



# SHENZHEN CHANGMAI TECHNOLOGY Co.,LTD

深圳市昌迈科技有限公司

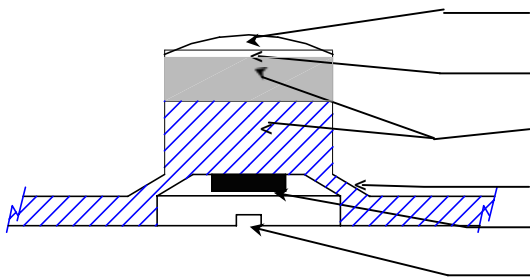
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## Rubber Key: Design & Confirmation Reference

### 1. Overview of silicone rubber buttons

#### 1. Rubber Key-- Basic structure of buttons



Plastic Cap

Key Top (/Laser Etching、Potting、Coating)

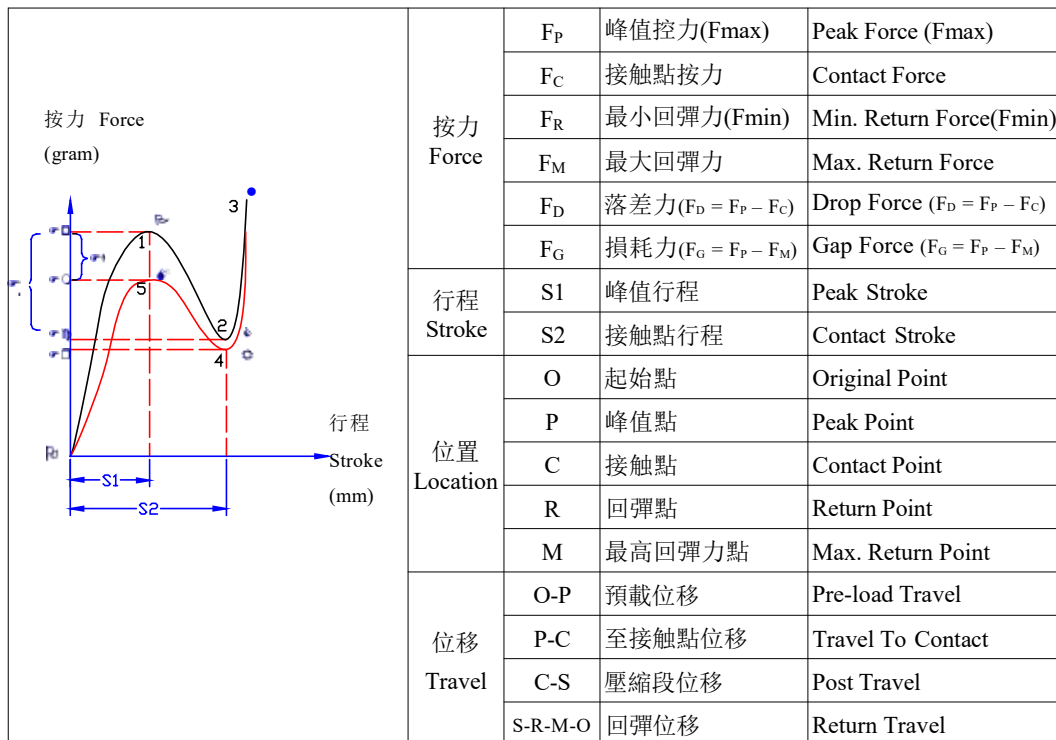
Optional Color Insertion Key

Wall

Conductive Part (Contact)

Air Path

#### 2. Silicone rubber button pressing force----stroke curve chart



### 3. Characteristics, performance and uses of silicone rubber buttons with different structures

Rubber Key 類型	圖示	行程、壓力曲線	Rubber Key 特性
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Flat Cone Type			Force Range 按力範圍	0 ~ 350grams
			Stroke Range 行程範圍	0.5 ~ 3.0mm
			Cycle Life 壽命 (×10 <sup>3</sup> )	500 ~ 2,000
			Typical Uses 主要用途	Telephone, Remote Control, Radio, Automotive, Toys, Calculator, etc. 電話、搖控器、收音機、玩具、計算器等。
Top Cylindrical Type			Force Range 按力範圍	0 ~ 250grams
			Stroke Range 行程範圍	0.7 ~ 1.5mm
			Cycle Life 壽命 (×10 <sup>3</sup> )	500 ~ 2,000
			Typical Uses 主要用途	Telephone, Remote Control, Toys, Games, Calculator, etc. 電話、搖控器、玩具、遊戲機、計算器等。
Flat Dome Type			Force Range 按力範圍	30 ~ 150grams
			Stroke Range 行程範圍	0.5 ~ 3.0mm
			Cycle Life 壽命 (×10 <sup>3</sup> )	1,000 ~ 3,000
			Typical Uses 主要用途	Telephone, Remote Control, Toys, Measuring Instruments, Office Machine. 電話、搖控器、微型測量儀、辦公室設備。
Double Cone			Force Range 按力範圍	30 ~ 80grams
			Stroke Range 行程範圍	2.0 ~ 4.0mm
			Cycle Life 壽命 (×10 <sup>3</sup> )	5,000 ~ 20,000
			Typical Uses 主要用途	Computer, Typewriter, etc. 電腦、打字機等。
Ring Dome			Force Range 按力範圍	30 ~ 200grams
			Stroke Range 行程範圍	1.0 ~ 2.5mm
			Cycle Life 壽命 (×10 <sup>3</sup> )	500 ~ 3,000
			Typical Uses 主要用途	Telephone, Typewriter, Test Instruments, etc. 電話、打字機、試驗儀器等。
Ring Dome Top			Force Range 按力範圍	20 ~ 80grams
			Stroke Range 行程範圍	0.2 ~ 1.0mm
			Cycle Life 壽命 (×10 <sup>3</sup> )	500 ~ 10,000
			Typical Uses 主要用途	Remote Control, Calculator, Typewriter, Computer, etc. 搖控器、計算器、打字機、電腦等。

## 二. Silicone rubber button structure design

### 1. Design functional requirements of Rubber Key

- ❶. The function can be achieved when the button is pressed;
- ❷. After the external force is removed, the button can be automatically and completely reset;
- ❸. The buttons have good feel during pressing and resetting, and there is no feeling of obstruction, sluggishness or astringency;
- ❹. Ensure that it also works when pressing the edge of the button.

## 2. Rubber Key (Key points of structural design)

❶.

	1. 外圓每半徑為 1.0 至 1.5mm.
	2. 最小半徑為 0.3mm .
	3. 最小內圓角半徑為 0.2mm.
	4. 定位孔至斜壁邊緣線不小於 1.0mm.
	5. 最小定位孔徑為 1.0mm
	6. 斜壁底間距比 a 大 2.0mm.
	7. 鍵面圓角半徑不小於 0.25mm.
	8. 鍵面頂邊圓角半徑不小於 0.2mm.
	1. Typical outside radius is 1.0 to 1.5mm.
	2. Minimum radius is 0.3mm.
	3. Minimum inside radius is 0.2mm.
	4. Spacing between the guide edges of a rubber dome hole is 1.0mm and a or more.
	5. Guide holes are a min . 1.0mm in diameter.
	6. The width of a rubber dome base is typically more than a.
	7. The minimum radius is 0.25mm. for the side edges of key top
	8. The minimum radius is 0.2mm. for the top edges of key top

❷. Technical requirements (in drawing sheet)

- a. Actuation force:  $130 \pm 35$  grams
- b. Tactile feedback required.
- c. Expected life cycle:  $1 \times 10^5$  minimum
- d. Silicone rubber hardness:  $50 \sim 60^\circ$  .
- e. Contact resistance less than 200 ohms
- f. Stroke = 1.0 (or 1.5) mm.
- g. Thickness of carbon pill = 1.0mm.
- h. Contact bounce less than 12m seconds.
- i. Pad color: optional.
- j. Graphic printing: optional.

## 3. Rubber Key (Matches with plastic shell)

❶. General design rules

	<p>A &amp; B : dimensions of plastic 塑膠殼鍵孔的尺寸  a &amp; b : dimensions rubber 矽橡膠鍵鈕的尺寸  合理比例為 <math>A - a \geq 0.3\text{mm}</math>, <math>B - b &gt; 0.2\text{mm}</math> (具體取值見下表)</p>
	<p>R : the corner radius of plastic 塑膠鍵孔圓角的半徑  r : the corner radius of rubber 矽橡膠鍵鈕圓角的半徑  <math>1\text{mm} \leq R \leq 1.25\text{mm}</math>, <math>0.75\text{mm} \leq r \leq 1\text{mm}</math> is better  合理比例為 <math>1\text{mm} \leq R \leq 1.25\text{mm}</math>, <math>0.75\text{mm} \leq r \leq 1\text{mm}</math></p>
	<p>H : the dimension of key tops &amp; plastic 鍵鈕露出膠殼的高度  S : the stroke of keypad 鍵鈕的行程  合理比例為 <math>H - S \geq 0.5\text{mm}</math></p>
	<p><math>D - d = 1.5 \sim 2.0\text{mm}</math> is preferred  合理比例為 <math>D - d = 1.5 \sim 2.0\text{mm}</math></p>
	<p>P : diameter of post 小柱直徑  t : the gap between post &amp; conductive pill 小柱與導電粒頂部之間的距離。  P: 1.0mm is preferred 標準尺寸 1.0mm.  <math>t = 0.1 \sim 0.15\text{mm}</math> is preferred 標準尺寸 <math>t = 0.1 \sim 0.15\text{mm}</math></p>
	<p>Fc : click force 接觸點動  <math>F_c = F_1 - F_2 &gt; 25\text{g}</math> is preferred 標準數據 <math>F_c = F_1 - F_2 &gt; 25\text{g}</math></p>

② Gap value recommended selection table




The shape, size, and stroke of the button are the main factors that affect the design clearance value of the button. Generally speaking, if the shape is simple, the size and stroke are small, the fit clearance value will be small, and vice versa. The clearance value between the Rubber Key and the plastic shell is shown in the table below:

**Rubber Key**




Table of recommended clearance values :for mating with plastic shells (all single-sided clearances)

a. Rubber distance= 1.0mm





尺寸 分類	1 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50	50 ~
	0.10	0.10	0.12	0.15	0.30	-----

	0.10	0.12	0.15	----	----	----
	0.10	0.12	0.15	0.18	0.20	----
	----	----	0.18	0.30	0.35	----
異形	----	0.15	0.20	----	----	----

b. Rubber distance= 1.5mm

分類 \ 尺寸	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50	50 ~
	0.10	0.12	0.14	0.16	----	----
	0.12	0.14	0.16	----	----	----
	0.12	0.14	0.16	----	----	----
多邊形	----	----	0.20	0.30	----	----
異形	----	0.16	0.20	----	----	----

c. Rubber distance=2.0mm

分類 \ 尺寸	0 ~ 10	10 ~ 20	20 ~ 30	30 ~ 40	40 ~ 50	50 ~
	0.10	0.12	0.14	0.16	----	----
	0.12	0.16	0.18	----	----	----
	0.12	0.16	0.18	----	----	----
	----	----	0.25	0.35	----	----
異形	----	0.18	0.22	----	----	----

③. General dimensional tolerances

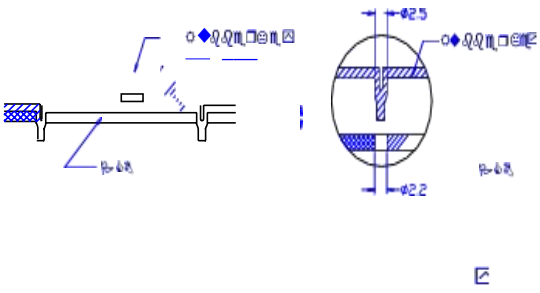
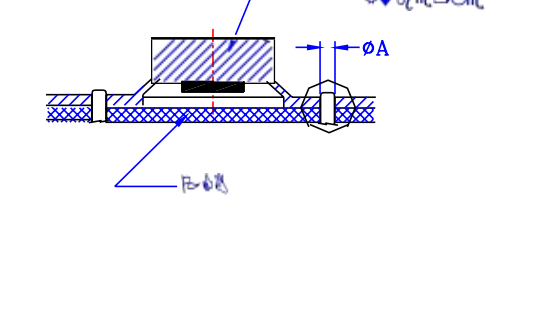
Length(mm)	< 10	20	30	40	50	> 50
Tolerance (mm)	± 0.1	± 0.15	± 0.2	± 0.25	± 0.3	0.6 %

④. General accuracy of elastic range

Force (g)	50	70	90	100	120	150	170	200 ~ 250
Tolerance (g)	± 15~20	± 20~25	± 20~30	± 25~35	± 25~35	± 30~40	± 35~40	± 50

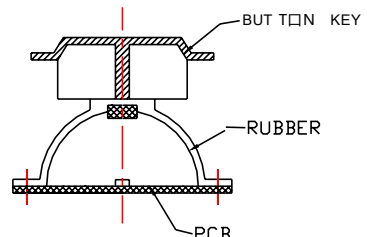
### 3. How to assemble Rubber and PCB

①.

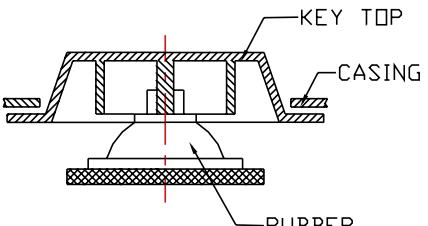
Example	Illustrate
	<p>a. Use pull-leg fixation</p> <p>b. Use an interference fit between the pull pin and the PCB</p> <p>c. Generally, the maximum interference measurement is 0.3mm.</p> <p>d. The height of the interference part of the pull leg is 2.0mm.</p> <p>e. The matching gap between the Rubber Key and the surface shell is generally 0.2 ~0.3mm on one side.</p>
	<p>a. Use pillar positioning and use PCB to press the Rubber key on the rubber shell.</p> <p>b. Positioning hole <math>\Phi A \cong 2\text{mm}</math> on Rubber key</p> <p>c. Use clearance fit between the column and the column, <math>\Delta</math> is generally 0.5mm;</p> <p>d. Clearance fit is also used between the punching holes at the corresponding positions of the PCB and the positioning pillars, <math>\Delta \cong 0.15\text{mm}</math>.</p>

### 4. Rubber + Key Top (Button) ASSEMBLE

①. Assembly method of multi-grain Rubber

	<p>a. Rubber 與 PCB 採用拉腳固定或柱仔定位;</p> <p>b. Key Top 的十字形骨壓在 Rubber 上, 預壓量 0.2mm.</p>
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②. Single grain Rubber assembly method

	<p>a. Rubber 上開十字型槽, Key Top 上做十字型骨;</p> <p>b. Rubber 與 Key Top 配合稍帶過盈, 配裝配后不致晃動;</p> <p>c. Rubber 預壓量 0.2mm 。</p>
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### 三. Rubber Key Choosing

#### 1. The following three points should be considered when selecting Rubber Key

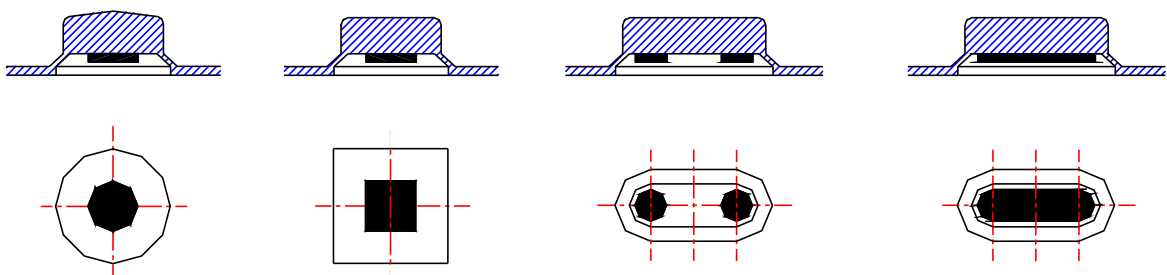
- ❶. Rubber Key 行程
- ❷. Resilience
- ❸. Preload amount (Rubber The height of the pressed part must be greater than the distance between the button and PCB, In order to prevent the keys from shaking during normal operation, the preload amount is generally 0.2mm)。

#### General selection example

Applications	Stroke(mm)	Actuation Force(g)	Durability( $\times 10^3$ cycles)
Calculators	0.2-3.5	30-80	300-1,000
Audio Equipment	0.3-1.5	60-150	100-500
Car Radios & Stereos	0.3-1.0	60-200	100-500
TV & VTR	0.1-1.5	30-100	300-1,000
Transmitters	0.3-1.5	80-150	300-1,000
Push-button Telephones	1.2-3.5	70-200	1,000-3,000
Electronic Games	0.2-1.5	30-150	500-1,000
Musical Instruments	0.7-3.5	30-70	1,000
Computer Terminals	2.0-4.0	40-90	5,000-10,000
Electric Typewriters	3.0-4.0	40-70	5,000-10,000
Printer	1.0-3.5	30-80	500-1,000
Instrument Measuring	0.3-1.5	30-100	100-300
Remote Control	0.3-1.5	50-150	300
Copy / Fax Machine	0.2-1.5	30-150	100

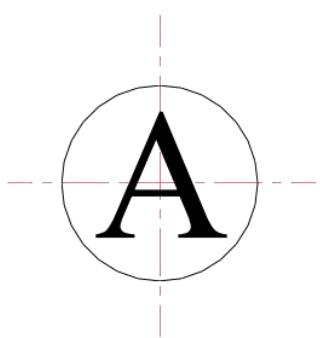
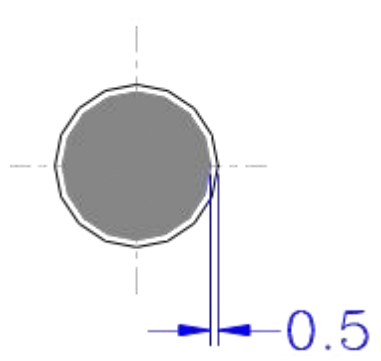
### 五. Rubber Key accessory design part

#### 1. General design specifications for conductive particles



項目 Items	導電粒的標準尺寸 Standard Sizes
圓形 Circle	Φ2、Φ2.5、Φ3、Φ3.5、Φ4、Φ4.5、Φ5、Φ5.5、Φ6、Φ7、Φ8
方形 Square 橢圓形 Ellipse	適宜做絲印導電油墨,尺寸不限制 Conductive ink printings contact is recommended, size is flexible
導電粒電阻值	施加 100g 力之下,小于 150 Ω
壽命	30,000,000
印刷型電阻值	施加 300g 力之下,小于 800 Ω
壽命	1 × 10 <sup>6</sup>
Conductive Pill Resistance	Less than 150 ohms with 100 grams loading
Load	30 million
Print Type Resistance	Less than 800 ohms with 300 grams loading

## 2. General concepts of screen printing

鍵鈕表面字體或圖形絲印 Button Graphics	鍵鈕表面全色絲印 Full Surface Printing
	
中心點公差為±0.3mm(Graphics Offset center±0.3mm)	
耐磨損能力: 能抵受 RCA 絲印壽命測試儀按照 IU4001 PORA 5.3.1 e 之 2018664 規格摩擦 15 次 Abrasion Resistance: All must pass 15 cycles minimum wear on RCA Abrader, 2018664 per IU4001 PORA 5.3.1e	

## 六. Rubber Key performance and testing

### 1. Silicone rubber mechanical and electrical properties

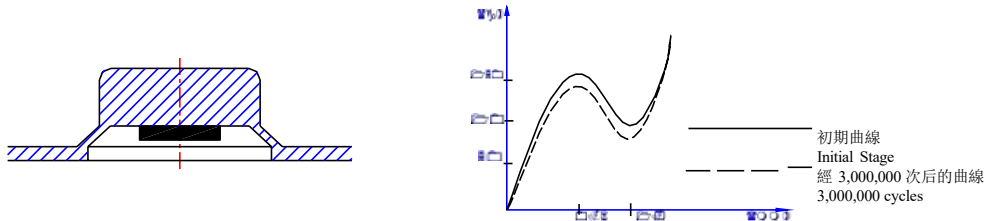
		非導電硅 Non-Conductive Silicone	導電硅 Conductive Silicone
使用溫度	Temperature For Use	- 50°C ----- + 250°C	- 50°C ----- + 250°C
單位比重	Specific Gravity	1.16	1.18
拉力強度	Tensile Strength	80 Kg /cm <sup>2</sup>	50 Kg /cm <sup>2</sup>
撕裂強度	Tear Strength	20 Kg / cm	12 Kg / cm
壓縮率	Compression Set	60% (180°C × 22hrs.)	28% (150°C × 22hrs.)
破壞伸度	Elongation At Break	310%	220%
電阻率	Specific Resistively	1 × 10 <sup>5</sup> Ω .cm	4 Ω .cm



接觸電阻	Contact Resistance	-----	< 100 Ω
接觸電流量(DC)	Contact Rating (DC)	-----	12V – 30 mA
接觸起彈時間	Contact Bounce	-----	< 20 msec.
諧震時間	Chattering	-----	< 5 msec.
絕緣度	Insulation Breakdown	26k V / mm	----
介質常數	Dielectric Constant	4.2 (50 Hz)	----
介質正切	Dielectric Tangent	13% (50 Hz)	----
顏色	Color	可選加顏色 Coloring Possible	黑色 Black

## 2. Silicone rubber button life test

橡膠按鍵之壽命測試 (Life test for rubber key)



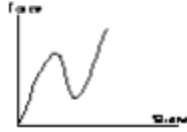
壽命測試方法是用 15mA DC 以每秒三次速度將鍵鈕按下接觸線路板

The durability test was conducted by operating a key at a rate of 3 times/sec with a current of 15mA DC applied on the Cu-Au plate PC board.

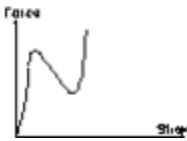
## 七 DA design review content

1. Check its corresponding performance from the structure and whether its use is consistent with the design requirements.
2. (1) The distance between the positioning hole and the edge line of the inclined wall shall not be less than 1.0mm;
  - (2) The positioning hole is not less than 1mm;
  - (3) The fillet radius of the key surface shall not be less than 0.25mm.
3. (1) The distance between the plastic shell and the Rubber Key must meet the requirements in the table.
  - (2)  $H-S \geq 0.5\text{mm}$
4. (1) Assembly method with PCB;;
  - (2) Rubber preload (usually 0.2mm)
5. Rubber Key surface screen printing test reference QAD-TEI-011.
6. Rubber Key life test can meet the corresponding life requirements.

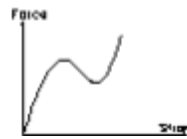
# Rubber Key Design Conditions



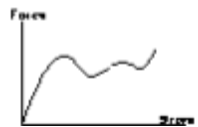
Force	0~350 grams
Range	0.5~3.0 mm
Stroke	0.5~2 ( × 10 <sup>6</sup> )
Range	Telephones, Remote Controls,
Cycle Life	Automotive, Radios, Toys, Calculators,
Typical Uses	etc.



Force	30~250 grams
Range	0.7~1.5 mm
Stroke	0.5~2 ( × 10 <sup>6</sup> )
Range	Telephones, Remote Controls,
Cycle Life	Toys, Games, Calculators__etc.
Typical Uses	



Force	30~150 grams
Range	0.5~3.0 mm
Stroke	1~3 ( × 10 <sup>6</sup> )
Range	Telephones, Remote Controls, Toys,
Cycle Life	Measuring Instruments, Office
Typical Uses	Machines__etc.



Force	30~80 grams
Range	2.0~4.0 mm
Stroke	5~20 ( × 10 <sup>6</sup> )
Range	Computers, Typewriters__etc.
Cycle Life	
Typical Uses	



Founded in 2004, ChangMai is a **one stop "silicone +" professional service provider** integrating design, R & D, production and manufacturing . **ChangMai adheres to the concept of "Only for Champions" and continues to innovate and lead breakthroughs in the field of silicone rubber and plastic customization. It has now achieved independent production of the entire process, and its products cover multiple industries such as consumer electronics, medical beauty, communication equipment, industrial machinery, and automobile manufacturing.**

**ChangMai silicone**

**Professional one-stop silicone + service provider  
Just for the championship, create 2024!**

**Liquid Silica Gel Custom | Solid Silicone Customization | Plastic Customization**

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