

## CHAPTER 1

### INTRODUCTION

#### 1.1 Long March Family and Its History

The development of Long March (LM) launch vehicles began in mid-1960s and a family suitable for various missions has been formed now. The launch vehicles (LV) adopt as much same technologies and stages as possible to raise the reliability. Six members of Long March Family, developed by China Academy of Launch Vehicle Technology (CALT), have been put into the international commercial launch services, i.e. LM-2C, LM-2E, LM-3, LM-3A, LM-3B and LM-3C, see **Figure 1-1**. The major characteristics of these launch vehicles are listed in **Table 1-1**.

**Table 1-1 Major Characteristics of Long March**

	LM-2C	LM-2E	LM-3	LM-3A	LM-3B	LM-3C
Height (m)	40.4	49.7	44.6	52.5	54.8	54.8
Lift-off Mass (t)	213	460	204	241	425.8	345
Lift-off Thrust (kN)	2962	5923	2962	2962	5923	4443
Fairing Diameter (m)	2.60/ 3.35	4.20	2.60/ 3.00	3.35	4.00/ 4.20	4.00/ 4.20
Main Mission	LEO	LEO/ GTO	GTO	GTO	GTO	GTO
Launch Capacity (kg)	2800	9500/ 3500	1500	2600	5100	3800
Launch Site	JSLC/ XSLC/ TSLC	JSLC/ XSLC	XSLC	XSLC	XSLC	XSLC

LM-2 is a two-stage launch vehicle, of which the first launch failed in 1974. An upgraded version, designated as LM-2C, successfully launched in November 1975. Furnished with a solid upper stage and dispenser, LM-2C/SD can send two Iridium satellites into LEO (h=630 km) for each launch. The accumulated launch times of LM-2C have reached 20 till December 1998.

LM-2E takes modified LM-2C as the core stage and is strapped with four boosters ( $\Phi 2.25\text{m} \times 15\text{m}$ ). LM-2E made a successful maiden flight in July 1990 and seven launches have been conducted till December 1995.

LM-3 is a three-stage launch vehicle, of which the first and second stages are developed based on LM-2C. The third stage uses  $\text{LH}_2/\text{LOX}$  as cryogenic propellants

and is capable of re-start in the vacuum. LM-3 carried out twelve flights from January 1984 to June 1997.

LM-3A is also a three-stage launch vehicle in heritage of the mature technologies of LM-3. An upgraded third stage is adopted by LM-3A. LM-3A is equipped with the newly developed guidance and control system, which can perform big attitude adjustment to orient the payloads and provide different spin-up operations to the satellites. Till May 1997, LM-3A has flown three times, which are all successful.

LM-3B employs LM-3A as the core stage and is strapped with four boosters identical to those on LM-2E. The first launch failed in February 1996, and other four launches till July 1998 are all successful.

LM-3C employs LM-3A as the core stage and is strapped with two boosters identical to those on LM-2E. The only difference between LM-3C and LM-3B is the number of the boosters.

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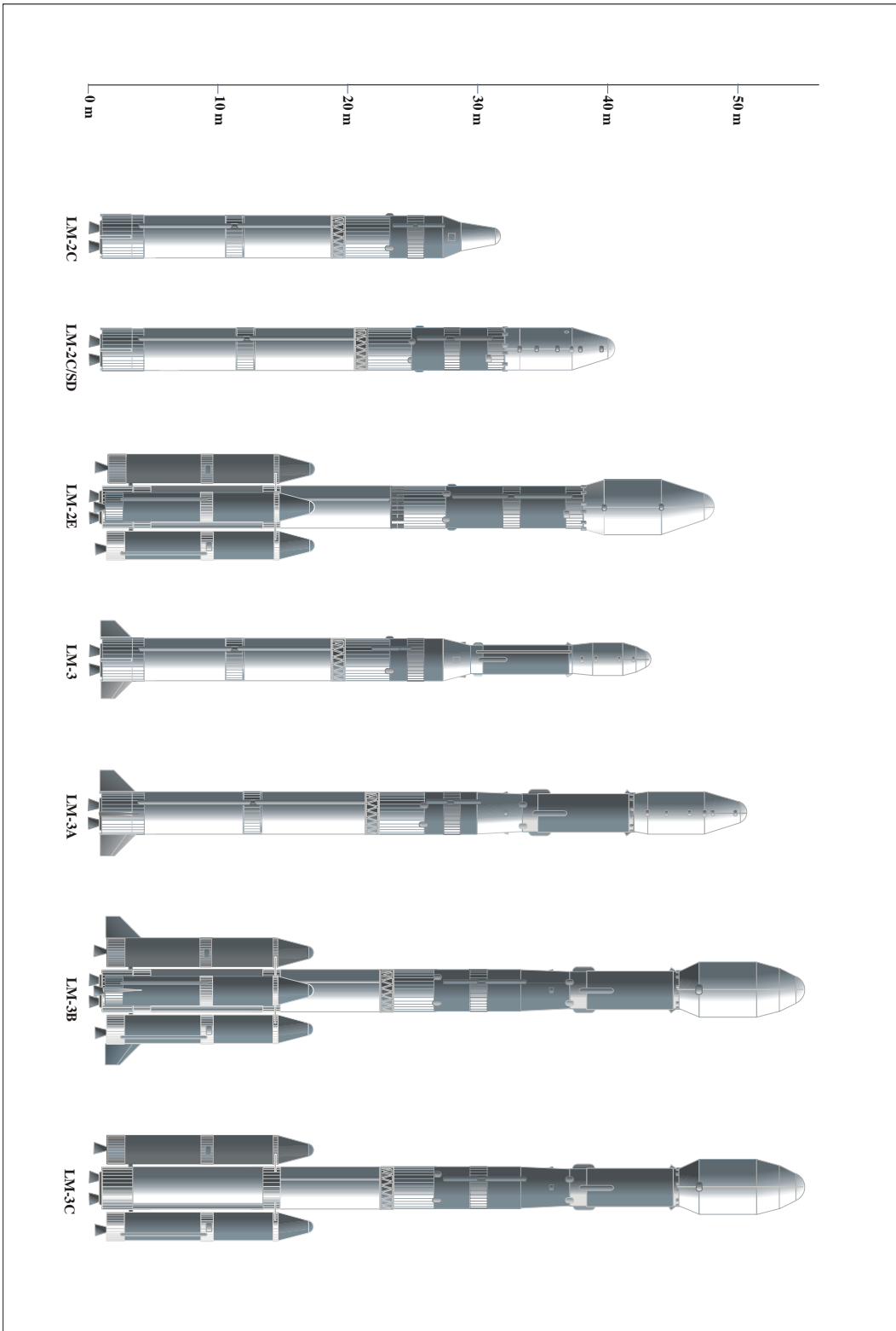
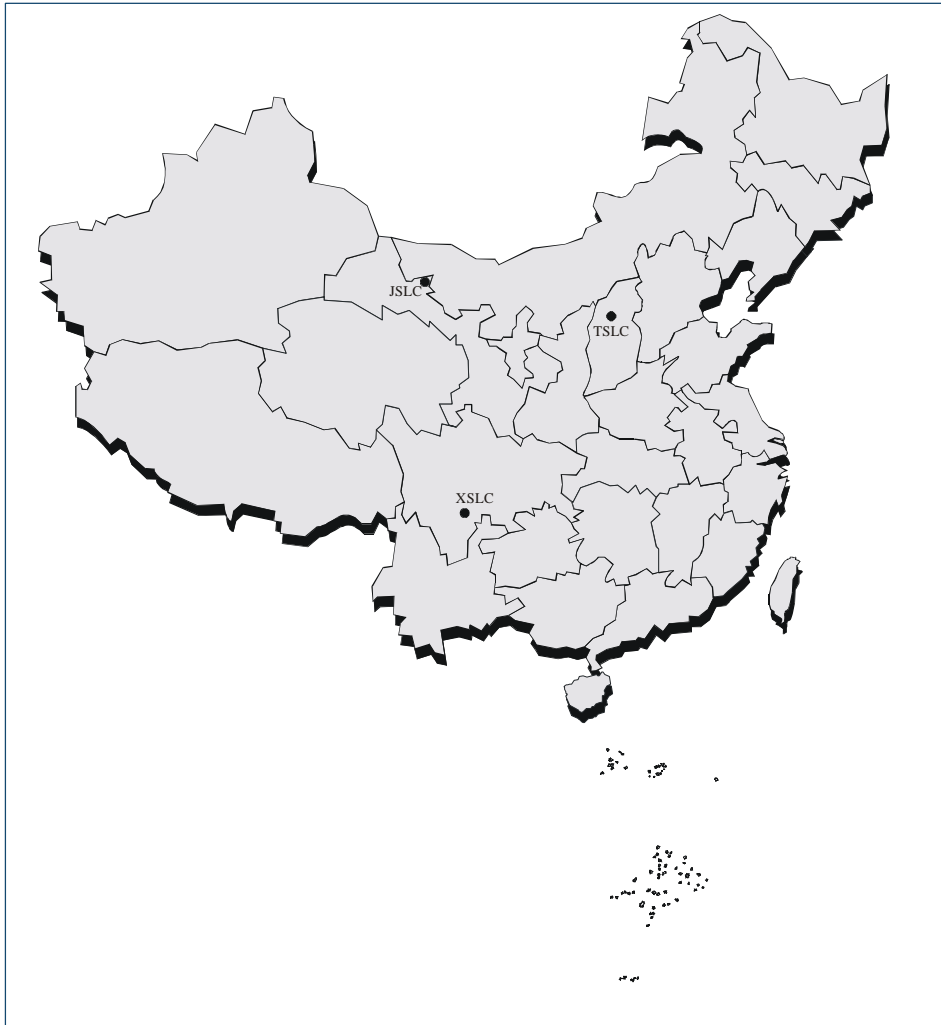


Figure 1-1 Long March Family

## 1.2 Launch Sites for Various Missions

There are three commercial launch sites in China, i.e. Xichang Satellite Launch Center (XSLC), Taiyuan Satellite Launch Center (TSLC) and Jiuquan Satellite Launch Center (JSLC). Refer to **Figure 1-2** for the locations of the three launch sites.



**Figure 1-2 Locations of China's Three Launch Sites**

### 1.2.1 Xichang Satellite Launch Center

Xichang Satellite Launch Center (XSLC) is located in Sichuan Province, southwestern China. It is mainly used for GTO missions. There are processing buildings for satellites and launch vehicles and buildings for hazardous operations and storage in the technical center. Two launch complexes are available in the launch

center, Launch Complex #1 for LM-3 and LM-2C, and Launch Complex #2 for LM-3A, 3B & 3C as well as LM-2E.

The customers' airplanes carrying the Spacecraft (SC) and Ground Support Equipment (GSE) can enter China from either Beijing or Shanghai with customs exemption according to the approval from Chinese Government. The SC team can connect their journey to XSLC by plane or train at Chengdu after the flights from Beijing, Shanghai, Guangzhou or Hong Kong.

### **1.2.2 Taiyuan Satellite Launch Center**

Taiyuan Satellite Launch Center (TSLC) is located in Shanxi province, Northern China. It is mainly used for the launches of LEO satellites by LM-2C.

The customer's airplanes carrying the SC and GSE can clear the Customs in Taiyuan free of check and the SC and equipment are transited to TSLC by train. The SC team can connect their journey to TSLC by train.

### **1.2.3 Jiuquan Satellite Launch Center**

Jiuquan Satellite Launch Center (JSLC) is located in Gansu Province, Northwestern China. This launch site has a history of near thirty years. It is mainly used for the launches of LEO satellites by LM-2C and LM-2E.

The customer's airplanes carrying the SC and GSE can clear the Customs in Beijing or Shanghai free of check. The SC team can connect their flight to Dingxin near JSLC.

### 1.3 Launch Record of Long March

**Table 1-2 Flight Record of Long March till March 25, 2002**

NO.	LV	Date	Payload	Mission	Launch Site	Result
1	LM-1 F-01	70.04.24	DFH-1	LEO	JSLC	Success
2	LM-1 F-02	71.03.03	SJ-1	LEO	JSLC	Success
3	LM-2 F-01	74.11.05	FHW-1	LEO	JSLC	Failure
4	LM-2C F-01	75.11.26	FHW-1	LEO	JSLC	Success
5	LM-2C F-02	76.12.07	FHW-1	LEO	JSLC	Success
6	LM-2C F-03	78.01.26	FHW-1	LEO	JSLC	Success
7	LM-2C F-04	82.09.09	FHW-1	LEO	JSLC	Success
8	LM-2C F-05	83.08.19	FHW-1	LEO	JSLC	Success
9	LM-3 F-01	84.01.29	DFH-2	GTO	XSLC	Failure
10	LM-3 F-02	84.04.08	DFH-2	GTO	XSLC	Success
11	LM-2C F-06	84.09.12	FHW-1	LEO	JSLC	Success
12	LM-2C F-07	85.10.21	FHW-1	LEO	JSLC	Success
13	LM-3 F-03	86.02.01	DFH-2A	GTO	XSLC	Success
14	LM-2C F-08	86.10.06	FHW-1	LEO	JSLC	Success
15	LM-2C F-09	87.08.05	FHW-1	LEO	JSLC	Success
16	LM-2C F-10	87.09.09	FHE-1A	LEO	JSLC	Success
17	LM-3 F-04	88.03.07	DFH-2A	GTO	XSLC	Success
18	LM-2C F-11	88.08.05	FHW-1A	LEO	JSLC	Success
19	LM-4 F-01	88.09.07	FY-1	SSO	TSLC	Success
20	LM-3 F-05	88.12.22	DFH-2A	GTO	XSLC	Success
21	LM-3 F-06	90.02.04	DFH-2A	GTO	XSLC	Success
22	LM-3 F-07	90.04.07	AsiaSat-1	GTO	XSLC	Success
23	LM-2E F-01	90.07.16	BARD-1/DPI	LEO	XSLC	Success
24	LM-4 F-02	90.09.03	FY-1/A-1, 2.	SSO	TSLC	Success
25	LM-2C F-12	90.10.05	FHW-1A	LEO	JSLC	Success
26	LM-3 F-08	91.12.28	DFH-2A	GTO	XSLC	Failure
27	LM-2D F-01	92.08.09	FHW-1B	LEO	JSLC	Success
28	LM-2E F-02	92.08.14	Aussat-B1	GTO	XSLC	Success
29	LM-2C F-13	92.10.05	Freja/FHW-1A	LEO	JSLC	Success
30	LM-2E F-03	92.12.21	Optus-B2	GTO	XSLC	Failure
31	LM-2C F-14	93.10.08	FHW-1A	LEO	JSLC	Success
32	LM-3A F-01	94.02.08	SJ-4/DP2	GTO	XSLC	Success
33	LM-2D F-02	94.07.03	FHW-1B	LEO	JSLC	Success

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NO.	LV	Date	Payload	Mission	Launch Site	Result
34	LM-3 F-09	94.07.21	APSTAR-I	GTO	XSLC	Success
35	LM-2E F-04	94.08.28	Optus-B3	GTO	XSLC	Success
36	LM-3A F-02	94.11.30	DFH-3	GTO	XSLC	Success
37	LM-2E F-05	95.01.26	APSTAR-II	GTO	XSLC	Failure
38	LM-2E F-06	95.11.28	AsiaSat-2	GTO	XSLC	Success
39	LM-2E F-07	95.12.28	EchoStar-1	GTO	XSLC	Success
40	LM-3B F-01	96.02.15	Intelsat-7A	GTO	XSLC	Failure
41	LM-3 F-10	96.07.03	APSTAR-IA	GTO	XSLC	Success
42	LM-3 F-11	96.08.18	ChinaSat-7	GTO	XSLC	Failure
43	LM-2D F03	96.10.20	FHW-1B	LEO	JSLC	Success
44	LM-3A F-03	97.05.12	DFH-3	GTO	XSLC	Success
45	LM-3 F-12	97.06.10	FY-2	GTO	XSLC	Success
46	LM-3B F-02	97.08.20	Mabuhay	GTO	XSLC	Success
47	LM-2C F-15	97.09.01	Iridium-DP	LEO	TSLC	Success
48	LM-3B F-03	97.10.17	APSTAR-IIR	GTO	XSLC	Success
49	LM-2C F-16	97.12.08	Iridium-D1	LEO	TSLC	Success
50	LM-2C F-17	98.03.26	Iridium-D2	LEO	TSLC	Success
51	LM-2C F-18	98.05.02	Iridium-D3	LEO	TSLC	Success
52	LM-3B F-04	98.05.30	ChinaStar-1	GTO	XSLC	Success
53	LM-3B F-05	98.07.18	SinoSat-1	GTO	XSLC	Success
54	LM-2C F-19	98.08.20	Iridium-R1	LEO	TSLC	Success
55	LM-2C F-20	98.12.19	Iridium-R2	LEO	TSLC	Success
56	LM-4 F-03	99.05.10	FY-1	SSO	TSLC	Success
57	LM-2C F-21	99.06.12	Iridium-R3	LEO	TSLC	Success
58	LM-4 F-04	99.10.14	ZY-1	SSO	TSLC	Success
59	LM-2F F-01	99.11.20	Shenzou-1 Ship	LEO	JSLC	Success
60	LM-3A F-04	2000.01.26	ChinaSat-22	GTO	XSLC	Success
61	LM-3 F-13	2000.06.25	FY-2	GTO	XSLC	Success
62	LM-4 F-05	2000.09.01	ZY-2	SSO	TSLC	Success
63	LM-3A F-05	2000.10.31	Beidou Nav.	GTO	XSLC	Success
64	LM-3A F-06	2000.12.21	Beidou Nav.	GTO	XSLC	Success
65	LM-2F F-02	2001.01.10	ShenZou-2 Ship	LEO	JSLC	Success
66	LM-2F F-03	2002.03.25	ShenZou-3 Ship	LEO	JSLC	Success