

Celxpert Energy(KunShan)Corporation

Battery Pack

UN38.3 Test Report

Customer:	Lenovo
Model:	L20C4P71
Nominal voltage:	15.44V
Rating Capacity:	Rated Capacity:56Wh,3610mAh Typical Capacity:57Wh,3695mAh
Issue Date:	May ,25 2020



1.UN38.3 Lithium Battery Test Summary

Edition of UN Manual of Tests and Criteria Used		ST/SG/AC.10/11/Rev.6/Amend.1	
Customer	Lenovo	Sample type	Rechargeable Li-ion Battery
Model Name	L20C4P71	Pack Configuration	4S1P
Rating	Rated Capacity:56Wh,3610mAh Typical Capacity:57Wh,3695mAh	Battery weight	213g
Cell Factory/Model	ATL4541A8-010H/L AC85 3695mAh ATL4541A8-010H/L HC85 3610mAh	Physical Description	Prismatic
Factory Address	NO.1111, Hanpu Road, Yushan Town, Kunshan City, Jiangsu Province, P.R. China	Laboratory Address	NO.1111, Hanpu Road, Yushan Town, Kunshan City, Jiangsu Province, P.R. China
Factory Name	Celxpert (kunshan) Enengy.Co,Ltd.	Laboratory Name	CPK LAB
Factory Tel	+86-512-57775999	Laboratory Tel	+86-512-57775999
Factory E-mail	Frank_Gao@cn.celxpert.com	Lab E-mail	Frank_Gao@cn.celxpert.com
Factory Web	www.celxpert.com.tw	Laboratory Web	www.celxpert.com.tw
Client Date	2020/05/05	Completing Data	2020/05/22
Item	Test Item	Test Result(Pass/Fail)	
38.3.4.1 T1	Altitude simulation	Pass	
38.3.4.1 T2	Thermal	Pass	
38.3.4.1 T3	Vibration	Pass	
38.3.4.1 T4	Shock	Pass	
38.3.4.1 T5	External Short Circuit	Pass	
38.3.4.1 T6	Crush	Pass	
38.3.4.1 T7	Overcharge	Pass	
38.3.4.1 T8	Forced Discharge	Pass	

Approved By	Checked By	Prepared By
		
Section manager	Section manager	Engineer

2. Test items and quantity

T.1. Altitude simulation

T.5. External short circuit

T.2. Thermal

T.6. Impact/ Crush

T.3. Vibration

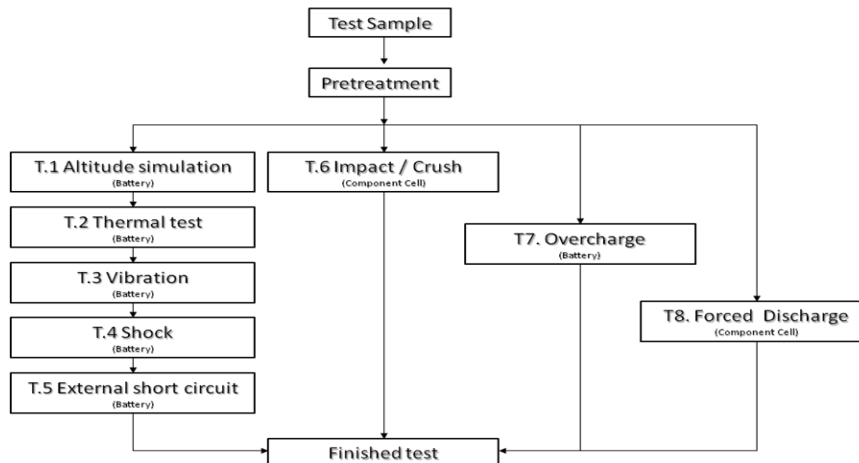
T.7. Overcharge

T.4. Shock

T.8. Forced Discharge

summary table of required test for rechargeable cells and batteries										
		T.1	T.2	T.3	T.4	T.5	T.6	T.7	T.8	SUM
Cell	First cycle,50% charged state						5			30
	25th cycle,50% charged state						5			
	First cycle, fully discharged state								10	
	25th cycle, fully discharged state								10	
<12kg Small batteries	First cycle, fully charged state	4						4		16
	25th cycle, fully charged state	4						4		
>12kg Large batteries	First cycle, fully charged state	2						2		8
	25th cycle, fully charged state	2						2		

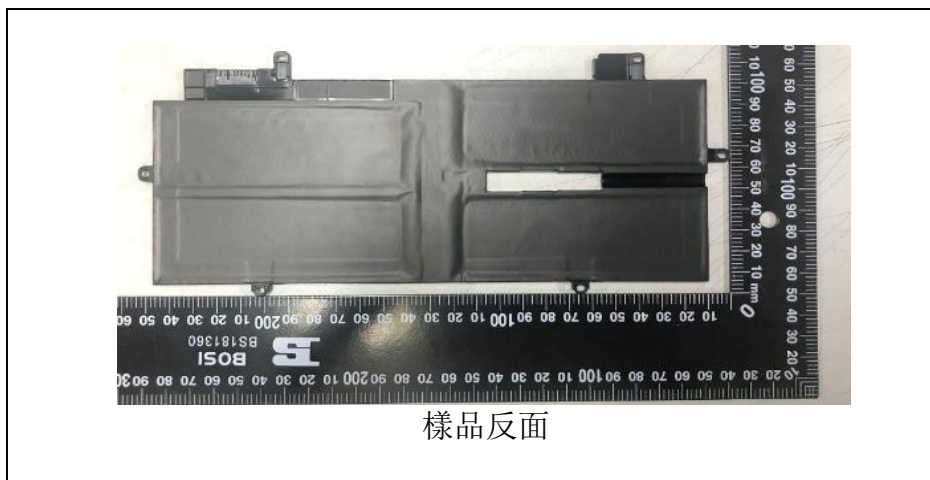
3. Test Procedure



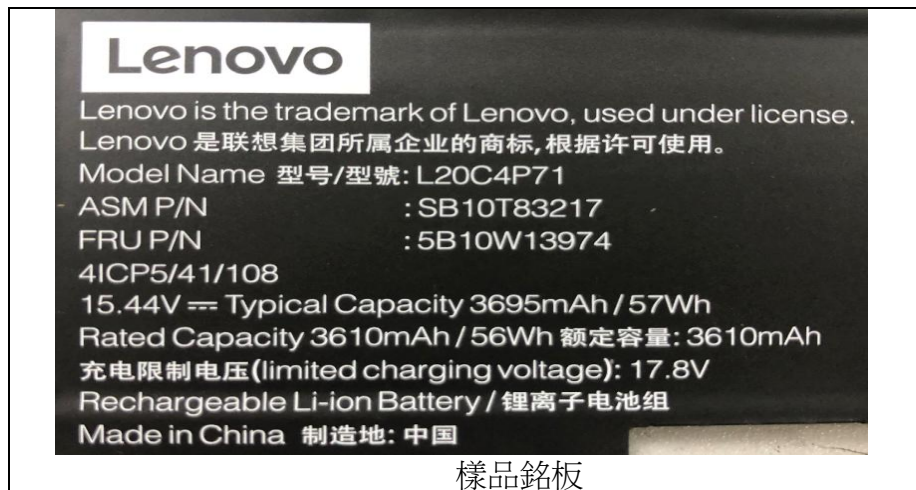
4.Photo of The Sample



样品正面
Photo 1 Front



样品反面
Photo 2 Rear



样品铭板
Photo 3 Label

5.Test method and verdict

Clause	Requirements	Verdict							
Table 38.3.1	Mass loss means a loss of mass that exceeds the values in table 38.3.1 below								
	Table 38.3.1:Mass loss limit <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Mass M of cell or battery</th> <th>Mass loss limit</th> </tr> </thead> <tbody> <tr> <td>M<1g</td> <td>0.5%</td> </tr> <tr> <td>1g ≤ M ≤ 75g</td> <td>0.2%</td> </tr> <tr> <td>M>75g</td> <td>0.1%</td> </tr> </tbody> </table>	Mass M of cell or battery	Mass loss limit	M<1g	0.5%	1g ≤ M ≤ 75g	0.2%	M>75g	0.1%
Mass M of cell or battery	Mass loss limit								
M<1g	0.5%								
1g ≤ M ≤ 75g	0.2%								
M>75g	0.1%								
38.3.4.1	T1 :Altitude simulation								
	This test simulates air transport under low-pressure conditions	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)							
	Test cells and batteries shall be stored at a pressure of 11.6kPa or less for at least six hour at ambient temperature (20±5°C)								
Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states									
38.3.4.2	T2:Thermal test								
	This test assesses cell and battery seal integrity and internal electrical connections. The test is conducted using rapid and extreme temperature changes.	No leakage no venting no disassemble no rupture no fire voltage not less than 90% Mass loss limit (see table 38.3.1).							
	Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72±2°C, followed by storage for at least six hours at a test temperature equal to - 40±2 °C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5°C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours.								
Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.									
38.3.4.3	T3:Vibration								
	This test simulates vibration during transport	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)							
	Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face.								
	For cells and small batteries: from 7 Hz a peak acceleration of 1gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 8gn occurs (approximately 50 Hz). A peak acceleration of 8gn is then maintained until the frequency is increased to 200 Hz.								
	For large batteries: from 7 Hz to a peak acceleration of 1gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 2gn occurs (approximately 25 Hz). A peak acceleration of 2gn is then maintained until the frequency is increased to 200 Hz.								
Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery directly after testing in its third perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.									

Clause	Requirements	Verdict
38.3.4.4	T4:Shock	
	This test assesses the robustness of cells and batteries against cumulative shocks	No leakage no venting no disassemble no rupture no fire. voltage not less than 90% Mass loss limit (see table 38.3.1)
	Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery	
	Each cell shall be subjected to a half-sine shock of peak acceleration of 150gn and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50gn and pulse duration of 11 milliseconds.	
	Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. The formulas below are provided to calculate the appropriate minimum peak accelerations. Each cell or battery is subjected to three shocks in the positive direction followed by three shocks in the negative direction of each of three mutually perpendicular mounting positions of the cell for a total of 18 shocks.	
Cells and batteries meet this requirement if there is no leakage, no venting, no disassemble, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.		
38.3.4.5	T5:External short circuit	
	This test simulates an external short circuit	no disassemble no rupture no fire. Packs exterior peak temperature <170°C Mass loss limit (see table 38.3.1)
	The cell or battery to be tested shall be shall be heated for a period of time necessary to reach a homogeneous stabilized temperature of $57\pm 4^{\circ}\text{C}$, measured on the external case. This period of time depends on the size and design of the cell or battery and should be assessed and documented. If this assessment is not feasible, the exposure time shall be at least 6 hours for small cells and small batteries, and 12 hours for large cells and large batteries. Then the cell or battery at $57\pm 4^{\circ}\text{C}$ shall be subjected to one short circuit condition with a total external resistance of less than 0.1 ohm.	
	This short circuit condition is continued for at least one hour after the cell or battery external case temperature has returned to $57 \pm 4^{\circ}\text{C}$, or in the case of the large batteries, has decreased by half of the maximum temperature increase observed during the test and remains below that value.	
	The short circuit and cooling down phases shall be conducted at least at ambient temperature.	
Cells and batteries meet this requirement if their external temperature does not exceed 170°C and there is no disassemble, no rupture and no fire within six hours of this test.		

Clause	Requirements	Verdict
38.3.4.6	T6:Impact/Crush	no disassemble no rupture no fire. not exceed 170°C Mass loss limit (see table 38.3.1)
	These tests simulate mechanical abuse from an impact or crush that may result in an internal short circuit.	
	Impact applicable to cylindrical cells not less than 18.00 in diameter.	
	The test sample cell or component cell is to be placed on a flat smooth surface. A 15.8mm±0.1mm diameter, at least 6cm long, or the longest dimension of the cell, whichever is greater, Type 316 stainless steel bar is to be placed across the centre of the sample. A 9.1 kg ± 0.1kg mass is to be dropped from a height of 61 ± 2.5 cm at the intersection of the bar and sample in a controlled manner using a near frictionless, vertical sliding track or channel with minimal drag on the falling mass. The vertical track or channel used to guide the falling mass shall be oriented 90 degrees from the horizontal supporting surface.	
	The test samples is to be impacted with its longitudinal axis parallel to the flat surface and perpendicular to the longitudinal axis of the 15.8mm±0.1mm diameter curved surface lying across the centre of the test samples. Each sample is to be subjected to only a single impact.	
	Crush applicable to prismatic, pouch, coin/button cells and cylindrical cells less than 18mm in diameter.	
	A cell or component cell is to be crushed between two flat surfaces. The crushing is to be gradual with a speed of approximately 1.5cm/s at the first point of contact. The crushing is to be continued until the first of the three options below is reached.	
	(a) The applied force reaches 13kN±0.78kN; Example : The force shall be applied by a hydraulic ram with a 32 mm diameter piston until a pressure of 17 MPa is reached on the hydraulic ram (b) The voltage of the cell drops by at least 100mV; or (c) The cell is deformed by 50% or more of its original thickness.	
	Once the maximum pressure has been obtained, the voltage drops by 100mV or more, or the cell is deformed by at least 50% of its original thickness, the pressure shall be released	
A prismatic or pouch cell shall be crushed by applying the force to the widest side. A button/coin cell shall be crushed by applying the force on its flat surfaces. For cylindrical cells, the crush force shall be applied perpendicular to the longitudinal axis.		
Each test cell or component cell is to be subjected to one crush only. The test Samples shall be observed for a further 6 h. The test shall be conducted using test cells or component cells that have not previously been subjected to other tests.		
Cells and component cells meet this requirement if their external temperature does not exceed 170°C and there is no disassemble and no fire during the test and within six hours after this test.		

Clause	Requirements	Verdict
38.3.4.7	T7:Ovecharge	No disassemble no fire. Mass loss limit (see table 38.3.1)
	This test evaluates the ability of a rechargeable battery or a single cell rechargeable battery to withstand an overcharge condition	
	The charge current shall be twice the manufacturer’s recommended maximum continuous charge current. The minimum voltage of the test shall be as follows:	
	(a) When the manufacturer’s recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V. (b) When the manufacturer’s recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage.	
	Tests are to be conducted at ambient temperature; the duration of the test shall be 24 hours	
38.3.4.8	T8:Forced discharge	no disassembly no fire Mass loss limit (see table 38.3.1)
	This test evaluates the ability of a primary or a rechargeable cell to withstand a forced discharge condition	
	Each cell shall be forced discharged at ambient temperature by connecting it in series with a 12V D.C. power supply at an initial current equal to the maximum discharge current specified by the manufacturer. The specified discharge current is to be obtained by connecting a resistive load of the appropriate size and rating in series with the test cell. Each cell shall be forced discharged for a time interval (in hours) equal to its rated capacity divided by the initial test current (in ampere).	
	Primary or rechargeable cells meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.	

6.Test Data

38.3.4.1		T1.Altitude simulation					
Test Equipment	Digital Meter :Q-153			, Vacuum Oven :Q-0443		Scales :Q-090	
Test Period	Start: 2020/05/05			End:2020/05/06			
Altitude Simulation Test on Charged Packs							
No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	17.204	213.55	17.122	213.49	99.52%	0.03%	O
2	17.188	213.47	17.077	213.43	99.35%	0.02%	O
3	17.193	213.61	17.100	213.58	99.46%	0.02%	O
4	17.197	213.59	17.073	213.54	99.28%	0.02%	O
5	17.166	213.51	17.054	213.47	99.35%	0.02%	O
6	17.182	213.66	17.067	213.63	99.33%	0.02%	O
7	17.174	213.38	17.032	213.35	99.17%	0.01%	O
8	17.179	213.43	17.028	213.40	99.12%	0.01%	O
Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire							
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire							
38.3.4.2		T2.Thermal test					
Test Equipment	Digital Meter :Q-153			, Programmable Thermal Tester:Q-0446		Scales:Q-090	
Test Period	Start:2020/05/08			End:2020/05/15			
Thermal Test on Charged Packs							
No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	17.122	213.49	16.953	213.38	99.01%	0.05%	O
2	17.077	213.43	16.919	213.36	99.07%	0.03%	O
3	17.100	213.58	16.961	213.50	99.19%	0.04%	O
4	17.073	213.54	16.912	213.44	99.06%	0.05%	O
5	17.054	213.47	16.917	213.40	99.20%	0.03%	O
6	17.067	213.63	16.896	213.55	99.00%	0.04%	O
7	17.032	213.35	16.883	213.29	99.13%	0.03%	O
8	17.028	213.40	16.897	213.35	99.23%	0.02%	O
Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire							
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire							

38.3.4.3		T3.Vibrationt					
Test Equipment		Digital Meter :Q-153		Vibration Tester :Q-300		Scales:Q-090	
Test Period		Start: 2020/05/18		End:2020/05/19			
Vibration Test on Charged Packs							
No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	16.953	213.38	16.889	213.34	99.62%	0.02%	O
2	16.919	213.36	16.844	213.30	99.56%	0.02%	O
3	16.961	213.50	16.874	213.47	99.49%	0.01%	O
4	16.912	213.44	16.846	213.40	99.61%	0.02%	O
5	16.917	213.40	16.823	213.37	99.44%	0.01%	O
6	16.896	213.55	16.823	213.51	99.57%	0.02%	O
7	16.883	213.29	16.822	213.26	99.64%	0.01%	O
8	16.897	213.35	16.812	213.31	99.50%	0.02%	O
Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire							
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire							
38.3.4.4		T4 Shock					
Test Equipment		Digital Meter: Q-153		Shock Tester:Q-154		Scales:Q-090	
Test Period		Start: 2020/05/20		End:2020/05/20			
Shock Test on Charged Packs							
No.	Before		After		voltage residue	mass loss	other event
	OCV (V)	Weight (g)	OCV (V)	Weight (g)	Volt (%)	Weight (%)	
1	16.889	213.34	16.855	213.32	99.80%	0.01%	O
2	16.844	213.30	16.772	213.28	99.57%	0.01%	O
3	16.874	213.47	16.820	213.46	99.68%	0.01%	O
4	16.846	213.40	16.763	213.37	99.51%	0.01%	O
5	16.823	213.37	16.761	213.35	99.63%	0.01%	O
6	16.823	213.51	16.779	213.49	99.74%	0.01%	O
7	16.822	213.26	16.750	213.24	99.57%	0.01%	O
8	16.812	213.31	16.759	213.29	99.68%	0.01%	O
Note: L-Leakage ; V-Venting ; D-Disassembly ; R-Rupture ; F-Fire							
O-No Leakage , No Venting , No Disassembly , No Rupture , No Fire							

38.3.4.5	T.5 External Short circuit																																																																																														
Test Equipment	Digital Meter:Q-153			Data Logger:Q-075			Oven:Q-171																																																																																								
Test Period	Start: 2020/05/21					End:2020/05/22																																																																																									
<table border="1" style="margin: auto;"> <thead> <tr> <th colspan="3" style="background-color: yellow;">Short Circuit Test on Charged Packs</th> </tr> <tr> <th style="background-color: yellow;">No.</th> <th style="background-color: yellow;">Max. Temp.(°C)</th> <th style="background-color: yellow;">Other event</th> </tr> </thead> <tbody> <tr><td style="background-color: yellow;">1</td><td style="background-color: lightgreen;">56.08</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">2</td><td style="background-color: lightgreen;">56.78</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">3</td><td style="background-color: lightgreen;">57.11</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">4</td><td style="background-color: lightgreen;">57.32</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">5</td><td style="background-color: lightgreen;">56.95</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">6</td><td style="background-color: lightgreen;">58.11</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">7</td><td style="background-color: lightgreen;">58.01</td><td style="background-color: lightgreen;">O</td></tr> <tr><td style="background-color: yellow;">8</td><td style="background-color: lightgreen;">57.16</td><td style="background-color: lightgreen;">O</td></tr> </tbody> </table> <p>Note: D-Disassembly ; R-Rupture ; F-Fire O- No Disassembly , No Rupture , No Fire</p>												Short Circuit Test on Charged Packs			No.	Max. Temp.(°C)	Other event	1	56.08	O	2	56.78	O	3	57.11	O	4	57.32	O	5	56.95	O	6	58.11	O	7	58.01	O	8	57.16	O																																																						
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Test Equipment	Digital Meter:Q-153			Data Logger:Q-152			Impact tester :Q-231/Crush tester:Q-0437																																																																																								
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