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SPECIFICATION

Type:	Ni-CD Cylindrical Cell
Model No.:	ITL-4000D
Prepared:	HML
Approved:	LFX
Date:	Aug 22, 2008



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1. PREFACE

This specification applies to the Intec Nickel Cadmium Cylindrical batteries or battery packs. Intec reserves the right to alter the product design or amend this specification without prior notice.

2. SCOPE

This specification applies to nickel cadmium cylindrical rechargeable single cell ITL-4000D. This cell is suitable for the permanent charge application at high temperature.

3. REFERENCE DOCUMENTS

IEC 61951 (2003) 《sealed Ni-CD cylindrical rechargeable single cells》.

4. GENERAL ELECTRICAL SPECIFICATION

	<i>SPECIFICATION</i>	<i>REMARKS</i>
Intec Cell Designation	ITL-4000D	
Nominal Voltage	1.2V	
Rated Capacity	4000mAh	At 20°C
Charge Current		
Permanent	200mA	36 – 48 hrs
Standard	400mA	16 – 20 hrs
Quick	1400mA	3 – 4 hrs with end of charge detection
Discharge Current		
Maximum Discharge (Continuous)	10 A	
Maximum Discharge (Momentary)	40 A	
Internal Impedance	10 mΩ	At 1000 Hz
Operating Temperature		
Charge (standard) 0.1C	5 to 65°C	
Charge (quick)	10 to 55°C	
Storage Recommended	5 to 25°C	
Extended Storage	-20 to 60°C	Short duration (<1 month)
In discharge	-20 to 70°C	



5. GENERAL MECHANICAL SPECIFICATION

Bare Cell Drawing (mm)	Bare Cell Dimensions
	Maximum Diameter(mm): 32.5 Maximum Height(mm): 60.3
	Typical Weight (g): 125

6. CAPACITY

6.1 IEC capacity:

IEC capacity is rated as follow:

Temperature: $20 \pm 5^\circ\text{C}$;

Charge current: $0.1C=400\text{mA}$;

Charge duration: 16h;

Rest: 1 to 4h;

Discharge current: $0.2C=800\text{mA}$;

Discharge end voltage: 1.0V/cell

The discharge continues until the voltage drops to 1.0V/cell, and the duration must not be less than 300 minutes. 3 Cycles are permitted. Therefore, the IEC capacity is 4Ah minimum.

6.2 Available capacity

The following table gives the minimum available capacity of ITL-4000D battery under various charge and discharge conditions. The temperature is $20 \pm 5^\circ\text{C}$, and the batteries are fully charged prior to testing.

<i>Charge</i>	<i>Permanent</i>	<i>Normal</i>
Rate	0.05C	0.1C
Current(mA)	200	400
Duration(h)	>36	16
Rest after charged(h)	0	1
<i>Discharge*</i>	<i>Capacity(mAh)</i>	<i>Capacity(mAh)</i>
0.2C(1000mA)	3900	4300
C(4000mA)	3600	4000
2C(8000mA)	3100	3400

Discharge end voltage: 1.0V/cell.



7. CHARGE

7.1 Permanent Charge

The ITL-4000D cells can be permanently charged between 0 to 55°C with a constant current of 200mA (0.05C).

Occasional temperature (0 to 70°C) is acceptable for a short duration.

7.2 Normal Charge

0.1C (400mA) for 14 to 16h.

The temperature during charge is ranged 10 to 65°C.

8. TEMPERATURE CHARACTERISTIC

The following table gives the typical available capacity of a ITL-4000D battery under the charge conditions:

- Standard Charge: C/10 for 16 hours
- Charge Temperature : +20±5°C
- Maximum rest after charge: 4 hours at temperature of discharge

Capacities (mAh) are given for a final discharge voltage of 1.0 volt / cell. Deviation depending on test conditions may be observed.

TEMPERATURE OF DISCHARGE	Discharge Rate C/5=0.2C=800mA		Discharge Rate C/2=0.5C=2000mA		Discharge Rate 1C=4000mA	
	Capacity	%C	Capacity	%C	Capacity	%C
+65°C	3400	85%	3200	80%	2800	70%
+45°C	3680	92%	3440	86%	3080	77%
+20°C	4240	106%	4120	103%	4000	100%
0°C	3320	83%	3000	75%	2400	60%
-20°C	2800	70%	2400	60%	2000	50%

9. CHARGE RETENTION

After 28 days' storage at 20±5°C, a fully charged cell should retain typically 70% of its rated capacity.

10. STORAGE

Intec recommends to store the battery under the room temperature within a range of 5 to 25°C, and relative humidity is 65±5%. An extended storage within -20 to +60°C temperature range and 65±20% relative humidity is permitted in short period.

11. SERVICE LIFE FOR PERMANENT CHARGE APPLICATION

Battery service life depends mainly on battery temperature and overcharge capacity. When the capacity falls to 60% of initial capacity, the battery life is over.

At the following average operating conditions, the battery life is 4 years:

- Battery operational temperature : 40°C;
- Permanent charge current: 0.05C;
- Discharge current: 0.5C;
- Work for 1~2 cycles per month.



12. PERMANENT CHARGE ENDURANCE

The permanent charge endurance test shall be performed in three steps according to the conditions specified in table 1.

It consists of:

- a charge efficiency test;
- an ageing period of six months at +70°C;

NOTE – The temperature of 70 °C is estimated to simulate four years of permanent charge operation at +55 °C. And

- a final charge efficiency test to check the cell’s performance after ageing.

Prior to the test, the cell shall be discharged at 0.2C₅A at 20°C±5°C to a final voltage of 1.0 V and stored for not less than 16 h and not more than 24 h at an ambient temperature of 55°C±2°C.

The cell shall then be charged and discharged at constant currents under the conditions specified in table 1 while maintained in an ambient temperature of 55°C±2°C or 70°C±2°C respectively as appropriate.

The discharge is carried out immediately on completion of charging.

After performing the first charge efficiency test at 55 °C the cell is stored for not less than 16 h and not more than 24 h at an ambient temperature of 70°C±2°C.

During the ageing period of six months at 70 °C, precautions shall be taken to prevent the cell-case temperature from rising above +75 °C, by providing a forced air draught, if necessary*.

*NOTE – actual cell temperature, not the ambient temperature, determines cell performance.

The discharge duration of the three cycles at +70 °C shall be recorded. Leakage of electrolyte shall not occur during this test.

After completion of the ageing period, the cells shall be stored for not less than 16 h and not more than 24 h at an ambient temperature of 55°C±2°C. The three cycles at 55°C of the initial charge efficiency test are then repeated using the conditions specified in table 1. The duration of discharge shall be not less than the minimum specified in table 1.

Table 1 – permanent charge endurance

Cycle number	Ambient Temperature	Charge	Discharge	Minimum Discharge duration
1	+55°C±2°C	0.05 C ₅ A for 48 h	0.2 C ₅ A to 1.0V	No requirement
2		0.05 C ₅ A for 24 h	0.2 C ₅ A to 1.0V	3 h 45 min
3		0.05 C ₅ A for 24 h	0.2 C ₅ A to 1.0V	3 h 45 min
4	+70°C±2°C	0.05 C ₅ A for 60 days	0.2 C ₅ A to 1.0V	No requirement
5		0.05 C ₅ A for 60 days	0.2 C ₅ A to 1.0V	
6		0.05 C ₅ A for 60 days	0.2 C ₅ A to 1.0V	
7	+55°C±2°C	0.05 C ₅ A for 48 h	0.2 C ₅ A to 1.0V	No requirement
8		0.05 C ₅ A for 24 h	0.2 C ₅ A to 1.0V	2 h 30 min
9		0.05 C ₅ A for 24 h	0.2 C ₅ A to 1.0V	2 h 30 min

A Intec ITL-4000D cell shall pass all the testing steps and with result as follows:

- Step 2: Minimum discharge duration 4 hours/3200mAh
- Step 3: Minimum discharge duration 4 hours/3200mAh
- Step 8: Minimum discharge duration 3 hours/2400mAh
- Step 9: Minimum discharge duration 3 hours/2400mAh



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13. ICEL TEST PROCEDURE

- Cycle 1: at a cell temperature of 55°C, charge for 48hours at C/16 and then discharge at 0.25C. No minimum duration requirement.
- Cycle 2: at a cell temperature of 55°C, charge for 24hours at C/16 and then discharge at 0.25C. 3hours minimum duration requirement.
- Cycle 3: at a cell temperature of 55°C, charge for 24hours at C/16 and then discharge at 0.25C. 3hours minimum duration requirement.
- Raise cell temperature to 70°C then at a cell temperature of 70°C, charge for 28 days at C/16 and then discharge at 0.25C. No minimum duration requirement.
- Cycle 5: Bring cell temperature down to 55°C, then at a cell temperature of 55°C, charge for 48hours at C/16 and then discharge at 0.25C. No minimum duration requirement.
- Cycle 6: at a cell temperature of 55°C, charge for 24hours at C/16 and then discharge at 0.25C. 3 hours minimum duration requirement.
- Cycle 7: at a cell temperature of 55°C, charge of 24hours at C/16 and then discharge at 0.25C. 3hours minimum duration requirement.

A Intec ITL-4000D cell shall pass the above testing with result as follows:

- At cycle 2: Minimum discharge duration 3.5hours/3500mAh.
- At cycle 3: Minimum discharge duration 3.5hours/3500mAh.
- At cycle 6: Minimum discharge duration 3hours/3000mAh.
- At cycle 7: Minimum discharge duration 3hours/3000mAh.

14. REFERENCE

Please refer to Intec's Customer Service if there is any question on using batteries.