity Point Distance Table on page 86 of *Strategic Operations*. (If the value is negative, then the planet is outside the Proximity Limit of the system and a vessel only needs minutes or hours to clear the planet's own small Proximity Limit.) Examples for the Sol System are found on page 133 of *Strategic Operations*.

### Step 3: Filling Orbital Slots

Beginning with the innermost orbital slot, roll 2D6 and refer to the corresponding row of the Object Type Table. This is the object (planet, asteroid belt, or simply empty space) that fills the slot. If the slot is beyond the life zone of the primary (see the Primary Stats Table, p. XX), add 2 to the roll. Then follow the guidelines below the Object Type Table to work out the details of each object. Day Length is addressed under Step 4.

In addition to empty slots, a number of objects can appear in the primary orbital slots of a system:

- An asteroid belt is a ring of debris circling the star and includes rocky inner system belts and icy outer system belts (i.e., Kuiper Belts and Oort Clouds).
- Dwarf terrestrial planets (in this document) are individual small bodies of rock or ice separate from an asteroid belt but large enough to form a sphere due to their own gravity (for example, Pluto or PSR B1257+12's companion A). Note that asteroid belts may come with dwarf terrestrials (see Step 3a).
- Terrestrial planets should not be confused with habitable planets—the term "terrestrial planet" herein refers to any sizable rocky or icy body larger than a dwarf terrestrial (for example, Mercury, Mars, Venus, and Earth; Ganymede would be an icy example if it were a planet and not a moon).
- Giant terrestrials ("Super Earths") cover the unusual, large extra-solar planets recently discovered (as of 2013). They do not seem to be gas giants or ice giants, but may straddle the divide between terrestrial planets and their larger, fluid



brethren. As such, a habitable surface is improbable (though not entirely out of the question); giant terrestrials may possess very dense atmospheres and "oceans" of water hundreds of kilometers deep, in addition to crushing gravity. (Probable real examples include Gliese 581c and 581D.)

- Gas giants address planets that are mostly hydrogen and helium by mass and typically very large; Saturn and Jupiter are examples.
- Ice giants might be called "gas midgets." They are large planets with massive hydrogen/helium atmospheres making up less than half their mass and thick mantles of "ice" (actually super-heated stews of water and other light compounds); Neptune and Uranus are two examples.

*Chuck has already decided Amtor-2 will be in Slot 4 (so it will be in the life zone of the star), but that leaves 7 other orbital slots. He notes that orbit slots 5 to 8 are beyond the life zone, so their rolls will have a +2 modifier. Chuck quickly rolls up the other slots just to see what's in the system. He rolls 2D6 repeatedly to get: 4, 8, and 7 for the inner orbital slots, and modified (+2) rolls of 7, 10, 9, and 13. So Slot 1 is an asteroid belt, Slot 2 is a giant terrestrial, Slot 3 is a terrestrial planet, Slot 5 (beyond the life zone) is another terrestrial planet, Slot 6 is a gas giant, Slot 7 is another gas giant, and Slot 8 is an ice giant.*

*For his own amusement, Chuck calculates the details on the giant terrestrial in Slot 2, the terrestrial planet in Slot 3, and the gas giant in Slot 6.*

*Rolling the specified 1D6 and obtaining a 5 for the diameter of the giant terrestrial, Chuck finds its diameter to be 12,500 kilometers + 5 x 1,000 kilometers = 17,500 kilometers. The density calls for another 1D6 roll, which gives a 3, so the planet's density is 2 + 3 = 5 grams per cubic centimeter.*

*Chuck rolls 2D6 for the terrestrial planet's diameter and gets a 3, meaning it is 2,500 kilometers + 3 x 1,000 = 5,500 kilometers—pretty small, like Mars or Mercury. For its density, Chuck rolls 1D6, getting a 4, and raises that to the 0.75 power. On a handy scientific calculator, 4<sup>0.75</sup> comes*

*to 2.83. The planet's density is 2.5 + 2.83 = 5.33. The planet turns out to be quite similar to Mercury in size and density.*

*Finally, Chuck rolls up the gas giant. He rolls 7 for the diameter and 9 for the density. The diameter is thus 50,000 kilometers + 7 x 10,000 = 120,000 kilometers, very similar to Saturn. The density is 0.5 + 9 ÷ 10 = 1.4, a very dense gas giant that probably has a large, rocky core.*

#### Step 4: Planetary Details

In this section, the finer details of the objects in the system's orbital slots are determined: number of moons, habitability, gravity, and so forth.

#### Common Details

Several features, like gravity, may be determined for any object using the following calculations.

Surface Gravity: The gravity of a planet (or other spherical object) in Gs may be calculated with the following equation:

$$\text{Gravity} = (\text{Diameter} \div 12742) \times (\text{Density} \div 5.5153)$$

Diameter is in kilometers (km) and Density is in grams per cubic centimeter (g/cm<sup>3</sup>). The equation is a simple ratio with Terra's equivalent diameter (12,742 kilometers) and density (5.5153 g/cm<sup>3</sup>). To find the surface gravity in meters per second per second, multiply the value in Gs by 9.8 m/s/s. In the case of ice and gas giants, the diameter represents gravity at an altitude where atmospheric pressure is 1 bar.

This equation for gravity assumes the object is spherical and has a relatively slow spin (i.e., its spin will not lower equatorial gravity by more than 1-2 percent). If the object is not spherical (like a lumpy asteroid) but still has a relatively slow spin, then the resulting value can be taken as an average value for gravity. Specific values at different locations on an asteroid may be calculated using Newton's Law of Universal Gravitation; the given values for density and diameter of the object are sufficient to determine the object's mass and thus its gravitational strength at different distances from the object's center.

The impact of high spins is also beyond the scope of this document, but is a straightforward subtraction of centripetal

### OBJECT TYPE TABLE

Roll 2D6	Type	Base Diameter (km)	Diameter Modifier (km)	Density (g/cm <sup>3</sup> )	Day Length (hours)
2-3	Empty	N/A	N/A	N/A	N/A
4	Asteroid belt	See below	See below	1D6 <sup>1.15</sup>	2D6
5	Dwarf terrestrial	400	+100 x 3D6	1D6	3D6+12
6-7	Terrestrial	2,500	+1,000 x 2D6	2.5 + 1D6 <sup>0.75</sup>	3D6+12
8	Giant terrestrial	12,500	+1,000 x 1D6	2 + 1D6	4D6
9-10	Gas giant	50,000	+10,000 x 2D6	0.5 + 2D6 ÷ 10	4D6
11+	Ice giant	25,000	+5,000 x 1D6	1 + 2D6 ÷ 10	4D6

Note: Do not round density values.

#### SOLAR SYSTEM GENERATION





acceleration from local gravity. (Note that should the value ever be negative, the object will probably fly apart, so keep the spin slow enough for the object to stay in one piece.)

*Chuck is shamelessly copying Venus's statistics for Amtor-2, so he already knows the surface gravity (0.904G). However, were he to calculate the gravity of Amtor-2, the calculation would use Amtor-2's density of 5.204 g/cm<sup>3</sup> and diameter of 12,103.6 kilometers. Putting those into the equation, Chuck would find:*

*Gravity = (12,103.6 ÷ 12,742) x (5.204 ÷ 5.5153) = 0.896G, or pretty close to reality.*

**Escape Velocity and Orbital Velocity:** Though rarely an issue due to *BattleTech's* powerful, efficient fusion rockets, these are quick calculations that can easily be performed once the diameter and density of a planet are known (and escape velocity affects atmospheric density). Escape Velocity is used in later calculations, while Orbital Velocity is "nice to know" information.

The Escape Velocity of a planet (the minimum velocity at which a coasting spacecraft will fly away from the planet, no longer tethered by the planet's gravity), in meters per second, may be calculated with the following equation:

$$Ve = (\text{Diameter} \div 12,742) \times \sqrt{(\text{Density} \div 5.5153) \times 11,186 \text{ m/s}}$$

In this equation, Diameter is the diameter of the planet in kilometers and Density is the density of the planet in g/cm<sup>3</sup>. Again, this is a ratio with respect to Terra's diameter (12,742 kilometers), density, and escape velocity (11,186 m/s). To convert escape velocity to hexes per turn, divide Ve by 300. To convert to kph, multiply Ve by 3.6.

The velocity of a circular, low-altitude orbit (within a few hundred kilometers of the surface) may be found by dividing Ve by the square root of 2 (1.414 as a quick approximation).

*Since Amtor-2 is a copy of Venus in many ways, Chuck could check handy online resources to find Venus's escape velocity, but not every planet he makes is going to copy something on the internet so he decides practice can't hurt. He plugs the diameter and density into the equation and obtains:*

$$Ve = (12,103.6 \div 12,742) \times \sqrt{(5.204 \div 5.5153) \times 11,186 \text{ m/s}} = 10,321 \text{ m/s}$$

*When the internet is accessible again, Chuck finds the calculation was extremely close to the real value of 10,460 m/s. For his notes, he divides his answer by 1.414 to find the velocity of a low altitude orbit around Amtor-2: 7,300 m/s.*

*Chuck is also curious about the giant terrestrial planet in Slot 2, which has a diameter of 17,500 kilometers and a density of 5 g/cm<sup>3</sup>. The result isn't as high as he was anticipating, but it's still high enough to hold onto a lot of atmosphere and challenge pre-fusion rocketry:*

$$Ve = (17,500 \div 12,742) \times \sqrt{(5 \div 5.5153) \times 11,186 \text{ m/s}} = 14,628 \text{ m/s}$$

**Year Length:** The time it takes a planet to circle its primary is:

$$T = 2 \times \text{Pi} \times \sqrt{[R^3 \div (G \times M)]}$$

In this equation, T is the time in seconds (1 Earth year = 31,536,000 seconds), R is the orbital radius in meters (1 AU = 150,000,000,000 meters), G is the universal gravitational constant of 6.674x10<sup>-11</sup> m<sup>3</sup> / (kg x s), and M is the mass of the star in kilograms (Sol's mass is 2x10<sup>30</sup>kg; use the multipliers on the Primary Stats table to find the local star's mass.) Those numbers involve some rounding; players may find more exact values online or in a handy encyclopedia.

The equation is versatile and will work for calculating the orbits of moons and manmade satellites around objects other than stars, assuming R and M are replaced with the appropriate orbital radii and mass of the orbited object. It will also work for elliptical orbits if R is replaced with the semi-major axis of the orbit.

*Chuck considers calculating the years for every planet in the system since he can plug the equation into a spreadsheet pretty quickly, but he's still got to write a lot of history behind Amtor-2 (as he's shortened the name) before the game starts. So he only calculates the year length of Amtor-2. Jumping ahead a bit, he's checked the Primary Stats table and finds that the fourth orbital slot, which is 2.4AU in radius, is in the life zone of the star and suited to be warm Amtor-2.*

*Chuck notes Amtor-2's star is 1.5 times Sol's mass (totaling 3x10<sup>30</sup>kg), and 2.704AU is 3.6x10<sup>11</sup> m. He plugs these into the equation:*

$$2 \times 3.14159 \times \sqrt{[(3.6 \times 10^{11})^3 \div (6.674 \times 10^{-11} \times 3 \times 10^{30})]} = 95,913,533 \text{ seconds}$$

*96 million seconds is not a convenient number for the length of a year, so Chuck converts that to Terran years by dividing with 31,536,000. Amtor-2's year is 3.04 Terran years long.*

**Year Length, Take 2:** A quicker conversion from orbital distance to year length is the following equation:

$$Ty = \sqrt{[Ra^3 \div Ms]}$$

In this equation, Ty is the planet's orbital period in terrestrial years, Ra is the orbital radius in AU, and Ms is the mass of the local star in multiples of Sol's mass (taken from the Primary Stats table). The number resulting from this equation for year length will vary slightly from the first equation due to small approximations in this one.

**Day Length:** Day length is calculated using the roll listed on the Object Type table (see p. XX). The following notes and exceptions are provided.

**Asteroids:** Minor and medium asteroids (see *Asteroid Belts*, p. XX) generally have 2- to 12-hour rotations, with averages of about 4-6 hours. Very long rotations sometimes occur in asteroids, with examples of up to 1200 hours known. Very slow and very fast rotations may be implemented at players' discretion. Each asteroid in a belt will have a different rotational period.





Dwarf terrestrials (including those in asteroid belts) and terrestrial planets likewise include some known extreme variations from these guidelines. In fact, there are as many exceptions (Mercury and pre-terraforming Venus) as examples (Terra, Mars), so players are encouraged to consider alternate rotations. Planets close to a star will tend to have rotations similar to their year length (like Mercury), while habitable planets should have day lengths similar to Terra to moderate day and night temperatures.

Giant terrestrials, ice giants, gas giants: Unlike lesser planets, these behemoths tend to keep the rotation imparted to them during their formation, which seems to fall into the 8- to 16-hour range (based on the limited sample of Jupiter, Saturn, Uranus, and Neptune).

*Chuck was going to pick 24 hours for Amtor-2, but decides to roll. As a terrestrial planet, Amtor-2 has a day of 3D6+12 hours. Rolling, Chuck gets 16 for a 28-hour day, which allows him to keep a Terran-standard week (with 6 rather than 7 days, and who couldn't use an extra 4 hours per day?).*

### Asteroid Belts

Asteroid belts are generated in a couple of steps. First, the belt's basic population multiplier is calculated compared to Sol's asteroid belt. Second, the number of significant asteroids is calculated based on the belt's density and its distance from the primary. These steps are repeated for each asteroid belt in the system. The belt's basic population multiplier is calculated as follows:

$$\text{Asteroid Population Multiplier} = (\text{Belt's Orbit} \div 2.8) \times [1D6 \div 3]^2$$

In this equation, the belt's orbit is the orbital distance from the primary in AU. Do not round at any step in the calculation.

This value of asteroid population multiplier is then used to multiply the following values (rounding normally after multiplying) to determine the number of these classes of asteroids in the belt:

- Dwarf terrestrials (500 kilometers+ diameter): 4
- Medium Asteroids (100-500 kilometers diameter): 200
- Small Asteroids (1-100 kilometers diameter): 1,200,000

*Since he wants a fairly advanced society that has nosed around the system and might have some off-planet bases, Chuck decides to work out the details of the asteroid belt in Amtor-2's system. He already knows that the belt is 0.6AU from the star. He rolls [1D6÷3]<sup>2</sup> and gets a 5, then divides 5 by 3 to get 1.667, and squares it to 2.778. The asteroid population multiplier is [0.6 AU ÷ 2.8 AU] x 2.778 = 0.595. Applying the multiplier, Chuck finds there are 2 dwarf terrestrials (4 x 0.595, rounded), 119 medium asteroids (200 x 0.595, rounded), and 714,000 small asteroids (1,200,000 x 0.595, rounded). Chuck notes that this belt will have about 60 percent as many asteroids as Sol's asteroid belt despite being about one-fifth the diameter, indicating the density is quite a bit higher than*

*Sol's belt. Keen-eyed observers on Amtor-2 will see fairly bright zodiacal light near dusk and dawn.*

*Chuck also takes time to note the location of the belt (0.6AU around a F3V star). It will be scorching hot. If he rolls densities for any asteroid of interest, he'll have to take care to avoid asteroids with low densities due to the presence of ice or other volatile compounds (see the Density discussion in Options, p. XX).*

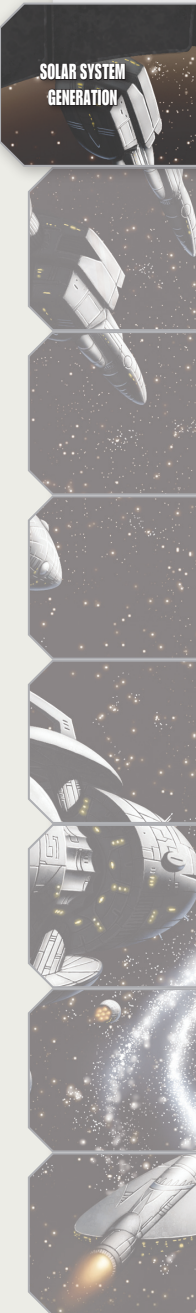
Once the numbers of each class of asteroid are generated, players may calculate individual asteroid diameters and densities, but it is recommended this be reserved for asteroids that characters will actually visit or that serve a significant plot point. After all, there are going to be a lot of asteroids in any belt.

- Asteroids of dwarf terrestrial size use the dwarf terrestrial row on the Object Type table for generating density and diameter.
- Medium asteroid diameter may be generated randomly by (1D6) x 100 kilometers.
- Minor asteroid diameter may be generated by rolling 2D6. For results of 2-10, subtract 1 from the roll and use the result as the diameter of the asteroid in kilometers. For an 11, reroll (ignoring results of 11 and 12) and multiply by 3 kilometers for the diameter. For a 12, reroll (ignoring results of 11 and 12) and multiply by 10 kilometers for the diameter.
- To calculate the density of a specific medium or minor asteroid, use the roll on the Asteroid Belt row of the Object Type table. The density calculation should be rolled for each individual asteroid; the composition of an asteroid belt will not be uniform, as belts often represent mixed leftovers from the birth of a star system.

### Moons

Larger objects tend to acquire natural satellites (moons) either during planetary creation or in subsequent events (asteroid capture or massive grazing impacts). Gas giants are particularly noteworthy collectors of moons, with the known examples of Saturn and Jupiter both possessing sixty or more moons at the writing of this document.

In reality, retention of moons depends on a number of factors and can make large, far-flung collections of moons a difficult proposition. Large neighboring planets are one such problem; Jupiter periodically flips Mars on its ear, prevented the formation of a planet between Mars and Jupiter, and prevents Saturn and Uranus from retaining many "Trojan" asteroids. A nearby primary can present a similar problem for inner planets. A small planet (like Earth) with a large moon (like Luna) is unlikely to keep other moons for long (on time scales of mere centuries and millennia); the large moon ends up scattering other moons, usually into the planet or into itself. Planets may also collect and lose moons over their lives, as might be the case with the Martian moons and many of the outer moons of Sol's giant planets. Players should keep those factors in mind when using the random moon generation rolls or when selecting moons without random rolls; it might



## MOON GENERATION TABLE

Planet Type	1-2	3-4	5-6
Dwarf terrestrial	1D6 – 5 Medium and 1D6 – 3 Small	1D6 – 2 Small	No Moons
Terrestrial planet	1D6 – 5 Large	1D6 – 3 Medium, 1D6 – 3 Small	2D6 – 4 Small, 1 in 6 chance of rings
Giant terrestrial	1D6 – 5 Giant, 1D6 – 3 Small	1D6 – 4 Large, 1D6 – 3 Medium, 1D6 – 2 Small	1D6 – 3 Medium, 2D6 Small, 2 in 6 chance of rings
Gas giant	1D6 – 4 Giant, 1D6 – 1 Large, 1D6 – 2 Medium, 5D6 Small, 3 in 6 chance of rings	1D6 – 3 Large, 1D6 – 2 Medium, 5D6 Small, 4 in 6 chance of rings	1D6 – 4 Large, 1D6 – 3 Medium, 5D6 Small, 4 in 6 chance of rings
Ice giant	1D6 – 4 Giant, 1D6 – 3 Large, 2D6 Small	1D6 – 3 Large, 1D6 – 2 Medium, 2D6 Small, 3 in 6 chance of rings	1D6 – 4 Large, 1D6 – 3 Medium, 2D6 Small, 3 in 6 chance of rings

be appropriate to reduce the number or size of moons around a planet. It should also be noted that planetary rings, while possibly quite pretty, send a constant rain of debris onto a planet. This makes a ringed planet less likely to be habitable.

To determine the number of moons a planet possesses, refer to the row of the Moon Generation Table appropriate to the planet's class (dwarf terrestrial, giant terrestrial, etc.). Then roll 1D6 and refer to the corresponding column of that row, where the table will indicate the rolls to determine how many moons a planet has. When rolling to determine the number of moons, any result of less than 1 is treated as 0.

For example, if a 3 is rolled for a terrestrial planet, the player selects the 3-4 column. The planet will have 1D6 – 3 Medium moons and 1D6 – 3 Small moons. A roll is then made for each class of moon: 1D6 – 3 for Medium moons produces a 1, and 1D6 – 3 for Small moons produces a 2. The terrestrial planet has 1 Medium and 2 Small moons.

### Size of Moons

The density and diameter of moons are calculated as follows:

- Giant moons are generated using the terrestrial planet line of the Object Type Table (see p. XX). By default, such a moon is uninhabitable (just big), but players may refer to Options (see p. XX) if they are interested in making a habitable moon (for a gas giant in or near the life zone).
- Large moons are generated using the dwarf terrestrial line of the Object Type Table (see p. XX). These moons, including the likes of Luna and the Galilean moons, are too small to be naturally inhabitable.
- Medium moons are generated like medium asteroids (see *Asteroid Belts*, p. XX).
- Small moons (such as Phobos and Deimos) are generated like small asteroids (see *Asteroid Belts*, p. XX).
- Calculations for gravity and other physical qualities are performed as for planets.

### Distribution of Moons

Like distributing planets around a star, moon distribution is a complicated process with many considerations. For example, placing a sizable moon in the wrong spot would, in reality, make a lot of orbital positions untenable for other moons. As another example, an orbit too close to a planet may result in the moon breaking up ("Roche's Limit.") In the absence of a succinct version of satellite distribution, the following guidelines are suggested:

- For each size class of moon, there are orbital slots numbered 1 to N, where N is the number of moons of that size class. For example, if a planet has 3 medium moons, then it has 3 medium moon orbital slots. Slot 1 is closest to the planet, and slots are placed sequentially outward from the planet.
- The spacing of the slots depends on the size class of the moon. Small moons may be placed at 10,000-kilometer intervals from the planet (in terms of distance above the surface); medium moons use a 50,000-kilometer spacing; large moons use a 250,000-kilometer spacing; and giant moons use a 500,000-kilometer spacing.
- Moon placement ignores moons of differing size classes unless orbital slots overlap, in which case the smaller moon's slot is moved outward by a spacing equal to the larger moon's interval.

*Chuck hadn't really intended to give Amtor-2 any moons, since by the time the Venus series was written it was known Venus had no moons. However, when detailing the giant terrestrial planet (he should name that soon...) in Orbital Slot 2, Chuck rolls 2 medium and 5 small moons for it. The 5 small moons would be placed at 10,000 kilometers, 20,000 kilometers, 30,000 kilometers, 40,000 kilometers, and 50,000 kilometers. The medium moons would be placed at 50,000 kilometers and 100,000 kilometers in altitude. Because of the overlap at 50,000 kilometers, the fifth of the small moons would be bumped outward by a medium moon's orbit (by 50,000 kilometers to 100,000 kilometers). In this case, the small moon ends up overlapping the orbit of the second medium moon, so it again gets bumped outward to 150,000 kilometers.*

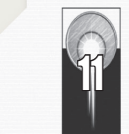
As an alternative to that arbitrary placement, players may place moons as they like (with or without independent research on realistic distributions). A suggestion is to refer to real-world moon systems like those of Sol's gas giants and liberally plagiarize those distributions. (Don't worry about plagiarizing because the gas giants have yet to retain counsel to defend their intellectual property.)

As another alternative, players can simply skip this step. The exact distribution of moons around a planet in *BattleTech* rarely matters, especially in randomly created star systems that will be visited for the length of one gaming session.





## SOLAR SYSTEM GENERATION



### Atmospheric Pressure and Composition

The atmosphere of a planet depends to some extent on its size class, which generally indicates how much atmosphere it might retain. Dwarf terrestrials, for example, are too small to retain atmospheres, while terrestrial planets are usually unable to retain hydrogen/helium atmospheres.

**Dwarf terrestrials:** Dwarf terrestrials will not have atmospheres in the conventional sense. To be scientifically precise, they might have some individual gas molecules flitting around them (as is the case with Mercury's and Luna's "exospheres"), but this would constitute a vacuum in *BattleTech*. Some ultra-cold, icy dwarf terrestrials like Pluto may retain a slightly more detectable atmosphere, but this is also a vacuum in *BattleTech* rules. Moons of this size may retain atmospheres if they orbit a gas giant (see *Options*, p. XX).

**Gas and Ice Giants:** Ice giants and gas giants have hydrogen, helium, and lots of both, plus traces of water, methane, etc. Giants closer to the star than the life zone may exhibit extremely hot atmospheres with unusual trace additions, like silicate and metal gases. In any case, these are very high and toxic atmospheres (and no solid surface to stand on, at least no surface that human technology can reach).

**Giant terrestrials:** These large planets are likely to have a considerable atmosphere by the standards of human-habitable planets, but they are atmospheric (and "ice mantle") lightweights by the standards of ice and gas giants. To determine giant terrestrial atmospheric composition, roll 1D6. On a result of 1-5, the giant terrestrial has an atmosphere like a gas giant of hydrogen, helium, and trace gases (see Gas Giant above), though the atmosphere is "only" 1-5 percent of the planet's mass (for comparison, Venus's super-dense pre-terraforming atmosphere was 0.01 percent of Venus's mass.) On a result of 6, the planet has an atmosphere like a terrestrial planet, and thus uses the terrestrial planet section on atmospheres.

*Chuck has some curiosity about the giant terrestrial in Amtor-2's system, since he's been seeing them appear in the news as astronomers spot more and more of these odd giants. So he rolls 1D6 to find out its atmospheric composition. He gets a 6, meaning the planet does not have a gas giant-like atmosphere. Instead, the details of its atmosphere will be like those of a smaller terrestrial planet.*

**Terrestrial Planets:** This section has a couple of purposes. First, it lets players determine the pressure of the atmosphere and whether the atmosphere is habitable or not. Second, if the atmosphere is not habitable, players can determine the atmosphere's composition. (Habitable planet atmospheric characteristics are determined later.)

In this step of planet creation more than others, players should remember these rolls and tables are merely guidelines. If a GM needs a new habitable planet for a campaign, don't keep rolling up new star systems until you get a habitable planet. Instead, make a planet in the life zone habitable and forget the dice. These guidelines are to help players when they want a random star system that is typical of the *BattleTech* universe (where most star systems are uninhabitable.)

It should also be noted that the incidence of habitable planets using this chart is far above the norm for *BattleTech* (which is about 1 habitable planet per 1,000 systems in the Inner Sphere), let alone reality. This is done for playability. For the same reason, players should also feel free to declare a planet uninhabitable rather than depending on dice rolls to create vast numbers of habitable worlds in their explorations.

For terrestrial planet atmospheres, two rolls are made using the Terrestrial Planet Atmospheric Pressure and Habitability Table. One roll, Atmospheric Pressure, is for all terrestrial planets in the star system. The second roll, Habitability, is only for terrestrial planets in the system's life zones. (Atmospheres outside the life zone are automatically treated as Toxic.)

The Atmospheric Pressure Roll is 2D6, modified by a couple of factors. First, if the planet is closer to the star than the life zone, subtract 2 from the roll because hot planets tend to lose atmospheres. Second, because escape velocity determines how well a planet retains an atmosphere, divide the escape velocity of the planet (in m/s) by 11,186 m/s and do not round to the nearest integer (yet). The roll is conducted in this order: make the 2D6 roll, apply the -2 modifier for a hot planet if appropriate, multiply the result by the escape velocity fraction, and round to the nearest integer normally. Consult the Atmospheric Pressure Column of the table to determine the planet's atmosphere. The resulting atmospheric pressure and its role in a *BattleTech* game are described on pp. 54-55, *Tactical Operations*.

The Habitability roll is also based on 2D6, with the planet being habitable if the result is 9 or higher—if certain conditions do not apply. First, the planet is automatically not habitable if

## ATMOSPHERIC PRESSURE AND HABITABILITY TABLE

Pressure Roll	Atmospheric Pressure
3 or less	Vacuum
4	Trace
5-6	Low
7-8	Normal
9-10	High
11 or more	Very High

Habitable: 9 or better on 2D6	
Planet Feature	Modifier
Vacuum, Trace, Very High Pressures	Not Habitable
Low, High Pressure	-1
Giant Terrestrial	-2
Star	See Primary Stats Table

it has vacuum, trace, or very high atmospheric pressures; do not roll if the planet has those features. Second, if those conditions are not present, then the planet has a chance of being habitable and the 2D6 roll is modified according to any of the Planet Features listed in the Atmospheric Pressure & Habitability Table. The star's habitability modifier is found on the Primary Stats Table. The extreme penalties for brighter stars reflect the short lives of those stars—sometimes too short for planets to even form, let alone ecosystems to develop.

*Chuck intended to make Amtor-2 habitable with a normal atmospheric pressure. But on a lark, he rolls.*

*Starting with the atmosphere pressure, Chuck notes the modifiers. Amtor-2 is in the life zone, so it does not have a -2 modifier for being a hot world. Second, its escape velocity modifier is  $10,321 \div 11,186 = 0.923$ . Finally, he rolls 2D6 and gets an 11. Multiplied by 0.923, the result is 10.153, which rounds to 10. This is a High atmospheric pressure. That actually sounds interesting to Chuck, so he keeps it.*

*Next, Chuck sees if this randomly generated Amtor-2 is habitable. The modifier for an F3 star is -2, since these short-lived, hot stars are not friendly to habitable planets. The high atmospheric pressure would add another -1 penalty. Amtor-2 isn't a giant terrestrial, so that -2 modifier does not apply. The total modifier, though, is -3. Looking across the High Pressure row, Chuck would need to roll a 12 on 2D6 for Amtor-2 to be habitable. However, since he already wants this planet to be habitable to fit his campaign, he waves his hand and makes it so.*

*While he's trying out the guidelines for Amtor-2, Chuck also wants to experiment on Amtor-2's giant inner sibling (which he still needs to name). The giant terrestrial is closer to the star than the life zone, so it has a -2 modifier for being a hot world. The escape velocity of 14,628 m/s becomes a multiplier of 1.31. Rolling 2D6, Chuck gets a 9, which the -2 modifier reduces to 7, and is then multiplied by 1.31 to 9.17 and finally rounded to*

*9: high pressure. That's actually not bad—Chuck may have to host a few 'Mech battles on the planet to experiment with the exotic environment.*

If the planet is not habitable, it still might be useful to know the composition of the atmosphere. The atmospheres of uninhabitable terrestrial planets are generated with the Uninhabitable Atmosphere Composition Table. (The atmospheres of habitable planets are generated under Habitable Planet Details.) The Uninhabitable Atmosphere Composition Table is also used for giant terrestrials that have atmospheres like terrestrial planets (otherwise they have the Atmospheric Composition described under Atmospheric Pressure and Composition, p. XX), and for any moons with atmospheres. These atmospheres assume a fairly mature planet at least 200 million years old, when the planet, primary and atmosphere have stabilized.

Roll 2D6 for each of the Base, Secondary, and Trace columns of the Uninhabitable Atmosphere Composition Table. For each roll on the Base and Secondary columns, apply the following modifiers: -2 if the planet or moon is cold (further from the star than the life zone), +2 if the planet or moon is hot (closer to the star than the life zone), -1 if the planet is large (escape velocity over 12,000 m/s), or +1 if the planet is small (escape velocity under 7,000 m/s).

To determine the percentage of each atmospheric component, use the following rolls: 1D6÷2 percent for each trace or special trace component (do not round) and 5D6 for the percentage of the secondary component. The percentage of the primary component is found by subtracting the percentages of the secondary and trace components from 100. It is possible to have the same base and secondary components (pre-terraforming Venus would be a good example of a planet with carbon dioxide primary and secondary components, while Saturn's moon Titan is an example of a moon with base and secondary nitrogen, plus traces of methane and simple hydrocarbons).

## UNINHABITABLE ATMOSPHERE COMPOSITION TABLE

Roll	Base	Secondary	Trace	Special Traces
2 or less	Methane	Methane	Chlorinet	Helium
3	Methane	Ammonia	None	Complex Hydrocarbons
4	Ammonia	Ammonia	Sulfur Dioxidet	Nitric Acid†
5	Ammonia	Ammonia	Carbon Dioxide	Phosphine
6	Nitrogen	Ammonia	Argon	Hydrogen Peroxidet
7	Nitrogen	Carbon Dioxide	Methane	Hydrochloric Acid†
8	Nitrogen	Carbon Dioxide	Water Vapor	Hydrogen Sulfide
9	Nitrogen	Carbon Dioxide	Argon	Simple Hydrocarbons
10	Carbon Dioxide	Nitrogen	Nitrous Oxide	Sulfuric Acid†
11	Carbon Dioxide	Nitrogen	*	Carbonyl Sulfide
12 or higher	Carbon Dioxide	Nitrogen	**	Hydrofluoric Acid†

\*Roll again twice on this column, ignoring results of 11 or 12

\*\*Roll again once on this column (ignoring 11 or 12) and once on the Special Traces Table

†Chemical makes the atmosphere Caustic per p. 56, Tactical Operations.





All of these uninhabitable atmospheres count as Toxic, per page 56 of *Tactical Operations*. By default, such toxic atmospheres are of the poisonous subtype. However, some trace compounds may make the atmosphere caustic instead. While a number of atmospheric trace compounds may make the atmosphere seemingly flammable, these uninhabitable atmospheres lack the oxidizers necessary to support combustion and thus will not be of the flammable subtype no matter what percentage of hydrocarbons or other flammable substance is present.

*While Chuck will handle Amtor-2's atmosphere (that of a habitable planet) in a following step, during this stage he determines the composition of the giant terrestrial's atmosphere. It is a large (-1), hot (-2) planet for a net of -3 on the base and secondary components. Chuck rolls 2D6 three times, once each for the base component, the secondary component, and the trace component. He gets 9, 10, and 12, respectively, which are modified to 6 and 7 while the 12 remains unchanged.*

*The giant terrestrial's atmosphere is thus mostly composed of nitrogen (base component roll of 6) with a good amount of carbon dioxide (secondary roll of 7) and Chuck needs to reroll twice (trace component roll of 12), once on the Trace column and once for special traces.*

*Rolling again (no modifiers for the Trace and Special Trace columns), Chuck gets a 12 (why can't he roll 12s this often with his Gauss rifles?) and an 8. The 12 has to be ignored and replaced with another roll: 8 this time. The giant terrestrial has traces of water vapor and hydrogen sulfide in the atmosphere. So this planet is a baking, uninhabitable greenhouse hellhole that smells of rotten eggs and is a bit toxic atop every other problem. Chuck makes a note to have his MechWarrior PCs bring cockpit air fresheners and use the excuse of "leaky seals" to cover any embarrassing bodily fumes.*

*Finally, Chuck checks the percentages. He rolls 1D6 ÷ 2 for the percentage of each trace component, getting 2.5 percent and 1 percent for water and hydrogen sulfide, respectively. 5D6 for the carbon dioxide results in a rather low 11 percent. The balance of the atmosphere (100 - 2.5% - 1% - 11%) is 85.5 percent nitrogen.*

A final comment: players may also be tempted to create worlds with exotic atmospheres, like atmospheres of pure chlorine or xenon or sulfur hexafluoride, but keep in mind several things. Elements with uneven atomic numbers (the number of protons in the element) tend to be rarer in the universe than elements with even atomic numbers because of details of nucleosynthesis in stars (with the obvious exception of hydrogen). All halogens (fluorine, chlorine, etc.) thus tend to be rarer than counterparts like oxygen and sulfur (and, because of their chemical aggressiveness, the halogens are even more likely to be bound in minerals). Further, light elements tend to be more common than any element with atomic number greater than iron. Chemical behaviors of the elements and the evolution of planets also tend to limit the range of gases that appear in an atmosphere. (Oxygen, for example, prefers

to form water, carbon dioxide, and rocks rather than exist as a free gas.) As such, the atmospheric gases found among Sol's planets can be taken as fairly representative of atmospheric gases elsewhere—the difference will be in percentages and quantities of the gases, not the types of gases. An interesting and realistic example of the range of terrestrial planet atmospheres can be found by researching the evolution of Earth's atmosphere, from its primary to secondary to modern atmospheres.

### Planetary Temperatures

While the calculations for planetary surface temperatures are relatively straightforward for airless planets (assuming you know the planet's albedo and solar illumination), planets with atmospheres become quite complicated. Exact temperatures are rarely important for most planets, and therefore the following guidelines apply:

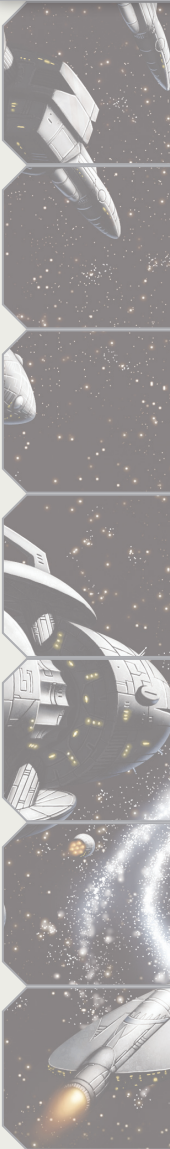
- The temperatures of habitable planets are found in the Habitable Planet Details section.
- The temperatures of giant terrestrials with very high atmospheric pressures, ice giants, and gas giants are moot; only aerospace vehicles can operate in their upper fringes, and there is no surface for BattleMechs to operate on (and so no need to worry about the multi-thousand degree heat of what passes for the planet's surface).
- The temperatures of giant terrestrials, terrestrial planets, dwarf terrestrials, asteroids, and moons with vacuum or trace atmospheres use the following airless world temperature calculation:

$$T = 277 \times (\text{Luminosity})^{0.25} \times \sqrt{1 \div R}$$

- In this equation the planet's temperature T is in Kelvin, R is the planet's orbital distance from the primary in AU, and Luminosity is a multiplier taken from the Primary Stats table. (Kelvin converts to Celsius simply by adding 273 to the Celsius value). Night-side temperatures will generally drop to about 50 to 100 K on an airless world, especially if rotation is slow enough to shed heat from the sun-warmed ground.
- As a simple expedient, planets with low atmospheric pressures may use the airless world temperature calculation, but first multiply their R value by 0.95 (without rounding); worlds with normal atmospheric pressure multiply R by 0.9; high atmospheric pressures by 0.8; very high atmospheres by 0.5. Night-side temperatures on planets with atmospheres will be relatively close to day-side temperatures (within 20-30 degrees) except under relatively extreme circumstances.

The calculation is simplistic, inaccurate, and ignores albedo and atmospheric composition. However, it will give a quick value for a *BattleTech* board game using extreme environment rules. Players are encouraged to research real-world examples (like Mercury, Venus, Luna, Titan, and Earth) for ideas of appropriate surface temperatures. The Primary Stats Table has information sufficient for more detailed calculations of surface temperatures.

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Since Amtor-2 is a habitable planet, it is handled in a later step. However, Chuck continues his fascination with the giant terrestrial in the system (Bob? No, Bob's getting a bit clichéd as a planetary name). Noting its orbital radius is 1.05AU, Atmospheric Pressure is High, and the star has a luminosity 4.94 times that of Sol, Chuck runs the calculation:

$$T = 277 \times (4.94)^{0.25} \times \sqrt{[1 \div (1.05 \times 0.8)]} = 450.6 \text{ K}$$

The average surface temperature would be 451 K (178°C), which would stress any BattleMech's heat system and tone down even a battle fought with double strength heat sinks. Chuck can't wait to try.

### Habitable Planet Details

If a planet turns out to be habitable (per the roll under Atmospheric Pressure and Composition), several additional details should be determined with rolls on the following table. All rolls are based on 2D6, with modifiers given in each step. The table below assumes relatively short day lengths and axial tilts of 0 to 30 degrees; more extreme conditions are addressed under Options (see p. XX).

A common modifier used in the following rolls is the Life Zone Position Modifier. This modifier is found by dividing a habitable planet's distance from its primary in AU by the difference in the outer and inner edges of the life zone in AU (per the Primary Stats table); do not round this modifier.

Life Zone Position Modifier = (Planet Orbit – Life Zone Inner Edge) ÷ Life Zone Width

Amtor-2 is a habitable planet around a bright F3V star. Looking at the Primary Stats table, Chuck finds the life zone, which has an inner edge at 220 million kilometers (1.467AU),

and an outer edge of 447 million kilometers (2.98AU), making it 227,000,000 kilometers (1.51AU) wide. Amtor-2's orbital slot is 2.4AU from the star (relatively close to the outer edge of the life zone). This makes the planet's Life Zone Position Modifier =  $(2.4 - 1.467) \div 1.51 = 0.618$ .

**Percent Surface Water:** Three modifiers apply to this 2D6 roll: the Life Zone Position Modifier, an Escape Velocity Modifier, and a giant terrestrial bonus.

Water coverage, like atmosphere, is partly dependent on the escape velocity of the object. This modifier is equal to the object's escape velocity (in m/s) divided by 11,186 m/s, and is not rounded.

The Giant Terrestrial Modifier adds +3 to the roll because giant terrestrials tend to retain lots of light elements like hydrogen and oxygen, and may be covered in a watery shell averaging dozens of kilometers deep (and uninhabitable giant terrestrials may have much more water).

After making the 2D6 roll, multiply the roll by the Life Zone Position Modifier and the Escape Velocity Modifier, then round to the nearest integer and (if applicable) add the Giant Terrestrial Modifier.

Amtor-2's escape velocity is 10,321 m/s (per Chuck's calculation, rather than slavishly duplicating Venus's 10,460 m/s) so the escape velocity modifier is 0.923. The planet is not a giant terrestrial, so that modifier does not apply. With the modifiers ready, Chuck rolls 2D6 and gets 5, which is multiplied by 0.618 and then 0.923, for 2.85. That rounds normally to 3, giving the planet 30 percent water coverage. This is not quite the ocean-covered Amtor Chuck was after, but vast, burning deserts give more room for BattleMech conflicts anyway.

**Atmospheric Composition:** The only modifier to the 2D6 roll for this aspect of habitable planets is for giant terrestrials. Giant terrestrial planets add –2 to this roll, reflecting their higher

## HABITABLE PLANET FEATURES TABLE

Modified Roll	Percent Surface Water	Atmospheric Composition	Temperature	Highest Life Form
<0	0	Toxic	Very High	Microbes
0	5	Toxic	Very High	Microbes
1	10	Toxic	High	Plants
2	20	Tainted	High	Insects
3	30	Tainted	High	Fish
4	40	Tainted	High	Fish
5	40	Tainted	Medium	Amphibians
6	50	Tainted	Medium	Amphibians
7	50	Breathable	Medium	Reptiles
8	60	Breathable	Medium	Reptiles
9	70	Breathable	Medium	Birds
10	80	Breathable	Low	Birds
11	90	Breathable	Low	Mammals
12+	100	Breathable	Low	Mammals





volcanism and other factors that might lead to a less-habitable atmosphere. The atmospheres of habitable planets will be largely nitrogen with some oxygen and trace gases, like Terra's.

A toxic atmosphere on a habitable planet indicates that the atmosphere is of generally tolerable temperature and pressure, and the gases are not immediately damaging to exposed human skin—the atmosphere is simply not breathable and requires breathing aid (either heavy filters or completely self-contained oxygen supplies). Tainted atmospheres are breathable, but need filtration to remove some pollutant—carbon dioxide is the most common, but extremely low oxygen levels or high pressures can also make an atmosphere tainted.

See page 56 of *Tactical Operations* for details on tainted and toxic atmospheres; the tainted and toxic atmospheres of habitable planets will be of the poisonous subtype if the pollutant is naturally occurring. Flammable conditions will only last briefly in an oxidizing habitable atmosphere and are likely to be the result of human intervention (for example, the rupture of large hydrogen storage tanks at a spaceport). Most caustic chemicals similarly only last a short time in an oxidizing atmosphere. While *BattleTech* has a long history of generating nuclear wastelands, radiological atmospheres will actually only last a short time—most lingering radiation from nuclear weapons is from fallout (local soil and water irradiated into radioactive isotopes by a nuclear explosion), and that fallout mostly decays to a harmless state in mere weeks. Even “salted” bombs produce fallout that is only a threat for several decades, not centuries.

*Chuck rolls 2D6 again to find out what sort of atmosphere Amtor-2 will possess. Again, the planet is not a giant terrestrial so the -2 modifier does not apply. A natural 12 (...never happens with his heavy PPCs...) gives Amtor-2 a completely breathable atmosphere.*

**Temperature and Terrain:** There are two modifiers to the 2D6 roll: the Life Zone Position Modifier and atmospheric pressure. Multiply the 2D6 roll by the Life Zone Position Modifier and round to the nearest integer, then add +1 for a Low Atmospheric pressure or -1 for a High atmospheric pressure.

The resulting temperature hints at planetary albedo, atmospheric composition, and other details beyond the scope of these rules but that may be of interest to players. For example, a hot planet at the outer edge of the life zone probably has nearly toxic levels of greenhouse gases. As another example, a cold planet at the inner edge of the life zone probably has a thin atmosphere, low surface water coverage, and a high albedo.

The resulting base temperature (low, medium, high, very high) normally applies to the equator of the planet (see Options, High Axial Tilts, p. XX). A low base temperature indicates an equatorial average of 287 K; a medium base temperature has an equatorial temperature of 297 K; a high base temperature indicates an equatorial average of 307 K; and a very high base temperature indicates an equatorial average of 317 K.

*Chuck is tempted to pick a High or Very High temperature for his steamy jungle world, but decides to roll just to see how the table works out. Amtor-2 has a high atmospheric pressure, so that's a -1 modifier to the roll, and the Life Zone Position Modifier is 0.618. Rolling a 6, Chuck applies the Life Zone Position Modifier to get 3.702, rounding to 4. The atmospheric pressure modifier then lowers the roll to 3: a planet with a High average temperature.*

Each planet is divided into climatic zones 1 to 6, with 6 being at the equator and 1 at the poles. Each zone represents about 15 degrees of latitude. Generally, each zone numbered lower than the equator (zones 1 to 5) decreases in temperature by 5 K per zone.

These temperatures are gross averages. Ocean currents, altitude, axial tilt, and other factors can heavily modify temperature. For example, the British Isles usually stay above freezing thanks to the Gulf Stream, particularly on their western coasts, despite being at the same latitude as portions of Siberia and Alaska. The equatorial Kenyan highlands are also much more temperate than the lowlands around them, thanks to their altitude. For some possible terrains in each climate zone, refer to the following Terrain Table.

Some guidelines for selecting terrains for a climate zone:

- If the planet's average equatorial temperature is below 298 K and water coverage is below 60 percent, much of the planet's terrain will be cool and arid in some way: tundra, plains, arctic desert, etc. will be the norm (though far from universal).
- If the planet's average equatorial temperature is above 298 K and water coverage is below 60 percent, the planet will also tend to be arid, but the terrains will lean toward warmer options: plains, savannah, desert, etc. (Again, this will not be universal.)
- Worlds with less than 40 percent water coverage of any temperature will be hyper-arid and likely have globe-spanning super-continents marked by vast sand and arctic deserts, as the water coverage is not usually sufficient to completely separate continents.
- Worlds with equatorial temperatures below 287 K will be understandably cold in most regions, though cold climes do not greatly limit terrain possibilities: swamps, forests, arctic deserts, tundra, and many more possibilities exist. Just bring your long underwear, and note that increasing water coverage will *tend* to produce more glaciers and larger ice caps.
- Worlds with average temperatures substantially above 318 K (for example, Hesperus II) would tend to have desert-like terrain regardless of water coverage if populated with an Earth-like ecosystem, but if the planet has a high percentage of native life (80 percent plus) it may have non-arid terrains like jungles, forests, plains, and swamps. These terrains would be filled with native plant and animal life that could survive temperatures that are lethal (or nearly so) to humans.
- Other combinations of temperature and water coverage will produce more varied terrain.

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## TERRAIN TABLE

Climate Zone Average Temperature	Terrain Suggestions (Terran examples)	Associated Weather Modifiers (see pp. 57-62, T0)
267 K or less	Snow field, glacier, arctic desert	Fog, Hail, Snow, Wind, Extreme Temperatures (cold)
268-277 K	Tundra, steppe, evergreen forest, swamp, arctic desert	Fog, Hail, Rain, Snow, Wind, Extreme Temperatures (cold), Blowing Sand
278-287 K	Plains, evergreen and deciduous forests, cloud forest, swamp, desert	Fog, Rain, Wind, Blowing Sand
288-297 K	Plains, forests, temperate rain forests, swamp, desert	Rain, Wind, Blowing Sand
298-307 K	Savannah, forest, jungle, swamp, desert	Rain, Wind, Blowing Sand
308-317 K	Savannah, jungle, swamp, desert	Rain, Wind, Extreme Temperatures (Hot), Blowing Sand
318 K+	Savannah, jungle, desert	Rain, Wind, Extreme Temperatures (Hot), Blowing
318 K+ and 80%+ native life	All non-cold terrain above	Wind, Extreme Temperatures (Hot), Blowing

A good start for describing the terrain of the planet is to determine the number of continents. The number of continents on a world depends on several factors. Smaller worlds are more likely to have cooled and had their plate tectonics come to halt (for example, Mars and Mercury) so that they have few continents, while planets with substantial hydrospheres are likely to have more continents thanks to the lubricating effect of water on plate movement. Larger, wet planets are thus likely to have more continents than small, dry ones. To calculate the number of continents on a planet, roll 1D6 and apply the following modifiers:

- If the planet is under 9,000 kilometers in diameter, divide the number by 2.
- If the planet has less than 30 percent water coverage, divide the number by 2.
- If the planet is over 15,000 kilometers diameter, multiply the number by 1.5.
- If the planet has over 60 percent water coverage, multiple the number by 1.5.

After applying all appropriate modifiers to the roll, round up to the nearest whole number.

Further, if players are ever tempted to make “an ice planet” or “desert planet” or “jungle planet,” please take a moment to note Earth’s endlessly varied terrain. Almost any planet will have a vast and diverse array of environments despite some average temperature trends. Even “icy” Tharkad has tropical islands, warm seas, and large temperate regions, while the driest world may have lush jungles and rain forests around its small bodies of water. A planet (especially a habitable planet) that is dominated by just a handful of terrains is improbable, even if it makes a quick way to describe one.

*Chuck quickly notes the average temperatures of the 11 climate zones. As a hot planet, Amtor-2 has a 307 K equator (Zone 6), 302 K Zone 5, 297 K Zone 4, 292 K Zone 3, 287 K Zone 2, and 282 K Zone 1. With an average temperature of 11°C in the Arctic and Antarctic circles, he notes the poles are unlikely to have permanent ice caps.*

*While he won’t fill in the details of the terrain in each climate zone until the players venture beyond Amtor-2’s starport, he*

*is mildly curious about the number of continents. Burroughs discussed this about Amtor, but Chuck wants to see the random results for Amtor-2. He notes that Amtor-2 would not have a size modifier to the number of continents (being between 9,000 and 15,000 kilometers diameter), but with 30 percent water coverage Amtor-2’s number of continents will be halved. Chuck rolls 1D6, getting a 3. Halved, that’s 2 after rounding. The same as Burroughs’ Amtor, actually.*

**Highest Life Form:** This 2D6 roll is only modified by the habitability modifier of the star (see Primary Stats Table, p. XX), because the habitability modifier represents (partially) the lifespan of the system and thus the opportunity to evolve advanced life. The resulting categories (insect, mammal, etc.) are approximations representing the depth and sophistication of local biology; a planet that has evolved mammals may have something completely bizarre and, well, *alien* of equivalent intelligence and physiological sophistication to terrestrial mammals, though the critters are not in the least bit mammalian.

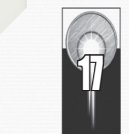
Despite a thousand years of interstellar exploration, no sapient life has been found—the most intelligent animals yet encountered have been somewhat in advance of Terra’s great apes. Very frequently, humans have imported large quantities of other plants and animals while shaping a planet to their needs, resulting in native life being squeezed into niches. (In *BattleTech*, terraforming is a broader industry than just turning uninhabitable planets into habitable ones; the frequent re-engineering of ecosystems also counts as terraforming.) It is left to player discretion how much native life remains; the House Sourcebook and House Handbook series gives a large selection of examples where planets have anywhere from 0 percent (all imported) to 100 percent (all native) ecosystems.

*Amtor-2’s roll for highest native life form is a 4: it has fish in the sea (and probably insects on the land), a raw planet like Devonian-era Terra. Chuck decides that native life will remain extensive (about 90 percent or so), and most of the 10 percent losses will be due to imported Terran life running wild amid the relatively defenseless, primitive native ecosystem.*





## SOLAR SYSTEM GENERATION



It should be noted that if a planet is habitable, it will almost certainly have life unless some natural disaster or humans recently got done destroying the ecosystem (and a mature ecosystem like Terra's extends some kilometers into the crust and ocean floor—it takes some effort to completely destroy an ecosystem). This is because atmospheres with enough oxygen to support human life do not last without artificial or biological intervention—oxygen is a chemically aggressive element that will quickly bind itself into rocks, depleting the oxygen within millennia to a few million years. Therefore, a habitable planet will have either native or imported (terraformed) life able to support the habitable environment.

### Special Features and Occupancy

The following additional rules apply to Special Features and Occupancy.

**Features:** The following table generates unusual planetary features and is applied to any planet. Some results may be inappropriate for an object (a native disease is unlikely on an airless moon) and others require interpretation to apply correctly to the planet. (For example, a Star League observation facility on a high-gravity gas giant is most likely to actually be an orbiting space station.)

Results on the table are generated by rolling 2D6. If the result is over 8, then roll 2D6 on the Special Features Table, modified as follows by the Habitability Modifier from the Primary Stats table: -4 for ice giants, gas giants, and giant terrestrials with gas giant-type atmospheres; -3 for giant terrestrials with terrestrial but uninhabitable atmospheres; and -2 for dwarf terrestrials.


- **Natural Disaster:** A pending or recent large-scale disaster on the planet, like an asteroid strike or super hurricane. Players may refer to Terrain Conditions, p. 54, and Weather Conditions, p. 57, of *Tactical Operations* for ideas.
- **Intense Volcanic Activity:** The planet is experiencing high levels of volcanism compared to Terra. This does not mean there is an erupting volcano on every mapboard, but at least somewhere on the planet are some active volcanoes affecting the climate and atmosphere. (If the planet had a breathable atmosphere, it may shift to tainted.) A planet with an ongoing traps-style eruption would be an example (and, contrary to some portrayals of traps volcanoes, this does not necessarily mean there are thousands of square kilometers of open magma seas, but rather a region with many, possibly small, volcanic vents.) Players interested in portraying volcanic effects on a battlefield should refer to pages 36-37 of *Tactical Operations* for rules on magma terrain and eruptions.
- **Intense Seismic Activity:** A particularly common feature of giant terrestrials (which have a lot of internal heat and thin crusts), the planet (or the region players plan to visit) has higher seismic activity than Terra. This doesn't mean earthquakes are an everyday occurrence, but many regions are akin to Terra's earthquake-prone zones (for example, Los Angeles)—big earthquakes happen every few years to decades, and small ones are more frequent. If players are interested in having one of those earthquakes

strike a battlefield, rules are provided on p. 55 of *Tactical Operations*.

- **Disease/Virus:** A native or imported microbe or virus has found humans to be fertile ground despite humanity's advanced medicine. This pesky disease may be quickly fatal or just debilitating; examples of both can be found in prior *BattleTech* publications (the Brisbane Virus, Cusset Crud, Fenris Flu, Laen's Regret, Eltanin Brain Fever, Black Marsh Fever, Waimalu Fever, Skokie Shivers, etc.). This is primarily a roleplaying concern that will not manifest in a *BattleTech* board game.
- **Incompatible Biochemistry:** Quite frequently, humans have found that native life forms are not edible and the ecosystem may even resist human crops and animal imports. The problem rarely lasts long if the planet is targeted for colonization—humans in *BattleTech* have a long history of replacing (annihilating) local ecologies with an ecology that favors humans. (In fact, this ecological replacement is the most frequent form of terraforming in *BattleTech*.) This is primarily a roleplaying concern that will not manifest in a *BattleTech* board game.
- **Hostile Life Form:** This may range from human-devouring bug swarms to pseudo-dinosaurs that can threaten a BattleMech, to acid-blooded monsters that mostly come out at night, to anything in between those extremes. Either way, the life forms are a problem for human visitors. Except for 'Mech-eating dinosaurs, most of these are concerns for roleplaying rather than *BattleTech* board games, but an unusual example—Bug Storms—may be found on page 41 of *Tactical Operations*.
- **Star League Facility:** A scientific, military, mining, pre-colony base, this relatively small facility may still possess items of interest (or resale value)—and may host inhabitants.
- **Colony:** The planet has been settled by humans who are in contact (infrequently, at least) with the outside universe. Refer to the Colony Creation chapter for guidelines on populating the planet.

### SPECIAL FEATURES TABLE

Modified Dice Roll	Feature
2 or less	Nothing
3	Natural Disaster (e.g., asteroid strike)
4	Intense Volcanic Activity
5	Intense Seismic Activity
6	Disease/Virus (hostile to humans)
7	Incompatible Biochemistry (for humans)
8	Hostile Life Form
9	Star League facility (abandoned)
10	Star League facility (occupied)
11	Colony (1-3, occupied; 4-6, abandoned)
12+	Lost Colony (occupied)

- 
- **Lost Colony:** The planet has been settled by humans who have lost contact with the Inner Sphere and “mainstream” humanity. In the Periphery, this is usually due to loss of space travel and being insufficiently interesting for pirates and traders to visit. In the Deep Periphery, this may be due to loss of space travel or sheer distance (Nueva Castile, for example, retained a few JumpShips but never knew of the founding or collapse of the first Star League until the thirty-first century). And the colony may not be occupied at all, but may have failed or been abandoned. Again, refer to the Colony Creation chapter for guidelines on populating the planet.

## OPTIONS

The following options are invoked by players as they will, rather than randomly rolling them. They provide guidelines for creating at least moderately realistic but exotic star systems.

### Brown Dwarfs

Brown dwarfs are a middle class of objects between the largest planets and the smallest stars. They are (roughly) defined as objects that were large enough to fuse deuterium (heavy hydrogen) in their cores (only in the first few million years after formation), but not large enough to fuse normal hydrogen. This means brown dwarfs fit into a mass range of about 13 to 75 times the mass of Jupiter; anything smaller is a planet (or moon, or dwarf terrestrial, or asteroid, or dust), while anything larger is a star (neglecting black holes and other strange super-stellar objects).

A number of classifications for brown dwarfs are extensions of the stellar classes given in *All the Pretty Colors* (p. XX), but the differences are primarily academic. It is generally enough to understand that brown dwarfs only give a dim red visible light glow (if any), somewhat more infrared light, and that older brown dwarfs (those beyond their brief deuterium-burning phases) will be dimmer. Their limited heat and light makes them unsuited to be primaries for human-habitable planets.

Players may place a brown dwarf in a star system like a gas giant, or may make it an independent “star.” A brown dwarf cannot recharge a JumpShip via its solar sail, and transit times for independent brown dwarfs are treated like that of an M9V star.

While not suited to be primaries for habitable planets, brown dwarfs can generate enough heat to make one or more of a planet’s moons habitable beyond the outer limits of a star’s life zone (about a 33 percent extension of the life zone’s outer edge). For terrestrial-type ecologies, the limit to this life zone extension is where sunlight drops too low to support sufficient photosynthesis and when even the brown dwarf’s heat cannot sufficiently warm the planet.

On the other hand, finding a brown dwarf close to a star (inside the life zone) likely means that the system will not have habitable planets, since the brown dwarf would disrupt the orbits of other planets as it settled into a close orbit around the primary (see *Realistic Planetary Placement*, p. XX).

### Exotic Moons

A number of unusual moons exist beyond the scope of the random rolls provided earlier. These include dual planets (a moon

of the planet’s own size class), habitable moons, and asteroids that possess moons.

**Dual Planets:** Dual planets are planets with a moon of the same size class as the planet, typically at least 4 percent of the planet’s mass. (Four percent might seem small, but Terra’s “giant” moon Luna is only one eighty-first of Terra’s mass, and even the planet Mars is only 10 percent of Terra’s mass. Four percent is quite sizable and is the point at which the L4 and L5 Lagrange points no longer host stable orbits, so it seems like a reasonable point to call a moon and its planet dual planets.)

A dual planet is created by skipping the usual moon creation step (and, in fact, the super-sized moon is likely to prevent the formation or accumulation of other moons). The players designing the planet simply designate it as a dual planet.

The moon (the slightly smaller of the dual planets) is created by rolling randomly on the Object Creation Table for an object the same size as the planet. If the resulting moon is larger and/or denser than the planet, reduce the moon’s diameter until it is at least 5 percent smaller than the planet and lower the density until it is equal to or denser than the planet.

The moon is placed normally in orbit around the planet, though players should feel free to move it out further. Players should avoid moving the objects closer than 3-5 times that planet’s diameter from the planet to avoid breaking up one or both objects. It is fairly important to calculate the length of time that the moon orbits its planet (the detailed year length equation in *The Planets*, Step 4, will suffice) because the dual planets will almost certainly be tidally locked to face each other, so the time it takes for them to circle their barycenter is the length of the dual planets’ day. This could result in day-night cycles of several weeks.

Players may be interested in Klemperer Rosettes, a circular arrangement of multiple planets (3 or more) in the same orbit. These are unstable, however. They will not exist in nature and moving planets is beyond the capability of *BattleTech*’s technology, so these rules do not address them.

**Habitable Moons:** A moon of at least terrestrial planet size (a giant-class moon) may be habitable if the moon is in the life zone. If the planet is a gas giant of at least Jupiter’s mass, it may radiate enough heat to allow the moon to be habitable further from the star than the life zone. This life zone extension should be limited to about 20 percent further from the star than the life zone’s outer edge, as gas giants are poor substitutes for a stellar heat source and the rapidly dropping light levels will make human-compatible ecologies difficult to sustain.

**Moons with Atmospheres:** Because atmospheric retention is significantly related to escape velocity, few moons can hold onto an atmosphere. One exception is a giant-class moon over 5,000 kilometers in diameter, in which case it may have a typical terrestrial planet atmosphere. (Obviously, habitable moons have habitable atmospheres by default.)

Likewise, a moon of dwarf terrestrial or smallish terrestrial planet size (under 3,000 kilometers in diameter) may have a trace atmosphere if its density is less than 2.5 g/cm<sup>3</sup>, and thus likely contains a large amount of volatiles (ice, hydrocarbons, etc.) to constantly replenish atmospheric losses. An example is Neptune’s moon Triton.

Third, if a moon is 2,000 to 5,000 kilometers in diameter, less than 3 g/cm<sup>3</sup> density, and orbits fairly close to a large gas giant





(Saturnian mass or larger, and within 10 planetary diameters), the atmosphere may be of any density. In this circumstance, the moon loses atmosphere but the stray gases cannot escape the planet's orbit and form a gas torus that constantly replenishes the atmosphere. Saturn's moon Titan is a prime example of this phenomenon.

**Asteroid Moons:** Asteroids are, by default, generated without moons. However, asteroids have been observed to possess moons on occasion (Gaspia and Ida, for example). An asteroid's moon (or moons) will be at least one size class smaller than the asteroid. If the asteroid is small to begin with, the moon(s) should be no more than one-tenth the diameter of the asteroid.

If players want an asteroid to have moons, the suggested limits are  $1D6 \div 3$  moons of one size smaller or  $1D6$  moons of two sizes smaller.

### Eccentric Planetary Orbits

By default, planets have a relatively circular orbit. However, greater eccentricities are possible. In this document, an eccentric planetary orbit is defined as one that crosses more than one orbital slot around the star, thus preventing planets from occupying those other orbits (except in peculiar situations like Neptune and Pluto).

A second effect applies to habitable planets. A habitable planet with an eccentric orbit will have sharply varying temperatures throughout its year. Seasonal variation is usually a result of axial tilt, not orbital eccentricity, but for sufficiently large eccentricities the effect may not be ignored. Calculating the degree of variation is beyond the scope of this document, but the rule of thumb is simple: further from the star = cold, closer to the star = hot. Players should note that orbits are slowest when furthest from the primary and fastest when closest. This means that a planet with an eccentric orbit will not only have cold winters, but it will have a much longer winter than its summer.

### High Axial Tilts

So far, these guidelines have assumed planetary tilts between 0 and 30 degrees. This is a fairly academic point for uninhabitable planets, while for habitable planets (in circular orbits) it means seasonal temperature variations range from nothing (0 tilt) to Terran-like (low 20s) to vigorous (30 degrees)...assuming orbital eccentricity is not very high.

More extreme axial tilts in a planet produce very odd circumstances that deviate from this pattern. First, for half the year one of the poles will be pointed at the star; for the other half of the year, the other pole will be pointed at the star. For tilts between 40 and 60 degrees, this results in oddities like an equatorial ice-belt and ice-free poles. At more extreme tilts, one hemisphere will be shaded half the year and thus locked in snowy darkness until switching roles with the other half. Adapting to this can be difficult for Terran-derived planets and animals.

While external influences can pull a planet into extreme tilts (as Jupiter does to Mars) and endanger its habitability to humans, external influences can also discourage such tilts. It is currently thought that Luna's tidal influence on Terra's

equatorial bulge helps stabilize Terra's tilt to about 20-25 degrees. This means that a planet with a small moon (a moon less than 10 percent of the planet's diameter) is more likely to have an extreme axial tilt than a planet with a sizable moon. Players should also consider a planet with an extreme axial tilt to have a -1 Habitability Modifier (see p. XX).

### Hot, Hot, Hot!

Type B and O stars, and giant stars of any luminosity class (-V, IV, III, II, Ia, and Ib), are largely beyond the scope of this document. (The Primary Stats table, p. XX, does address BxV stars.) If players wish, they may build a system around a giant star, a B star, or an O star, but the details (beyond main sequence B stars) are left to independent research. Some suggestions are provided below:


**O-Class Stars:** These stars are too short-lived, too hot, and too violent to have planets. By the time hypothetical protoplanets started looking like planets, the star would be in its death throes and ready to explode as a supernova. However, it is unlikely protoplanets would even begin to form around an O-class star because the furious heat and solar winds would blast away any material in the system that could form planets. Indeed, O-class stars are noted for evaporating and clearing away material in nearby nebulas (up to several light years) that might form nearby star systems. The system of an O-class star is thus likely to resemble a particularly raw and ill-formed asteroid belt at distances from the star where one would normally find an Oort cloud.

**B-Class Stars:** The systems of B-class stars are little better than those of O-class stars. The dimmer main sequence B-class stars can last long enough for planets to form, but the terrestrial planets are unlikely to solidify significantly before the star dies, usually in a supernova.

**Giant Stars:** Giant stars are the aged form of what were once main sequence stars that have largely exhausted hydrogen in their cores and thus are going through a destructive sequence of burning consecutively heavier elements in faster and faster cycles of fuel exhaustion. Any human-habitable planets these stars may have likely exist through artificial intervention (terraforming) because the star will only briefly be in a giant form. Even giant stars with seemingly long lifespans (for example, Sol should be a giant star for over 1 billion years) will go through drastic changes in illumination (by factors of hundreds and thousands) on time scales of mere millions or thousands of years as they turn into giants and enter their death throes, seeing only a relatively brief period of stability (about 100 million years as a true red giant in the case of Sol). This is faster than biological evolution can cope with even if the life zone was stationary and illumination shifts were minor, but the changing stellar radius and illumination means the life zones will move in and out from the star by huge distances, stranding planets beyond the life zone (and perhaps even inside the star). It is quite possible for a giant star to greatly change in brightness during the course of a few centuries, which would render even a terraformed planet into a frozen lump or scorched ball of lava.

Because of this, by default the stars in this document are main sequence stars. However, *BattleTech* has placed habitable

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worlds around stars of different sizes, particularly giant stars (size class IV to Ia). A star system built around a giant star multiplies the Luminosity by a factor of 4 over the value listed in the Primary Stats Table, doubles the inner and outer radii of the life zone, and reduces the habitability modifier by 2.

Transit and recharge times are not affected by giant stars, though this is an unrealistic and arbitrary rule to prevent retroactive continuity changes to many published *BattleTech* planets (which orbit giant stars almost as often as not). In fact, this may mean (particularly in the case of M-class giants) that the habitable planet and zenith/nadir jump points are inside the bloated star, a detail that is deliberately overlooked when keeping transit times fixed.

### **"It's Life, But Not As We Know It"**

Only human-habitable planets have an opportunity to determine highest life form. If players prefer, they can roll on the Habitable Planet Features Table (see p. XX) to determine the level of life on worlds with uninhabitable atmospheres. In addition to the normal modifiers on the Highest Life Form roll, a modifier of -4 applies to the roll.

The probability of life in exotic environments is hard to estimate; there are fair arguments for life in gas giant atmospheres, and if you get into the science fiction cliché of "silicon-based life," you might argue reasonably for life on pre-terraforming Venus, Mercury, or other hell-worlds. The versatility of water and carbon-based combinations compared to other chemical and environmental systems argues that life elsewhere may not be as sophisticated as life on terrestrial planets (hence the -4 modifier), but if you're invoking this option and interested in some exotic life on an exotic world, then—as with all of these guidelines—feel free to simply pick the highest life form on the planet. After all, you'll be the one who has to describe this truly alien life.

Players using this option may also want to refer to the option Water, Water Everywhere (see p. XX.)

### **Multi-Star Systems**

The Primary Table only deals with single stars, not binary or multiple star systems. Though binary stars represent a slight majority of the stellar population, they complicate the generation of star systems and thus are left to the discretion of players. The following are some pertinent points for adapting binaries to *BattleTech*.

**System Layout:** Except in stellar clusters, combinations of more than two stars tend to group into binaries. For example, the real star system Capella consists of four stars. However, this is not a system of four stars swirling around an area the size of a star system. Rather, Capella consists of a pair of giant yellow stars orbiting each other at about 100 million kilometers and then a pair of close-orbiting red dwarf stars about a light-year from the yellow giants.

**Distant Binaries Only:** This system generation option also "takes the easy way out" by only providing guidelines for "distant" binaries, which in the context of this document refers to stars separated by sufficient distance to not significantly influence the position of standard jump points or habitable zones.

As a rule of thumb, the stars need to be about four times as far apart as the proximity jump limit of the larger star at the closest

point of their orbit. For example, a system consisting of a G2V and a K2V star (like Alpha Centauri or, as it's known in *BattleTech*, Rigil Kentarus from its Arabic name) would need to be separated by at least 40 AU to qualify, or else players will be left trying to recalculate the position of the standard jump points of both stars.

**Planet Spacing and Numbers:** Players considering a binary or multiple star system should note that planetary orbits are disrupted if they are beyond one-third of the separation between stars. For example, a pair of stars circling each other at 60 astronomical units would each be able to support planets out to about 20AU around each star, and the gravity of the stars would prevent stable planetary orbits in the central 20AU region. (This varies depending on the orientation of the planets with respect to the other star, but one-third is a reasonable rule of thumb.) Therefore, ignore any objects that would be placed in orbital slots beyond this distance.

Another handy rule of thumb is with respect to the thermal effects of one star on another. If the stars qualify as distant binaries, the separation will prevent any climate disruptions from the other star's illumination. The inverse square effect quickly reduces the level of illumination from other stars. The level of illumination from another star (the secondary or tertiary of a system) can be quickly confirmed using the following calculation:

$$\text{Illumination} = \text{Luminosity} \div \text{Distance}^2$$

In this equation, luminosity is found on the Primary Stats table and distance is the closest separation between the other star and the planet in AU. If the illumination is 0.05 or less, heating effects of the other star(s) will be minor and, if below 0.001, negligible. However, a secondary star might be quite bright—an illumination of 0.005 is like a moderately bright, artificially lit room. Terra's moonlight from a full Luna is equivalent to (approximately) an illumination of 0.000001.

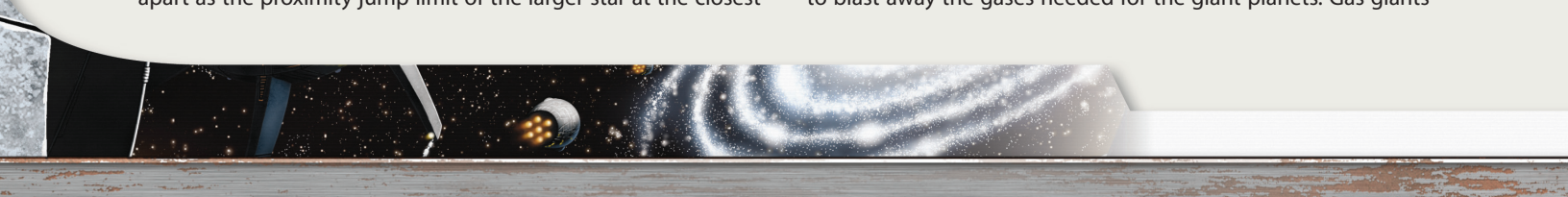
A good example of a "life zone-compatible" binary star on which to model multi-star systems is Alpha Centauri, a system of two sun-like stars with elliptical orbits and (probably) safe life zones. Details of the two stars can be found at length on the internet. The third star of the system, Proxima Centauri (or Alpha Centauri-C), is about one-fifth of a light-year from the other two stars and is an example of a very distant "binary" that is virtually a single star unto itself.

### **Realistic Planetary Placement**

The following paragraphs provide realistic planetary placement guidelines.

**Asteroid Belts:** Asteroid belts are usually the result of debris that did not coalesce into a planet. This, of course, means something has to prevent the system from coalescing, typically a nearby gas giant. Therefore, an asteroid belt is likely to be adjacent to a gas giant or brown dwarf (not counting any intervening empty orbital slots). If a gas giant is not next to the asteroid belt (ignoring empty orbits), players may wish to place a gas giant there instead of accepting random rolls for filling that orbital slot.

**Migrating Gas Giants:** Current models of star system formation suggest it is improbable for gas giants to form close to a star because the tantrums thrown by newborn stars tend to blast away the gases needed for the giant planets. Gas giants





are thus thought only to form in colder regions of the system beyond the life zone. However, astronomers have found gas giants, some very large, orbiting close to stars. With new models of system formation, it seems possible for interactions between protoplanetary disks and proto-gas giants to rob the gas giants of momentum and send them spiraling into the inner system.

This phenomenon applies to realistic planetary placement. A wandering gas giant is a bull in a china shop, scattering or colliding with smaller planets. By the time it settles into a close orbit around the star, it is unlikely any terrestrial planets will be left between the gas giant's final orbit and the outer edge of the star's life zone.

Therefore, if a gas giant is placed in the life zone or closer to the star, the only terrestrial planets or dwarf terrestrials will be either in closer orbits to the star than the gas giant, or will be further from the star than the life zone. The only possible occupants of orbits in the "swept zone" are giant terrestrials, ice giants, or gas giants (which might have followed the first gas giant's migration) or asteroid belts (lingering debris from the birth of the system or from the trauma of the gas giant's passage.)

**Gas Giant Exclusion:** Because of the strong influence of gas giants, a gas giant should not be in an orbit next to a habitable planet. It is recommended that the gas giant be moved to a more distant orbit and replaced by either an empty orbit or an orbit containing an asteroid belt, terrestrial planet, or dwarf terrestrial.

**No Titius Bode Law:** The default spacing of orbital slots in these rules is based on a system that only addresses some of Sol's brood and does not work at smaller scales or in other observed star systems (at least, not yet). Rather, planetary spacing seems to be a result of original instabilities in the protoplanetary disk and subsequent gravitational interactions between the forming planets, the disk, and other influences. Players with a lot of time on their hands are welcome to try to model likely spacings of gas giants, terrestrial planets, and other objects in a system.

### Variable Stars

Stars are not all steadily burning fusion reactors. Some stars have a variable output, falling into two categories: flare stars and long-term variables. Players that want a star to be variable may select whether the star is a flare star or long-term variable, and apply the following guidelines to the star.

Long-term variable stars alter their luminosity over a period of  $1D6 \times 1D6 \times 1D6$  months (do not cube  $1D6$ ; multiply together the results of three separate  $1D6$  rolls). During this period, the star will increase its luminosity from the value on the Primary Stats Table by  $[(4D6) \div 2]\%$ . Temperatures of planets should be recalculated (see p. XX).

Flare stars alter their luminosity in brief spurts lasting days. Every  $1D6$  months, roll a second  $1D6$ : on a result of 1-3, the star flares. During a flare, the star's luminosity increases by 100 percent for  $1D6$  days, increasing temperatures appropriately (see p. XX).

### Very Young and Very Old Systems

For main sequence stars of stellar classes M, K, and G, age can offer an advantage or disadvantage in determining habitability.

Very young systems of these types (under 1 billion years old) reduce their Habitability Modifier by 1 for all planets in the life zone, reflecting the higher quantity of debris, unsettled star, and other issues. On the other hand, very old systems (those over 8 billion years) are generally clear of such threats and gain a +1 bonus to their Habitability Modifier.

### Water, Water Everywhere

Water on uninhabitable worlds is ignored by default, but uninhabitable giant terrestrial planets with non-gas giant atmospheres and terrestrial planets may have some water coverage. This option refers to thin (1-5 kilometers deep) oceans that do not completely cover a planet's surface, like those of Terra, not the thick water mantles of ice moons and giant planets.

Planets with surface gravities below 0.5G, atmospheric pressures of vacuum or trace, and temperatures above  $323\text{ K}/50^\circ\text{C}$  are not eligible for water coverage as they generally will not retain open water for significant periods. (Astute players may note that higher atmospheric pressures allow water to remain liquid above  $100^\circ\text{C}$ , but the  $50^\circ\text{C}$  limit represents a rule of thumb point where water—a powerful greenhouse gas—is likely to evaporate rapidly in a runaway greenhouse effect under a variety of atmospheric pressures.) Planets with average equatorial temperatures below  $14^\circ\text{C}$  will have significant ice coverage on their oceans.

If such conditions are met, then players should feel free to roll on the Habitable Planet Details Table to determine water coverage despite a planet being otherwise uninhabitable.

### Planetary Location Versus Density and Exotic Densities

This isn't an option so much as notes that players should consider when creating objects.

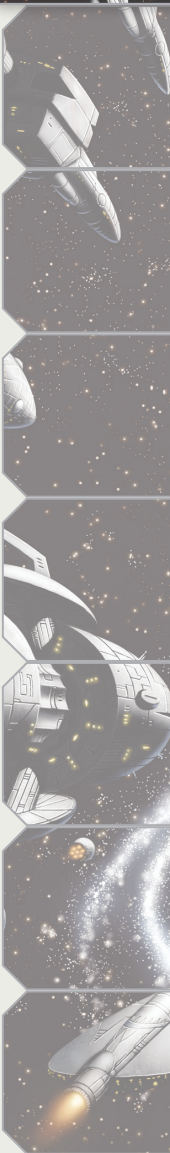
Density says a lot about objects in space: their possible origin, their composition, where they can appear in a system, and more. While the random rolls in the Planet Generation Table should give realistic results, very low or very high results—or players interested in arbitrarily selecting densities for their planets—should consider the following information.


A quick selection of densities to give a baseline: Liquid water has a density of 1 gram per cubic centimeter (1 kilogram per liter, 1 metric ton per cubic meter). Many rocks (silicates) range from 2 to  $4\text{ g/cm}^3$ . Objects with increasing metal content will push toward the density of iron (roughly  $8\text{ g/cm}^3$ ). Non-stellar objects denser than iron are unlikely since denser materials (like lead, gold, and platinum) are very rare. (Very massive gas giants, brown dwarfs, red dwarfs, white dwarfs, neutron stars, and black holes are exempt from this—gravity compresses these objects to densities beyond those normally found in their constituent materials.)

Location matters. Low density objects are unlikely to be found inside the life zone or closer to the star and so players should reroll if such a result occurs. The reason is that low



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density materials are generally volatile. That is, easy to evaporate, like the ices that make up comets. There are exceptions, however. Planets large enough to retain an atmosphere may be low in density, like ice giants and gas giants. Asteroids made of rock and metal may also have low density deep in a star system if they are “rubble piles” (a common form of asteroid): piles of shattered gravel and rubble with a significant amount of space between each nugget.

Terrestrial (rocky) planets generally range from about 3 g/cm<sup>3</sup> to 6 g/cm<sup>3</sup>, depending on their percentages of siliceous (rock-like) materials versus metallic (primarily iron) materials. Earth (5.51 g/cm<sup>3</sup>), Mercury (5.43 g/cm<sup>3</sup>) and Venus (5.2 g/cm<sup>3</sup>) are at the high end of this range, while Mars (3.93 g/cm<sup>3</sup>) and Luna (3.35 g/cm<sup>3</sup>) are at the low end.

The only non-stellar objects that might regularly be found in the 6 to 8 g/cm<sup>3</sup> range would be giant terrestrial planets and metallic asteroids. Giant terrestrial planets can be large enough to actually compress their solid cores, while metallic asteroids are usually the cores (or parts of cores) of large, primordial asteroids that were big enough to melt during their formation and differentiate (dense materials sank to the core, light material floated to the surface), and were small enough to be subsequently blown apart by collisions.

While asteroids might be as dense as solid iron, they generally follow the density trends of terrestrial planets (if in the life zone or closer to the star) when measuring their solid portions (3 to 6 g/cm<sup>3</sup>). Many asteroids are “rubble piles,” flying mounds of gravel broken up by repeated impacts but lacking the gravity to compress back into a solid form, and thus are less dense than solid rock (perhaps 1-3 g/cm<sup>3</sup>). Asteroids further from the star than the life zone will have increasing quantities of ice and low-density carbonaceous materials, falling into the range of 4 g/cm<sup>3</sup> to 1 g/cm<sup>3</sup>, depending on their specific mix of metals, rocks, and ices. Further from the inner system, asteroids blur into comets—the latter (generally 0.9-2 g/cm<sup>3</sup>) can be considered very icy asteroids (or asteroids could be very dry comets).

Ice giants cover a type of smallish gas giant (like Uranus and Neptune) that are actually mostly water by mass, with a relatively shallow hydrogen/helium shell (10-30 percent of the planet by mass) covering a massive mantle of what astronomers call ice (but that may actually be heated to thousands of degrees). Densities of 1.1 to 2 g/cm<sup>3</sup> are reasonable for ice giants.

Gas giants cover a range of densities. Sol's gas giants range from 0.687 g/cm<sup>3</sup> (Saturn) to 1.64 g/cm<sup>3</sup> (Neptune); a reasonable range is 0.6 to 1.5 g/cm<sup>3</sup>. Small and medium gas giants may be quite low in density, less than water (as in the case of Saturn), while larger gas giants tend to compress under their own weight.

The largest gas giants handled by the Planet Generation Table are about 2.5 times Jupiter's mass. More massive gas giants begin behaving oddly: they cease growing in diameter despite increasing mass. After some initial growth beyond Jupiter's diameter, gas giants then *shrink* as their mass increases. For example, it is currently estimated that 14 Andromedae b is about 4.8 times Jupiter's mass and 99.5 percent of Jupiter's radius (about as dense as Earth, despite being mostly made of hydrogen), while 18 Delphini b is about 10.3 times as massive as Jupiter and only has about 75 percent of Jupiter's diameter—the planet is denser than iron.

Brown dwarfs are only slightly larger than Jupiter, and might be more compact, exhibiting great densities due to gravitational compression. It is only with fusion heating that stars begin to swell. (The smallest, dimmest red dwarfs are about 80 times as massive as Jupiter, but only 30 percent larger in diameter.)


These guidelines are not inclusive of all the oddities astronomers have spotted in the heavens, but they cover the majority. Players may select dramatically different densities or diameters of planets to suit themselves, but should understand that the result may be quite implausible. Of course, if “quite implausible” means “quite fun,” go for it.

### Math Guidance

A number of calculations in the system generation rules involve more complicated math than the usual for *BattleTech*. However, the most intimidating calculations are only unusual exponents and long, but simple equations (remember your order of operations and how to use mathematical parentheses and you'll be fine). If you can handle one equation, you can handle any of them.

The Object Type Table is a good example. It includes raising numbers to 1.15 and 0.75. Either exponent can be applied with a typical scientific calculator or the calculator accessory program commonly found on personal computers. The function is usually displayed on common scientific calculators as “^”, “x^y”, or “y”.

In fact, the other significant math in this chapter is square roots, which are a special case of exponents: applying a square root to a number is the same as raising the number to the 0.5<sup>th</sup> power.





# COLONY CREATION

These guidelines are intended to help players describe populated planets such as those found in the *BattleTech* universe. The process involves several steps, beginning with determination of the population, which will influence a number of subsequent steps.

The second step provides guidelines to determine a planet's Universal Socio-Industrial Level Rating (USILRs). The USILR code uses an A through F grading system to represent (in order) a settled world's level of technological sophistication, industrial development, dependence on imported raw materials, industrial output, and agricultural dependence (both of the latter relative to population).

The third step is to determine the planet's style of government. In cases where the planet is a member of an interstellar, multi-system faction, the planetary government is sometimes different than the interstellar government (many of which function as alliances or confederacies and thus are tolerant of differences in member-planet governance).

Finally, a number of secondary planetary characteristics like the presence of recharge stations and HPGs are determined.

## STEP 1: POPULATION

Determining a planet's population is a straightforward set of three rolls. The results determine when the colony was settled and by whom, and then the population itself.

### Step 1A: History of Occupancy

If the player does not have a preference for who settled the colony (non-Clan or Clan) and when it was settled (Star League era, earlier, or more recently), a 1D6 roll on the Occupancy History Table will determine those aspects. Alternatively, players may use a date and faction of their own choosing. The date and settlement are then used in Step 1B.

### OCCUPANCY HISTORY TABLE

Die Roll	Occupants
1	Colonists who settled before the founding of the Star League
2	Colonists who arrived during the Star League's heyday
3	Colonists who settled during the Succession Wars, fleeing the Inner Sphere
4	Recently established colony/occupation force from the Periphery
5	Recently established colony/occupation force from the Inner Sphere
6	Recently established colony/occupation force from the Clans

## Population

The Planetary Population Table below captures the general diffusion and growth of humanity beyond the confines of Terra. Until the fall of the Star League, the "borders" of the Inner Sphere were porous while habitable planets in the Periphery are no less common than in the Inner Sphere, and thus humanity continued to spread away from Terra in an ever-thinning density. However, the Succession Wars sharply curtailed the number of JumpShips available to the bulk of humankind (either by destroying the ships outright or destroying their shipyards, which the Star League had concentrated in the Inner Sphere). The Clans, on the other hand, have a very restricted population to work with, which limits the size of their colonies.

The top row of the two "Inside the Inner Sphere" rows addresses a special circumstance: an Inner Sphere world depopulated by the Succession Wars and subsequently removed from the maps by ComStar, who judged it destroyed. Over 200 planets experienced that fate as they were directly attacked by weapons of mass destruction or suffered from collapsing technology, and there are a rare few failed colonies from before the Succession Wars that were likewise marked off the maps. However, humans are hard to completely exterminate and some of those worlds may still host small populations. Other worlds in the Inner Sphere would use the lower "Inside the Inner Sphere" row.

To determine a colony's population, the Planetary Population Table first requires players to select, either from the results of Step 1A or their own choice, who settled the colony, when, and how far the colony is from Terra in light-years. Once the founding culture, era and distance is known, the player cross-references the Distance row with the Founding Era column to find what dice rolls are required to determine the population.

The Planetary Population Table has two numbers for a given combination of distance, era, and founding culture. The number to the left of the colon is the result of a 1D6 roll that determines whether the colony falls into a low or high population category; the number to the right of the colon is the second roll that specifies the population. For example, a planet inside the Inner Sphere settled during the Star League lists 1-5: 20 million x 4D6, and 6: 500 million x 4D6. This means a 1D6 roll of 1-5 requires a second roll of 4D6 multiplied by 20 million to determine the population, while a 1D6 result of 6 requires a second roll of 4D6 multiplied by 500 million. (This reflects the tendency of *BattleTech* planets to fall into a pool of modestly populated planets, while some thrive. The average Inner Sphere planet has a population of several hundred million, but a sizable minority boasts populations in the billions.)

The population result may be multiplied with the Planet Condition Modifiers listed on the Planetary Population Table. Each modifier that applies to a planet is applied in sequence. For example, a planet that initially rolled a population of 500 million but had 20 percent water coverage and a tainted atmosphere would multiply the population by 0.8 for both conditions, giving a final population of 320 million.



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## PLANETARY POPULATION TABLE

Distance from Terra	Founded in the Star League and Earlier	Founded More Recently	Comments
Inside Inner Sphere (<500LY from Terra)	1-5: 10,000 x 2D6 6: 100,000 x 2D6	N/A	This is for a Lost Colony (destroyed by Succession Wars)
Inside Inner Sphere (<500LY from Terra)	1-5: 50 million x 4D6 6: 500 million x 4D6	1-5: 10,000 x 2D6 6: 100,000 x 2D6	New colonies in the Inner Sphere are likely on barely habitable planets because few habitable planets are left in the Inner Sphere for settlement
500 to 600LY	1-5: 10 million x 4D6 6: 100 million x 4D6	1-5: 2 million x 2D6 6: 20 million x 2D6	—
601 to 750LY	1-5: 2.5 million x 4D6 6: 25 million x 4D6	1-5: 50,000 x 2D6 6: 1 million x 2D6	—
751 to 1000LY	1-5: 500,000 x 4D6 6: 5 million x 4D6	1-5: 20,000 x 2D6 6: 200,000 x 2D6	Few modern colonies are founded this far from the Inner Sphere
1001 to 1250LY	1-5: 100,000 x 4D6 6: 1 million x 4D6	1-5: 5,000 x 2D6 6: 50,000 x 2D6	—
1251 to 2000LY	1-5: 10,000 x 4D6 6: 200,000 x 4D6	1-5: 500 x 2D6 6: 10,000 x 2D6	—
2000LY+	1-5: 2,500 x 4D6 6: 50,000 x 4D6	1-5: 100 x 2D6 6: 2,500 x 2D6	—
Clan Colony, any distance from Terra	N/A	1-4: 1,000 x 3D6 5-6: 50,000 x 3D6	—
Outpost, any faction, any distance from Terra	1-4: 100 x 4D6 5-6: 1,000 x 4D6	1-4: 50 x 2D6 5-6: 1,000 x 2D6	—
Planet Condition	Modifier	Modifier Description	
Uninhabitable	x0.05	Planet has a toxic, very thick, vacuum, and/or trace atmosphere; gravity is over 1.5Gs	
Tainted Atmosphere	x0.8	—	
Very High Temperature	x0.8	—	
Gravity below 0.8G or above 1.2G	x0.8	—	
Water coverage 40% or less	x0.8	—	

The Planetary Population Table provides guidelines, not hard rules for populations. It is meant to approximate population distribution trends in *BattleTech*, but there are anomalies that it does not capture and, of course, players may always feel free to assign populations to their colonies as best suits their game.

*Continuing from the System Generation chapter, Chuck had a sketch of a background story for Amtor-2. It was in the Periphery, once part of the Outworlds Alliance but one of the 75 percent of the Outworlds' pre-Succession Wars planets that seceded during those dark centuries. Amtor-2 was a place of several warring ideologies, none of them anti-technological pacifists like the Outworlds' norm (hence the secession in disgust when the Alliance could not protect Amtor-2 from pirates during the Succession Wars). It would be on the far fringes of the Alliance, which once spanned an area nearly the size of the Combine, and is thus some 600 light-years from Terra. While Chuck isn't certain which year Amtor-2 was settled (something else to figure out beside planetary names), he knows it predates the Succession Wars.*

*Looking at the line addressing 600 light-years (500 to 600) and the column "Founded in the Star League or Earlier," Chuck sees Amtor-2 might have a population of either 10,000,000 x 4D6 (on a first roll of 1-5) or 100 million x 4D6 (on a first roll of 6).*

*Chuck rolls a 1D6 and gets a 3. With a 3, the population formula he'll use is 4D6 x 10 million, so Chuck rolls 4D6 and gets 15 for a base population of 150 million. Looking through the modifiers, Chuck notes that the only applicable modifier is for low water coverage, 0.8. That lowers the population to 120 million.*

*He's not sure that's populous enough for his needs, but if he doesn't like the roll he can always fudge it later and adjust the planet's history to explain the higher population.*

### STEP 2: USILR CODES

The following guidelines for generating a planet's USILR code are primarily intended for independent planets with limited interstellar commerce—in other words, a typical Periphery planet, not typical Inner Sphere planets. Inner Sphere planets tend to have higher Industrial Development and Output than is suggested herein.





Players should not take the results of these guidelines as ironclad, particularly for planets with references in other *BattleTech* publications. A degree of judgment and reference to other *BattleTech* publications may be called for. If Agricultural Output seems too high compared to prior descriptions of the “barren” planet, feel free to lower it. If the Technological Sophistication generated here seems too primitive for prior descriptions of an industrialized planet, raise the Technological Sophistication. If the planet is a generic Inner Sphere planet and ends up more industrialized and advanced than New Avalon, lowering the scores is probably warranted.

Of course, it is a good idea to note the justifications. It's one thing to make a core Inner Sphere planet more industrialized than the first results suggested by these guidelines (because the core of the Inner Sphere is heavily developed and industrialized), and another to create a Deep Periphery planet with a score of A/A/A/A/A just because you didn't like the original D/D/C/C/B score. (Unless, of course, you're having fun with a 200-world, super-advanced Shadow Wolverine Empire in the Deep Periphery. Fun comes first—this is a game.)

**Technological Sophistication:** The first part of the 5-letter USILR code, Technological Sophistication, marks the level of advancement a planet can locally sustain. (Much more advanced technology may be found on the planet, but the code indicates the technology that local facilities could produce when mostly bereft of outside support).

A key element of maintaining advanced technology is a large, educated, prosperous population. Technology exhibits an exponentially increasing demand for population, at least to be independently and economically sustainable. In certain conditions (extreme automation or hand-built, cottage industries) high technology can be more sustainable (Niops being a notable example of the latter). However, to truly comprehend and be able to improve technology requires vast amounts of educated citizens—early 21st-century Terra being a prime example of a situation where the ability to build the most advanced technologies is found in far fewer nations than actually use (and support) those technologies, and the Terran Alliance had to bankrupt its poorer member-nations to develop and support some portions of Tech Levels C and D (notably JumpShips and fusion power). The Clan homeworlds found an interesting middle position by simply duplicating Star League technology in most areas (with no innovation or diversification) while using the 1.15 billion subjects of the Clan homeworlds to sustain an advanced military industry for a limited warrior caste. The shortcoming is not in factory labor either, so automation is a limited fix—there must be enough warm bodies to provide sufficient consumers, thinkers and taxpayers to support the technology, not necessarily to staff the factories and supporting industries.

Note that isolated planets settled before 2450, even if possessing advanced technology, may not necessarily possess BattleMechs and battle armor. If they do, the units are likely independent developments with odd characteristics.

Once the population and founding faction is known, players can determine the planet's technology from the USILR Table. To use the Technological Sophistication section of the

table, note the starting technology base (C). Add together all applicable modifiers, then apply the result to adjust the score. Each -1 modifier raises the technology level by one letter up the alphabet (for example, D to C). Each +1 modifier similarly reduces the Technological Sophistication by one letter (for example, B to C). Modifiers are cumulative; a colony of 100,000 would apply both +1 for a population under 100 million and +1 for a population under 100,000. As an example, a planet with -3 in bonuses and +2 in penalties would have a final modifier of -1, and so the Technological Sophistication would improve from the base of D to C.

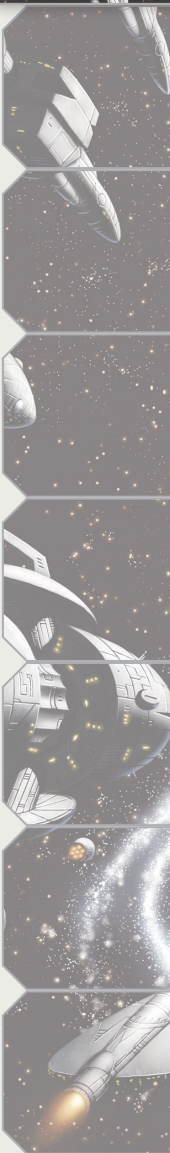
While A and F officially mark the highest and lowest technology levels available, it is possible to exceed either. The highest nominal Technological Sophistication is A, but this score covers a broad range of technologies from the peak of the Star League (equivalent to Terra and advanced worlds of the Inner Sphere after 3050) and the hyper-advanced aspects of Clan technology (Tech Ratings of E and F). If the sum of modifiers would raise the Technological Sophistication above A, and if the planet may reasonably be said to host a center of Clan or Inner Sphere ultra-advanced research (like New Avalon or a Clan homeworld capital), then its Technological Sophistication code may be marked “Advanced” rather than A. However, it is extremely unlikely to find such advanced technology elsewhere. Players should note that few human planets have more than Technological Sophistication B, so even if the modifiers suggest an isolated Deep Periphery planet has Tech Level A, it should probably be limited to B or C.


It is also possible for a planet to regress below Technological Sophistication F (a score of F corresponds to the early twentieth century). If the modifiers would lower the Technological Sophistication Level below F, do not use a letter. Instead, note “Regressed” for the Technological Sophistication portion of the USILR code. The specific level of technology on a Regressed planet is open to player interpretation, but it is likely that the planet is at a pre-steam or even a Stone Age level of technology.

The USILR Technological Sophistication code is easy to convert to the *Total Warfare* Tech Rating. A USILR score of A corresponds to Tech Rating E, USILR B to Tech Rating D, USILR C to Tech Rating C, USILR D to Tech Rating B, and USILR F to Tech Rating A. A Regressed world remains regressed by any scale, while Advanced corresponds to Tech Rating F.

*Special Note:* Players may bypass the Technological Sophistication calculation for previously published *BattleTech* planets. Instead, if the planet produces a known unit (battle armor, BattleMech, fighter, etc.) with a known availability code, the Tech Rating in the availability code may be assumed to represent the planet's Tech Rating. According to the conversion given above, the Technological Sophistication derives from the Tech Rating. For example, in 3025 the Taurian planet New Vandenberg built Tech Rating D BattleMechs almost entirely from on-planet factories. Tech Rating D is equivalent to a Technological Sophistication of B, and thus New Vandenberg may be given a USILR Technological Sophistication score of B regardless of its other attributes. Likewise, GM of modern Kathil produces Tech Rating E BattleMechs and other war machines

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of many models, allowing Kathil's Technological Sophistication to be designated as A without using the USILR Table. On the other hand, some planets may require a more nuanced assessment: an Outworlds Alliance planet that recently received a Clan Snow Raven OmniMech factory does not automatically rate an A (Advanced) score, but instead should reflect the technological sophistication possessed by most of the population.

**Industrial Development:** This represents less a gauge of how much the world produces and more the sophistication and depth of its industry. During the Star League, some Periphery colonies were so extremely specialized (such as in shoes) that they would score very low in this USILR code, but would have very high Industrial Output (producing shoes for many planets but little else, they starved and collapsed when the Star League fell). The age of such interstellar specialization has disappeared along with most of humanity's JumpShips, but planets may still have very backward levels of Industrial Development. As a result, scores of D to B are typical on developed worlds.

This score is only weakly linked to the military industry, which for the most part is an extremely specialized industry in *BattleTech*—production of medium lasers and BattleMech chassis are not indicative of a planet's ability to build home computers, bicycles, bedpans, and modern medical scanners. Rather, Industrial Development marks how likely a planet is to support the full range of technologies for a specific Technological Sophistication score. A planet of Technological Sophistication A and Industrial Development D probably only builds a few advanced technologies and may be deficient in whole sectors of industry, like transportation or medicine. This may result in typical Succession Wars technological incongruities, like a planet able to put advanced telecommunications in every home while the majority of residents make do with animal-drawn conveyances and hand-operated home water pumps.

Despite the weak link, some connection does exist between a planet's Industrial Development rating and military production. A higher Industrial Development rating indicates an ability to produce increasingly complicated war machines, which draw on increasing numbers of industries. While a score of F or D might be sufficient for simple items like infantry weapons and simple armored vehicles, scores of C, B, and A indicate the ability to support more complicated units, like battle armor, BattleMechs, aerospace fighters, and large spacecraft (in approximately that order, as allowed by the Technological Sophistication of the planet). A high Industrial Development score does not guarantee military production is present, it only indicates what the planet might accomplish if it possessed military factories.

Like Technological Sophistication, the degree of Industrial Development is highly sensitive to population. More consumers, engineers, and taxpayers support a deeper, broader industrial base than a smaller population. Advanced technology also helps, of course.

Industrial Development is calculated in the same manner as Technological Sophistication. The score starts at D and moves toward A as each -1 modifier is applied, and decreases toward F for each +1 modifier applied. Add together all modifiers before applying them. Unlike Technological Sophistication, there is no way to progress above A or below F.

*Special Note:* When writing up a *BattleTech* planet with known military factories, players can use established factories to roughly judge the Industrial Development of a planet without consulting the USILR table. A planet that builds aerospace fighters probably has an Industrial Development of at least B, while a planet building many different unit types (battle armor, BattleMechs, and combat vehicles) probably has a score of A, and a planet that can barely equip an infantry unit might have an Industrial Development score of D or F (or is an advanced, pacifist world).

**Raw Material Dependence:** This rating indicates how dependent the world is on off-world materials, which may come from other planets and asteroids in the system or from other star systems. However, the vast majority of planets have a large amount of easily-accessed materials when first settled (comparable to Earth before 2,000 BC), the placer deposits and rich ores never pillaged by a rapacious sapient species like humans. The degree of raw material dependence also mostly refers to rare and heavy elements; some elements (hydrogen, carbon, oxygen, silicon, iron, aluminum, etc.) are simply too widespread in the universe to ever really be deficient on a planet. As a result, most planets have by default a fairly low level of resource dependence (typically C to A).

In *BattleTech*, humankind has grown jaded by this abundance of materials on habitable planets. While humanity explored the boundless mineral wealth of Terra's asteroid belt in the 21st century (which is still hardly tapped by the 31st century), it soon found habitable worlds almost always preferable (meaning less expensive) sources of raw materials than asteroids, deep mines, or other costly extraction techniques. Hence, a score of A or B represents a wealth of easily extracted resources on the planet, akin to those rarely seen on Terra after the mid-twentieth century, not the overall abundance of materials in the star system. This focus on habitable planets reached the point that it was economically worthwhile for Terra to import common ores from planets in the Outworlds Alliance during the Star League, and the Lyrans entered the Federated-Commonwealth treaty in 3020 at least partly for the untapped planetary resources of the Federated Suns despite having vast resources of their own in asteroid belts and uninhabitable systems within the Commonwealth.

In the modern era, civilizations must be largely independent of off-world resources. JumpShips and DropShips are few and far between, and they haul only small quantities of materials (mere kilotons) compared to the needs of a well-developed planet. Terra, for example, was consuming over a *billion* tons each of iron, coal, and oil *per year* in the late 20th century. This means that, one way or another, most planets in *BattleTech* must be self-sufficient for common materials, reinforcing the relatively high (independent) starting Resource Dependence score. The planets that truly needed off-world resources died in the Succession Wars.

In turn, a planet that ends with a low score (D or F) probably depends on imports of rarer, small-quantity materials—rhenium, gallium, tungsten, platinum-group metals, germanium, and so on—that can reasonably be delivered by JumpShips and DropShips. If such a resource-starved planet is also deficient in common substances (iron, petroleum, aluminum), it is unlikely to actually import its needs. Rather, the low score means that the planet is resorting to difficult and expensive mining techniques: mines more than several hundred meters deep,





ocean floor mining, asteroid mining, chemical synthesis of fuels, and so on, making resources more expensive than on neighboring planets that have not tapped out their easily accessed reserves.

Such resource-starved planets may occasionally import common materials (iron ore and petroleum being published examples), but this is mostly a case of individual merchants exploiting local JumpShip availability and ore prices to get a few kilotons at cut rates while their competitors get their megatons at the usual prices. All the JumpShips in the Inner Sphere could not actually transport enough iron or aluminum to meet the demands of more than a few average Inner Sphere planets.

Obviously, worlds that have been settled longer and have higher populations will have a higher Raw Material Dependence. Less dense worlds usually have lower percentages of rare, heavy elements, while denser worlds have greater mineral wealth in their crusts. Further, advanced technology allows improved resource extraction and recycling, while lower levels of technology hinder access to resources.

Raw Material Dependence is calculated in the same manner as Technological Sophistication. The score starts at B and moves toward A as each -1 modifier is applied, and decreases toward F for each +1 modifier applied. Add together all modifiers before applying them. Unlike Technological Sophistication, there is no way to progress above A or below F.

**Industrial Output:** Simply put, this is how much a world can produce from its non-agricultural, non-service industries. Industrial Output is not particularly representative of military production (unless the population is very small, like Hesperus II), but rather how well the world's industry can sustain its population, because military production on an average Inner Sphere planet is much, much smaller than civilian industry. Industrial Output is also not representative of Technological Sophistication; primitive nations (like "developed" Terran nations of the late 20th century) can produce staggering quantities of goods.

This score is proportional to population: a planet of 100 million people with an Industrial Output of A does not produce as many goods as a planet of 5 billion people with an Industrial Output of A (or B, or C, or D, for that matter). Finally, even worlds that are allegedly covered in factories and heavily industrialized (terms involving a great deal of artistic license) are unlikely to involve more than 10 percent of their populations in industry unless their Technological Sophistication is F or Regressed. Those who build goods for others are rarely a large percentage of the population of even moderately advanced worlds; most of the rest of the population is in the service industry.

In the modern era, many planets start off fairly independent of outside industrial support unless relatively primitive or low in population. The era of worlds supported by their neighbors mostly ended at the dawn of the Succession Wars; today, there are too few JumpShips to export all but the most critical of goods between star systems. Even a planet with an Industrial Output of A in the center of a Successor State will likely only devote a tiny percentage of its industrial output to interstellar

trade due to the lack of transport (though it might be a critical percentage for the economy if, for example, a dozen nearby worlds are depending on ultra-advanced microchips only available from that single planet). As a result, scores of C to B are typical in the Inner Sphere, and D to C are the norm elsewhere.

Industrial Output is calculated in the same manner as Technological Sophistication. The score starts at B and moves toward A as each -1 modifier is applied, and decreases toward F for each +1 modifier applied. Add together all modifiers before applying them. Unlike Technological Sophistication, there is no way to progress above A or below F.

**Agricultural Dependence:** This rating is a measure of how much food the world needs to import to support its population. In the modern era, the dearth of JumpShips has made virtually all planets self-sustaining. (The Inner Sphere planets that could not feed themselves died in the early Succession Wars.) Hence, scores of C to B are the norm.

Generally, only the smallest worlds (with thousands of inhabitants) can effectively be sustained by interstellar (or even interplanetary) imports, though a few populous worlds of the Inner Sphere that are extremely wealthy and powerful (like Galax and Irian) are able to survive on interstellar (or at least interplanetary) imports. This is because feeding hundreds of millions of people (the Inner Sphere average planetary population) calls for millions of tons of daily food imports, which the JumpShips and DropShips of *BattleTech* cannot easily deliver. If more than a few average Inner Sphere planets had Agricultural Dependence scores of D or F, most of the JumpShips and DropShips in the Inner Sphere would be monopolized to keep them fed. The other side of this transportation bottleneck is that even abundant worlds (with scores of A or B) can only export a fraction of their food production (most often luxury foods, seeds, and other compact, light agricultural products).

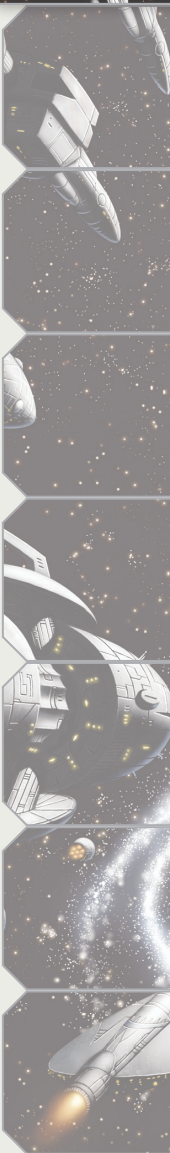
Finally, even "breadbasket" worlds with huge surpluses of food are unlikely to involve more than 1 percent of the population in agriculture (and perhaps quite a bit less) unless their Technological Sophistication is F or Regressed. Likewise, agricultural regions rarely cover more than a small percentage of land area on a planet, despite dramatic fictional descriptions to the contrary. As with Industrial Output, the Agricultural Dependence rating of a planet is related to its population. A planet with a population of 100 million and an Agricultural Dependence of A produces far less food than a planet with a population of 5 billion and an Agricultural Dependence of C.

Technological Sophistication has an enormous impact on Agricultural Dependence, with dependence dropping rapidly as Technological Sophistication improves. A world's population has an opposite impact, as does a water-poor environment.

Agricultural Dependence is calculated in the same manner as Technological Sophistication. The score starts at B and moves toward A as each -1 modifier is applied, and decreases toward F for each +1 modifier applied. Add together all modifiers before applying them. Unlike Technological Sophistication, there is no way to progress above A or below F.



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## USILR TABLE

### TECHNOLOGICAL SOPHISTICATION

Base Technological Sophistication: C
Technological Sophistication Modifiers:
–1 (i.e., C to B) for Star League or Earlier Settlement
–1 for a population over 1 billion
–1 for Clan settlement
+1 if the planet is not part of an Inner Sphere House, Clan, or major Periphery nation
+1 (i.e., C to D) for a population under 100 million
+1 for a population under 1 million
Technological Sophistication Ratings:
Advanced: Ultra-Tech world. Hosts the most advanced research centers and universities in human space, equivalent to New Avalon or Strana Mechty.
A: High-tech world. Advanced research centers and universities; best medical care; cutting-edge microelectronics industry
B: Advanced world. Access to many new technologies; hosts universities; good medical care available (though lacking in most cutting-edge medical tech); basic microelectronics industry.
C: Moderately advanced world. Average local education and medical care; minimal microelectronics industry.
D: Lower-tech world. Poor educational system; medical care equivalent to 21st- to 22nd-century levels; nonexistent microelectronics industry (excepting possible isolated regions run by private concerns).
F: Primitive world. Inhabitants live without dependence on technology; no advanced education; medical care equivalent to twentieth-century level (at best).
Regressed: Pre-twentieth century technology, maybe Stone Age.

### INDUSTRIAL OUTPUT

Base Industrial Output: C
Industrial Output Modifiers:
–1: Population over 1 billion
–1: Technological Sophistication Advanced or A
–1: Industrial Development A or B
+1: Technological Sophistication D or F
+1: Technological Sophistication Regressed
+1: Industrial Development D or F
Industrial Output Ratings:
A: High output. World has wide industrial and commercial base capable of exporting most of its excess output, if sufficient space transport is available.
B: Good output. World's industrial and commercial base sufficient for modest product export.
C: Limited output. World has a small industrial base which limits exports; imported goods common.
D: Negligible output. World's industrial base insufficient for major exports; reliant on imported goods.
F: No output. World must import most—if not all—of its heavy industrial and high-tech needs.

### INDUSTRIAL DEVELOPMENT

Base Industrial Development: D
Industrial Development Modifiers:
–1 for a population over 1 billion
–1 for a population over 4 billion
–1 for a Technological Sophistication of Advanced, A or B
+1 for a population under 100 million
+1 for a population under 1 million
+1 for a Technological Sophistication of F or Regressed
Technological Sophistication Ratings:
A: Heavily industrialized. Capable of manufacturing any and all complex products.
B: Moderately industrialized. May produce a limited quantity and range of complex products.
C: Basic heavy industry. Equivalent to roughly 22nd-century tech; fusion technology possible, but no complex products (including BattleMechs).
D: Low industrialization. Roughly equivalent to mid-twentieth century level; fusion technology must be imported.
F: No industrialization.

### AGRICULTURAL DEPENDENCE

Base Agricultural Dependence: C
Agricultural Dependence Modifiers:
–1 for a Technological Sophistication of Advanced, A, or B
–1 for a Technological Sophistication of C
–1 for an Industrial Development of A, B, or C
+1 for a Technological Sophistication of F or Regressed
+1 for a population over 1 billion
+1 for a population over 5 billion
+1 for a Surface Water Percentage under 50%
+1 for Tainted atmosphere or high pollution
+2 for Toxic atmosphere
Agricultural Dependence Ratings:
A: Breadbasket. Planetary agro industries meet all local needs and sustain a thriving export trade, as allowed by available space transport.
B: Abundant world. Rich agricultural environment sustains local needs and permits limited exports.
C: Modest agriculture. Most food locally produced, though some agricultural needs rely on imports.
D: Poor agriculture. Minimal agricultural output forces heavy reliance on off-world imports to sustain the local population.
F: Barren world. World's agricultural output cannot sustain the local population without continuous off-world imports.

### RAW MATERIAL DEPENDENCE

Base Raw Material Dependence: B
Raw Material Dependence Modifiers:
–1: Technological Sophistication Advanced
–1: Technological Sophistication A, B, or C
–1: World's density over 5.5 g/cm <sup>3</sup>
+1: Population over 3 billion
+1: Industrial Output Rating A or B
+1: Settled over 250 years ago
+1: World's density under 4 g/cm <sup>3</sup>
Raw Material Dependence Modifiers:
A: Fully self-sufficient. System produces all needed raw materials and may export in large quantities.
B: Mostly self-sufficient. System produces all needed raw materials and may export a small surplus.
C: Self-sustaining. System produces some of its needed raw materials and imports the rest.
D: Dependent. System is poor in raw materials and must import most of its material needs.
F: Heavy dependent. System utterly reliant on imported materials to maintain industry and population.





Chuck had some ideas for the various warring factions on Amtor-2, but he hadn't put a lot of thought into the planet's overall state of development. The USILR Table is as good a start as any for filling out the USILR code of Amtor-2.

For Technological Sophistication, Chuck notes the base code of C. Amtor-2's first modifier is a -1 for having been settled during or before the Star League, which would make the score B. However, Amtor-2 is not part of a House, major Periphery nation, or Clan (+1 modifier), so the final modifier is 0: Amtor-2's Technological Sophistication is thus C. That gives Chuck a lot of the advanced technology he wanted, like large fusion power systems, spacecraft and computers, but he's not sure he likes the absence of a domestic BattleMech industry. Then again, it is a Periphery world that seceded from the weakest of the major Periphery states—Chuck thinks he might be able to live with a Technological Sophistication of C. The need to import 'Mechs gives him an excuse to have interstellar traders visit distant Amtor-2.

Industrial Development of Amtor-2 starts at a base of D, rather sparse and backward, and no modifiers apply. Amtor-2 does not have high enough technology or population to really support a complicated industrial base. Chuck's not entirely happy with that, but the planet is supposed to host a lot of illiterate peasants toiling under intellectual and political elites, which doesn't encourage a complicated industry. (And it is in the Periphery.) He might revisit this code later.

Raw Material Dependence starts at B. Chuck notes the Technological Sophistication of Amtor-2 is sufficient to improve resource extraction, but Amtor-2 has definitely been settled over 250 years (since it predates the Star League). The net result is B: a fairly independent planet that has enough spare raw materials to trade a bit with visiting merchants, probably funding those BattleMech imports.

Chuck next looks over Industrial Output. It starts at a modest level, C, enough to sustain Amtor-2's basic needs, but Amtor-2 does not have enough population or technology to improve it (though the planet has enough technology and population to prevent it from sliding). Thus, Industrial Output remains at C.

Finally, Chuck calculates Agricultural Dependence. Like most post-Succession War worlds, Amtor-2 starts quite independent at C. Agricultural output responds sharply to technology, so Amtor-2's Technological Sophistication raises the Agricultural Dependence to B, which is plenty for Chuck's plans. He figures the water-sparse Amtor-2 will have a number of heavily defended breadbasket, water-rich regions around which each faction clusters.

The USILR code of Amtor-2 is thus C/D/B/C/B.

Chuck is rethinking the population of Amtor-2. A population of over 1 billion would definitely improve a number of the USILR codes, even though the population would be hard to justify so far from Terra. Looking at some of the planned factions (plagiarized from the Venus series), Chuck can imagine they were founded by a large, dedicated colonial program, probably fleeing the Inner

Sphere for their detestable eugenicist theories. A few million people in the mid-2600s could grow to over 1 billion by 3050, and Amtor-2 is a quite habitable planet that could support such growth.

If Chuck raised the population to a bit over 1 billion, there USILR codes would change in several ways. Technological Sophistication would improve to B; Industrial Development would improve to C for the population and then B because of the improved technology; Raw Material Dependence would be unchanged; Industrial Output would climb to B; and Agricultural Dependence would lower to C for the population, then improve to B for the improved technology, and then improve to A for the improved industrial development. The more populous Amtor-2 would thus have a code of B/B/B/B/A. Chuck will have to sleep on it before deciding if he wants an over-the-top Deep Periphery world like that.

### Exceptions

As always, the above are guidelines, not cast-in-stone rules. The Clans have produced a knot of 30-odd worlds about 1,500LY from Terra with an average planetary population of over 30 million, at high levels of Technological Sophistication and Industrial Development. On the other hand, quite a few notable worlds closer to the Inner Sphere (or in it) have very small populations and low technology, though the Inner Sphere average is about 3 billion per planet. The Hanseatic League also bucks the trend for a Deep Periphery, post-Star League settlement (though it might be a case of Lyran Hansa founders forming a nation out of existing, pre-Star League colonies).

On the other hand, the noteworthy Deep Periphery nations have already been noted in previous *BattleTech* publications, so finding an unknown colony or multi-system nation capable of constructing JumpShips and BattleMechs is a stretch at best.

### STEP 3: GOVERNMENTS

This section only applies to planetary governments, which may vary from the style of the interstellar government.

When selecting a planetary government, examples and suggestions are provided on page 362 of *A Time of War*. Independent Periphery and Deep Periphery planets are likely to have representative democracies or oligarchies more often than feudal systems; feudal governments are an Inner Sphere development meant to hold together far-flung interstellar nations despite the stresses of slow communications and long travel times. In addition to *A Time of War*, players may consult the House Handbooks and *Major Periphery States Handbook* (all of which have chapters on government) for suggestions on planetary government types appropriate to an existing faction.

Planets with clear governments based on published data do not roll on the Base Government Table. The Clan homeworlds, for example, automatically fall under Clan-style government (a caste-driven, warrior-dominant hierarchy). Planets in the Capellan Confederation and Draconis Combine are automatically oligarchies or autocracies. Planets in most other existing multi-world factions tend to allow some diversity in their planetary governments.

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Players determine a planet's government by rolling 2D6 on the Base Government Table. The roll may be modified using the modifiers listed in the Base Government Table, depending on the faction to which the planet belongs, though that may require a judgment call based on limited data. For example, determining whether ancient factions like the Chesterton Trade League were liberal or authoritarian is difficult, and in such situations the player should use a modifier of 0.

The Base Government Table provides a handful of broad government classes (base governments, sometimes with preliminary qualifiers) listed roughly in order of the level of control and freedom. After generating a result from the roll on the Base Government Table, players may apply additional qualifiers. This is done by looking at the base government's row on the Detailed Government Table and selecting modifiers (if any) that suit the player's concept of the colony's government.

Definitions of the base government types and government qualifiers follow the Base and Detailed Government Tables.

### Government Definitions

The following definitions are supplied in an absolute form. That is, they are stripped of political stylings of their members. They describe a planet's government as it actually exists, not as the government describes itself. (Many dictatorial governments have described themselves as liberal democracies – these rules would call such governments dictatorships. Similarly, the name of a major faction, like the Outworlds Alliance or Lyran Commonwealth, says little about the actual form of government.)

## BASE GOVERNMENT TABLE

2D6 Roll	Inner Sphere	Periphery
2 or less	Democracy (Athenian or Representative)	Anarchy
3 – 6	Democracy (Representative)	Democracy (Athenian or Representative)
7 – 8	Democracy (Limited)	Democracy (Representative)
9 – 10	Autocracy/Oligarchy	Democracy (Limited)
11+	Dictatorship	Autocracy/Oligarchy
Modifiers	+/-	Modifier Example
Very Liberal Faction	-3	Outworlds Alliance, Free Rasalhague Republic
Liberal Faction	-2	Free Worlds League, Magistracy of Canopus
Typical Faction	0	Lyran Commonwealth, Federated Suns, Taurian Concordat
Authoritarian Faction	+2	Capellan Confederation, Draconis Combine
Very Authoritarian Faction	+3	Clans

**Base Governments:** The definitions below form the basis for most governments in human space. These base types may be complemented by the modifiers listed in the Government Table.

**Anarchy:** Not so much a government as a lack of one, these "governments" rarely are larger than provinces, though the post-Civil War Terran Hegemony was an interstellar anarchy until conquered by the Houses. Anarchies rarely last long, generally only surviving while potential leaders or power groups have no advantage over each other.

At the player's discretion, anarchies may also represent a situation where the planet has multiple governments (each rolled up and detailed separately per the steps above), but no overarching planetary government. If the player does not have a preference, roll 1D6. If a 1 or 2 results, then roll 1D6 again to determine the number of governments. If this result is 3-5, then roll 2D6 x 10 to determine the number of governments; if the result is a 6, roll 3D6 x 100 to determine the number of governments.

**Autocracy/Oligarchy:** These are highly authoritarian governments with little input from the common citizen/subject. Autocracies are ruled by one person (an absolute monarchy, a hereditary dictatorship), while oligarchies are ruled by small groups (a military junta, a religious council, a corporate board, feudal lords).

**Clan:** Clan governments are an unusual form of oligarchy. Overall Clan government consists of five castes (warriors, scientists, merchants, technicians, laborers), each with their own ruling councils and ranks. The civilian castes handle most minutia of running Clan society, with the warrior caste rubber-stamping most civilian decisions except the overall direction of the Clan. Clan government also comes with a peculiar Communist-style economic system where the state controls all means of production, and economic activities outside the bare necessities are suppressed. Most invading Clans learned to rule their conquests with a light hand, leaving planetary governments and economies untouched due to significant disparity in populations, thus forming *de facto* confederacies with a Clan central government and differing planetary governments.

## DETAILED GOVERNMENT TABLE

Base Government	Acceptable Qualifiers
Anarchy	Constitutional, Socialist, Communist
Democracy	Athenian/Cyberdemocracy, Communist, Confederacy/Alliance, Constitutional, Corporate, Delegated Democracy, Demarchic, Federal, Feudal, Limited Democracy/Hybrid Regime, Monarchy, Parliamentary, Republic/Representative Democracy, Socialist, Theocracy, Unitary
Autocracy/Oligarchy	Communist, Constitutional, Corporate, Federal, Feudal, Monarchy, Parliamentary, Socialist, Theocracy, Theocracy, Unitary
Dictatorship	Communist, Constitutional, Corporate, Feudal, Monarchy, Socialist, Theocracy, Unitary
Clan	Confederacy, Federation





**Democracy:** These governments grant electoral or even legislative authority in varying levels to the citizenry. The variations are vast: federal republics, confederations, constitutional monarchies, and many more.

**Dictatorship:** These highly authoritarian governments are ruled by a single individual. Long-lived dictatorships tend to evolve into autocracies or oligarchies.

**Government Modifiers:** The following terms further refine the type of government.

**Athenian/Cyberdemocracy:** An Athenian democracy directly engages every member of the electorate in legislative and sometimes executive decisions. The electorate may be extremely small (for example, “all free male wealthy landowners”), but each member of it participates in legislative decisions. A cyberdemocracy is a minor variation on an Athenian democracy where polling is handled electronically. This modifier only applies to Democratic and Oligarchic governments.

**Communist:** An ideal Communist society would be classless, moneyless, and stateless. In practice (and for these rules), Communism refers to governments where almost all businesses are owned by the state. It is not a comment on how authoritarian the government is; after the twentieth century, humanity did manage to create a few liberal Communist governments on its many far-flung worlds.

**Confederacy/Alliance:** Confederacies and commonwealths are unions of smaller provincial governments that grant substantial powers to those member-governments. Alliances are even looser associations of governments. This contrasts with federations, which tend to grant greater authority to the central government. Confederacies and alliances may be applied to almost any type of government.

**Constitutional:** A constitutional government imposes a fundamental set of laws around which the government is organized. This is a staple of most governments and thus does not need to be stated, but some governments—like autocracies, dictatorships, and monarchies—are not necessarily run to constitutional standards, and thus it is worth noting when such governments adhere to a constitution.

**Corporate:** This type of government is overtly run by corporations, with the government contracting out most services to corporate entities. This definition specifically applies to governments where corporations supply most services, not to other types of governments that are simply heavily influenced or informally ruled by corporate/business interests (which are better classified as oligarchies or autocracies). Corporate qualifiers apply to almost any type of government, though most commonly democracies.

**Delegated Democracy:** A hybrid of Athenian and representative democracies, this sort of government uses representatives for the electorates (like a representative democracy) but ties the representatives’ votes rigidly to the preferences of the electorate. Like Athenian democracies, it has rarely succeeded well on a large scale.

**Demarchic:** Based on the premise that the best rulers do not aspire to the throne, demarchic governments randomly select citizens to serve as leaders, or (in more extreme forms) treat time in government service as a tax. (The time in gov-

ernment for such “tax”-type demarchies is typically scaled in response to something the founders think should be cause for giving back to society, such as large amounts of wealth or amount of government services used.)

**Federal:** Federal governments are unions of smaller governments (provinces, states, planets, etc.) where a separation of powers exists between the central government and sub-governments, but the central government has sovereignty. This differs from confederacy/alliances where the sub-governments retain greater powers.

**Feudal:** Feudal governments in *BattleTech* are unions of smaller states linked by personal, often hereditary ties between leaders of member-states (rather than constitutional hierarchies). Such governments are suited for decentralized interstellar states where round-trip communications and passenger (that is, military) transits may be weeks or months, but are less common on planetary scales. The Lyran Alliance/Commonwealth, Free Worlds League, and Federated Suns often have representative democracies on the planetary level that use feudal ties to the central government.

**Limited Democracy/Hybrid Regime:** These governments include partial democracies, pseudo-democracies, hybrid regimes, and related governments that are nominally democratic but legally or unofficially limit actual public input into governance. Civil rights are restricted and elections may be frequently rigged. In some cases, this stems from corruption. In others, it derives from a very limited electorate (for example, only nobles or major landowners or corporate shareholders may participate). Despite their limitations, these governments have broader participation and more civil rights than autocracies and oligarchies.

**Monarchy:** These governments consolidate their sovereignty into one person. The difference between an autocracy (absolute monarchy) and representative democracy (constitutional monarchy, parliamentary democracy) depends on the level of authority granted to the monarch. Long-lived monarchies tend to be less authoritative (if not necessarily less powerful) than younger monarchies because, as an ancient monarch once said, “The buck stops here.” In other words, the more a monarch is associated with unpopular legislation and executive decisions, the shorter their term in office (and the greater the frequency of regicide).

**Parliamentary:** Parliamentary governments include some executive powers (head of government) in their legislative bodies, compared to governments that assign both head of state (monarch, premier, president) and head of government (president) duties to personnel outside the legislative body. Most commonly, parliamentary systems are used in monarchies and representative democracies.

**Republic/Representative Democracy:** These governments delegate the will of the electorate to representatives. When the electorate is sufficiently small, such governments are better described as oligarchies.

**Socialist:** Socialist economic systems assign significant (but not total) ownership of the means of production to the state; socialist systems blur into Communist ones. Socialist economic systems are applied to almost any form of government, from authoritarian to Athenian democracies.

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**Theocracy:** While many governments incorporate some level of religious or philosophical authority, a theocracy is specifically governed (to a large extent) by a church, or possibly multiple religions. Theocracies lean toward autocracies or oligarchies, but more liberal and democratic theocracies are possible.

**Unitary:** Unitary governments are those of multiple provinces (or planets) where governmental sovereignty is fully vested in the central government, forming the far end of the spectrum of federal, feudal, confederacy, and alliance governments. Provinces simply serve as convenient regional administrative districts for the central government. The unitary nature of governments is by default; most often it is a non-unitary element (federal, feudal, confederacy, etc.) that is stated.

*Chuck already knows what sort of a government he wants on Amtor-2. His world is based on the Carson Napier of Venus series by Edgar Rice Burroughs. The known governments include the Havatoo (a technocratic oligarchy), Kormor (zombies), Thorists (Communists), and Zani (fascists). Some groups on Burroughs' Amtor do not translate into fixed nations (the displaced Vepajans, the Cloud People, and pirates), so Chuck makes them footnotes as potential tormentors for his players. So how does this translate into the rules?*

*With no central government, Chuck notes Amtor-2 as an anarchy (4 regional governments) on the planet construction sheet.*

*The Havatoo are a technocracy led by a council of 5 eugenicist super-scientists. The technocracy aspect has no bearing (there are many forms of oligarchies: by engineers in the case of a technocracy, by Communist party leaders, by colonial first families, by a feudal court, etc.). The key feature of such a government, Chuck sees, is that the Havatoo are ruled by a small clique: this means the base government is an oligarchy. No qualifiers seem to apply, so Chuck notes Havatoo as simply an oligarchy.*

*Chuck has no idea how to approach a zombie nation, since zombies are (lamentably) not a part of the BattleTech universe. He decides to replace them with the Vepajans. The Vepajans are ruled by a monarch held in near-divine reverence. The base government is thus an autocracy (a long-lived government dominated by one person), with the Monarchy qualifier. Chuck notes the Vepajans as a monarchy (autocracy).*

*The Thorists were modeled on Communists as seen by an American writer in the 1930s. Chuck glances over some reference material on the Soviet Union for the time and decides that a base government of oligarchy (a small group of party leaders autocratically ruling the population) is appropriate, as is the Communist qualifier, so he notes the Thorists as a Communist oligarchy.*

*The Zani were modeled on mid-twentieth century fascist governments near the outbreak of World War Two. The Zanis were ruled by a single dictator and were violently racist. The base government is simple: dictatorship. Chuck sees no qualifiers appropriate to the Zani, so he notes the government as a dictatorship.*

#### STEP 4: OTHER FEATURES

Finally, players may want to add other features to their colony worlds such as hyperpulse generators (HPGs) and recharge stations.

**Hyperpulse Generators:** Introduced in 2630, the HPG substantially cut communication times previously bottlenecked through JumpShips. The two types of HPGs available for star systems are A-rated and B-rated. A-rated HPGs have a 50-light-year range. Serving as communication hubs for B-rated HPGs, an A-rated HPG transmits to each B-rated HPG in range sequentially every 12 to 24 hours (sooner for priority messages).

ComStar also sometimes offers C- and D-rated services for Periphery planets near the Inner Sphere (within 550 light-years of Terra), which are not HPGs but rather courier JumpShips that provided scheduled message deliveries (visits every 3 months in the case of C-rated service, or annually for D-rated service), plus offering subsidized collars to traders' DropShips.

Determining whether an inhabited planet has an HPG is simple for a majority of settled planets. If the colony is Clan, it has an A-rated HPG. No roll on the HPG Table below is required.

In the Inner Sphere, a majority of planets have a B-rated HPG while the remainder (varying by era) have A-rated HPGs (about 200 in the Star League, about 50 for most of the Succession Wars, and about 100 in the late 31st century).

Planets in Major Periphery nations usually have B-rated HPGs, with A-rated HPGs reserved for capitals; a handful resorted to C- and D-rated non-HPG service. Some independent Periphery worlds within about 550 light-years of Terra have B-rated HPGs or non-HPG communication services, while most Periphery worlds have no regular service except for what is passed along by the occasional visiting trader JumpShip.

In cases where a planet is already published as having an HPG, this step is not necessary. Give the planet its published HPG.

To determine whether a colony has an HPG, first review the above discussion and determine if the planet automatically has a specific type of HPG. Otherwise, roll 2D6, apply the modifiers on the HPG Table, and compare the modified roll to the appropriate column of the HPG Table.

#### HPG TABLE

2D6 Roll	Inner Sphere	Major Periphery State	Other Periphery
1 or less	C-rated Service	D-rated Service	None
2	B-rated HPG	C-rated Service	None
3-10	B-rated HPG	B-rated HPG	None
11	A-rated HPG	B-rated HPG	C-rated Service
12	A-rated HPG	A-rated HPG	B-rated HPG
Modifiers			
-1 per 100LY from Terra			
-1 if population under 1 billion			
-1 if Technological Sophistication of D or less			
-1 if Industrial Development of D or less			
+2 if the year is before 2800			
+1 if population over 2 billion			
+3 if national capital			





**Recharge Stations:** These space stations are deployed at the zenith and nadir jump points of star systems to accelerate and standardize recharge times (see p. 87, *Strategic Operations*). They can reduce the minimum safe recharge time of a JumpShip from 175 hours to 100 hours, and are even more useful at dim K- and M-class stars.

Recharge stations proliferated from the 2200s throughout the old Star League era, but the Succession Wars found them easy targets. Less than 1 in 4 Inner Sphere systems after 2820 have recharge stations, and even fewer have stations at both their zenith and nadir points. Recharge stations are even rarer in the Periphery during the Succession Wars, and scarce in the Deep Periphery (outside of Clan systems), but are not dependent on ComStar and the Word of Blake like HPGs.

## RECHARGE STATION TABLE

2D6 Roll	Inner Sphere	Major Periphery State	Other Periphery	Clan
2 or less	None	None	None	None
3–9	None	None	None	1 station
10–11	1 station	1 station	None	2 stations
12	2 stations	1 station	1 station	2 stations

### Modifiers

- 1 if population under 1 billion
- 1 if Technology Sophistication of D or less
- 1 if Industrial Development of D or less
- +2 if the year is before 2800
- +1 if population over 2 billion
- +1 if national capital

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## BASIC STAR SYSTEM CONSTRUCTION SHEET

### STAR SYSTEM DATA

System Name: \_\_\_\_\_

Star Name: \_\_\_\_\_

Star Type: \_\_\_\_\_

Recharge Time: \_\_\_\_\_

Proximity Limit: \_\_\_\_\_

Number of Planets: \_\_\_\_\_

Orbit 1: \_\_\_\_\_ Orbit 8: \_\_\_\_\_

Orbit 2: \_\_\_\_\_ Orbit 9: \_\_\_\_\_

Orbit 3: \_\_\_\_\_ Orbit 10: \_\_\_\_\_

Orbit 4: \_\_\_\_\_ Orbit 11: \_\_\_\_\_

Orbit 5: \_\_\_\_\_ Orbit 12: \_\_\_\_\_

Orbit 6: \_\_\_\_\_ Orbit 13: \_\_\_\_\_

Orbit 7: \_\_\_\_\_ Orbit 14: \_\_\_\_\_

Orbit 15: \_\_\_\_\_

### PLANETARY DATA

Planet Name: \_\_\_\_\_

Position in System: \_\_\_\_\_

Moons (Number, Names, Orbit): \_\_\_\_\_

Diameter: \_\_\_\_\_

Surface Gravity: \_\_\_\_\_

Day Length: \_\_\_\_\_

Habitable: ☐ Yes ☐ No

Atmospheric Density: \_\_\_\_\_

Surface Temperature: \_\_\_\_\_

Percent Surface Water: \_\_\_\_\_

Highest Life Form: \_\_\_\_\_

### Inhabited Planet Details

Noble Ruler: \_\_\_\_\_

Political Ruler: \_\_\_\_\_

HPG Class: \_\_\_\_\_

Recharge Stations: \_\_\_\_\_

Population: \_\_\_\_\_

USILR Code: \_\_\_\_\_

Notable Military Units: \_\_\_\_\_

Major Industries: \_\_\_\_\_

Notes: \_\_\_\_\_

### PLANETARY MAP

