U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

FEB 2 0 2015

Carol Vierling
Acting Regulatory Affairs Manager
Invacare Corporation
One Invacare Way
P.O. Box 4028
Elyria, OH 44036

Ref. No. 15-0002

Dear Ms. Vierling:

This responds to your December 30, 2014 letter requesting clarification of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) applicable to a portable oxygen concentrator (POC). Specifically, you inquire about obtaining approval from the Pipeline and Hazardous Materials Safety Administration (PHMSA) and the Federal Aviation Administration (FAA) to allow a passenger to carry and operate the POC on board an aircraft.

According to your letter, the POC (trade name Invacare XPO_2) is a device for use by patients requiring high concentrations of oxygen on a supplemental basis. The device in question is a modified version of an earlier model of the Invacare XPO_2 POC that is currently listed in Special Federal Aviation Regulation 106, *"Rules for Use of Portable Oxygen Concentrator Systems on Board Aircraft"* (SFAR 106) and approved for use on board aircraft. The modified version of the Invacare XPO_2 POC for which you seek approval has a maximum operating pressure of less than 21.0 pounds per square inch (psia). It is powered by multiple sources, including AC or DC power, a captive internal lithium ion battery pack, and a rechargeable external accessory lithium ion battery pack. Both the captive internal lithium ion battery pack and the rechargeable external accessory lithium ion battery pack have a Watt-hour (Wh) rating of 83.5 (2.9 ampere-hour (Ah) x 3.6 volts (V) x 8 cells). Both the captive internal and the rechargeable external accessory lithium ion battery packs meet the appropriate testing requirements of the United Nations Manual of Tests and Criteria, and both battery packs are packaged in a manner to prevent short circuits. You ask whether the modified version of the Invacare XPO_2 POC is authorized under the HMR to be carried on board an aircraft.

Based on the information provided in your letter, the modified version of the Invacare XPO_2 POC is not subject to the HMR as a Division 2.2 non-flammable gas, the captive internal and the rechargeable external accessory lithium ion battery packs used to power the device

conform to § 175.10(a)(18), and the POC contains no other hazardous materials. Therefore, in accordance with HMR § 175.10(a)(18), the modified version of the Invacare XPO_2 POC is authorized to be carried on board an aircraft by passengers or crew members.

Please note that notwithstanding the passenger exception in § 175.10(a)(18) of the HMR, the provisions of SFAR 106 apply and are under the purview of the FAA. This response satisfies only one requirement in the FAA approval process before a POC may be carried and operated on board an aircraft. You may contact Ms. DK Deaderick in FAA's Flight Standards Service at (202) 267-7480 for questions regarding FAA's approval process.

I trust this satisfies your inquiry. Please contact us if we can be of further assistance.

Sincerely,

Duane A. Pfund
International Standards Coordinator
Standards and Rulemaking Division

December 30, 2014

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Hazardous Materials and Standards
1200 New Jersey Avenue, SE
Washington, D.C. 20590-0001

Dear Sir or Madam,

Invacare Corp. is requesting confirmation from the Pipeline and Hazardous Materials Safety Administration (PHMSA) that the Invacare® XPO_2™ Portable Oxygen Concentrator (XPO2 POC) is not subject to the U.S. Hazardous Materials Regulation (HMR) under HMR 49 CFR Parts 100-180 after review of all appropriate information.

Introduction

Invacare Corp. manufactures portable oxygen concentrators (POCs) and has marketed the XPO2 POC since receiving 510(k) clearance from the Food and Drug Administration (FDA) on December 12, 2007. The XPO2 POC is currently allowed to be used onboard aircraft and was added to SFAR No. 106 published in the Federal Register on January 15, 2009. As part of that application, Mr. Mazzullo of the U.S. Department of Transportation sent a letter to Invacare Corp. stating that the Invacare® XPO_2™ Portable Oxygen Concentrator is not subject to the HMR. Please refer to Attachment 1 for the Federal Register Notice.

The XPO2 POC continues to provide oxygen by separating oxygen from room air utilizing a molecular sieve and pressure swing adsorption methodology. The resultant concentrated oxygen is directed toward an oxygen reservoir for delivery to the patient. The XPO2 device delivers the oxygen to the patient through the pulse delivery method for maximum effectiveness and operational time. This means that the subject devices deliver oxygen only when a breath is detected. If no breath is detected (i.e. the cannula detaches from the device or the patient takes the cannula off), no oxygen is delivered. This feature of delivering oxygen only when a breath is detected prevents oxygen saturation of the surrounding area or materials when the cannula is not connected to the concentrator or the patient. The technological characteristics of the modified XPO2 POC remains the same as the original XPO_2 Portable Oxygen Concentrator listed under SFAR No. 106. Please refer to Attachment 2 for the finished device drawing.

INVACARE CORPORATION
One Invacare Way P.O. Box 4028 Elyria, Ohio 44036-2125 USA

Yes, you can.®

Proposed Modifications

Invacare Corporation has modified the internal and external batteries of the XPO2 device to improve use duration and to increase the expected life cycle. In addition, some minor design changes have also been incorporated for quality improvement purposes only.

Power Source for the Invacare XPO2 POC

The subject device can be powered by an internally captive lithium ion battery pack that is not customer removable or replaceable, an external AC to DC power adapter, an external DC to DC power adapter, or an external accessory lithium ion battery pack. This allows for maximum flexibility and operational time with multiple power sources. Recharging of either the internal or external accessory batteries is only available with the use of the Invacare supplied AC/DC or DC/DC power adapters.

The internally captive lithium ion battery pack (see Attachment 3) consists of 8 cylindrical 2.9 amp-hour lithium ion cells with a total lithium equivalent content of 6.36 grams of lithium, and watt hour rating of 85.3 Whr (see Attachment 4). The internally captive battery pack is not user accessible and not replaceable by a patient/user. The internally captive mechanism of the subject devices also prevents any user from generating sparks or short-circuiting as it is not externally accessible. The battery pack terminals are not exposed to any outside contact by virtue of being totally integrated into the product.

The external accessory battery module for extended operating time is a self-contained power accessory for the XPO2 device. The external battery module contains a separate lithium battery pack that consists of 8 cylindrical 2.9 amp-hour lithium ion cells with a total lithium equivalent content of 6.36 grams of lithium, and watt hour rating of 85.3 Whr. The lithium battery pack is not user accessible and is not replaceable by a patient/user. The captive mounting mechanism of the external battery module also prevents any user from generating sparks or short-circuiting the lithium battery pack. The battery pack terminals are not exposed to any outside contact as they are connected to an intervening power switching and charging circuit board that interfaces to the Invacare XPO2 device. The external battery module connection cable contains a connector that prevents accidental shorting or generation of sparks during handling or storage. Please refer to Attachment 5 for the external battery module, external battery pack, circuit board schematic and external battery module connection cable.

The table below compares the XPO2 POC currently marketed with PHMSA approval in 2008 and the evaluation results of the proposed modification

PHMSA Special Provision 188 Comparison Table Invacare XPO2 Portable Oxygen Concentrator

		PHMSA 2008 Approval		2014 Submittal		
Item	PHMSA Criteria	Value	Result	Value	Result	Comments
1	Pressure of the oxygen in the device does not exceed 40.6 PSIA at 20C	< 21 PSIA	Pass	< 21 PSIA	Pass	No change
2	Lithium cells do not contain more than 1.5 grams of lithium equivalent content	2.6 AH Cell 0.78 L.E.gram	Pass	2.9 AH Cell 0.87 L.E.gram	Pass	Slight increase in lithium content
3	Lithium batteries contain an aggregate equivalent lithium content of not more than 8g	8 cells/battery 6.24 L. E. grams	Pass	8 cells 6.96 L. E. grams	Pass	Slight increase in lithium content
4	The device contains no other materisl sujbect to the HMR	No other hazardous materials	Pass	No other hazardous materials	Pass	No change
5	The batteries are fully contained in equipment and packaged in a manner to preclude sparks or the generation of a dangerous quantity of heat	Fully contained inside of protective product enclosure	Pass	Fully contained inside of protective product enclosure	Pass	No change

L.E. gram = Lithium equivalent grams content

Yes, you can.®

Compliance with RTCA/DO-160G

The Invacare XPO2 POC has successfully undergone testing pursuant to the requirements of RTCA/DO-160G, Section 21, Category M to demonstrate that the device will not interfere with an aircraft's electrical, navigation or communication equipment. A summary of the test report is provided in Attachment 6.

Conclusion

In conclusion, the updated XPO2 device continues to meet the five PHMSA Special Provision 188 criteria. In addition, data show acceptable RTCA DP-160 test results. Based on this information, Invacare Corp. asks that the PHMSA confirm that the Invacare XPO2 device is not subject to the U.S. Hazardous Materials Regulation under HMR 49 CFR Parts 100-180.

Invacare has discussed the minor modifications to the XPO2 with the Federal Aviation Administration (FAA) and submitted the proposed changes with supporting documents to the agency. Prior to their approval, the FAA has requested that Invacare Corp. obtain a letter from the PHMSA stating that the XPO2 does not contain hazardous materials.

We would appreciate your timely response. A letter from the PHMSA is all that is needed for FAA approval. If you have any questions, please contact me by telephone at 706-476-2938 or by email at carol.vierling@yahoo.com.

Sincerely,

Carol Vierling
Acting RA Manager

INVACARE CORPORATION
One Invacare Way P.O. Box 4028 Elyria, Ohio 44036-2125 USA

more about SBREFA on the Internet at our site, *http://www.faa.gov/regulations_policies/rulemaking/sbre_act/*.

Authority for This Rulemaking

The FAA's authority to issue rules regarding aviation safety is found in Title 49 of the United States Code (49 U.S.C.). Subtitle I, Section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

The FAA is authorized to issue this final rule pursuant to 49 U.S.C. 44701. Under that section, the FAA is authorized to establish regulations and minimum standards for other practices, methods, and procedures the Administrator finds necessary for air commerce and national security.

Background

On July 12, 2005, the FAA published Special Federal Aviation Regulation 106 (SFAR 106) entitled, "Use of Certain Portable Oxygen Concentrator Devices On Board Aircraft" (70 FR 40156). SFAR 106 is the result of a notice of proposed rulemaking (NPRM) the FAA published in July 2004 (69 FR 42324) to address the needs of passengers who must travel with medical oxygen. Prior to publication of SFAR 106, passengers in need of medical oxygen during air transportation faced many obstacles when requesting service. Many aircraft operators did not provide medical oxygen service aboard flights, and those that did often provided service at a price that travelers could not afford. Coordinating service between operators and suppliers at airports was also difficult, and passengers frequently chose not to fly because of these difficulties.

New medical oxygen technologies approved by the Food and Drug Administration (FDA) reduce the risks typically associated with compressed oxygen and provide a safe alternative for passengers who need oxygen therapy. Several manufacturers have developed small portable oxygen concentrator (POC) devices that work by separating oxygen from nitrogen and other gases contained in ambient air and dispensing it in concentrated form to the user with an oxygen concentration of about 90%. The POC devices operate using either rechargeable batteries or, if the aircraft operator obtains approval from the FAA, aircraft electrical power.

In addition, the Pipeline and Hazardous Materials Safety Administration (PHMSA) has determined that the POC devices covered by this amendment are not hazardous materials. Thus, they do not require the same level of special handling as compressed oxygen, and are safe for use on board aircraft, provided certain conditions for their use are met.

SFAR 106 permits passengers to carry on and use certain POC devices on board aircraft if the aircraft operator ensures that the conditions specified in the SFAR for their use are met. The devices initially determined acceptable for use in SFAR 106, published July 12, 2005, were the *AirSep Corporation's LifeStyle* and the *Inogen, Inc.'s Inogen One* POCs. SFAR 106 was amended on September 12, 2006 (71 FR 53954) to add three additional POC devices, *AirSep Corporation's FreeStyle, SeQual Technologies' Eclipse*, and *Repironics Inc.'s EverGo*, to the original SFAR. This final rule adds two additional POC devices, *Delphi Medical Systems' RS–00400* and *Invacare Corporation's XPO2*, that may be carried on and used by a passenger on board an aircraft.

Aircraft operators can now offer medical oxygen service as they did before SFAR 106 was enacted, or they can meet certain conditions and allow passengers to carry on and use one of the POC devices covered in SFAR 106. SFAR 106 is an enabling rule, which means that no aircraft operator is required to allow passengers to operate these POC devices on board its aircraft, but it may allow them to be operated on board. If the aircraft operator allows one of these devices to be carried on board, the conditions in the SFAR must be met.

When SFAR 106 was originally published, the FAA committed to establishing a single standard for all POC devices so that regulations would not apply to specific manufacturers and models of devices. Whenever possible, the FAA tries to regulate by creating performance-based standards rather than approving specific devices by manufacturer. In the case of SFAR 106, the quickest and easiest way to serve both the passenger and the aircraft operator was to allow the use of the devices determined to be acceptable by the FAA in SFAR 106 in a special, temporary regulation. As we stated in the preamble discussion of the final rule that established SFAR 106, "while we are committed to developing a performance-based standard for all future POC devices, we do not want to prematurely develop standards that have the effect of stifling new technology of which we are unaware." We developed and published SFAR 106 so that passengers who otherwise could not fly could do so with an affordable alternative to what existed before SFAR 106 was published.

We continue to pursue the performance-based standard for all POC devices. This process is time-consuming and we intend to publish a notice in the **Federal Register** and offer the public a chance to comment on the proposal when it is complete. In the meantime, manufacturers continue to create new and better POC devices, and several have requested that their product also be included as an acceptable device in SFAR 106. These new manufacturers include Delphi Medical Systems and Invacare Corporation. Each of these companies has formally petitioned the FAA for inclusion in SFAR 106 by submitting documentation of the devices to the Federal Docket Management System. That documentation is available at *http://www.regulations.gov* under the following docket numbers:

1. Delphi Medical Systems—FAA–2008–0261; and

2. Invacare Corporation—FAA–2008–0278.

As stated in Section 2 of SFAR 106, no covered device may contain hazardous materials as determined by PHMSA (written documentation necessary), and each device must also be regulated by the FDA. Each petitioner included technical specifications for the devices in their request for approval, along with the required documentation from PHMSA and the FDA. The petitioners provided the FAA with the required documentation for the following POC devices:

1. Delphi Medical Systems', Model RS–00400; and

2. Invacare Corporation's, Model XPO2.

The Rule

This amendment to SFAR 106 will include the *Delphi Medical Systems' RS–00400* and *Invacare Corporation's XPO2* devices in the list of POC devices authorized for use in air commerce. The FAA has reviewed each individual device and accepted the documentation provided by the two manufacturers. That documentation includes letters provided to the manufacturer by PHMSA and the FDA affirming the status of each device as it pertains to the requisites stated in SFAR 106.

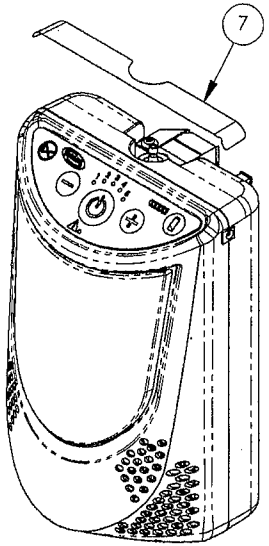
After reviewing the applicable FDA safety standards and the PHMSA findings, these two devices were determined by the FAA to be acceptable for use in air commerce.

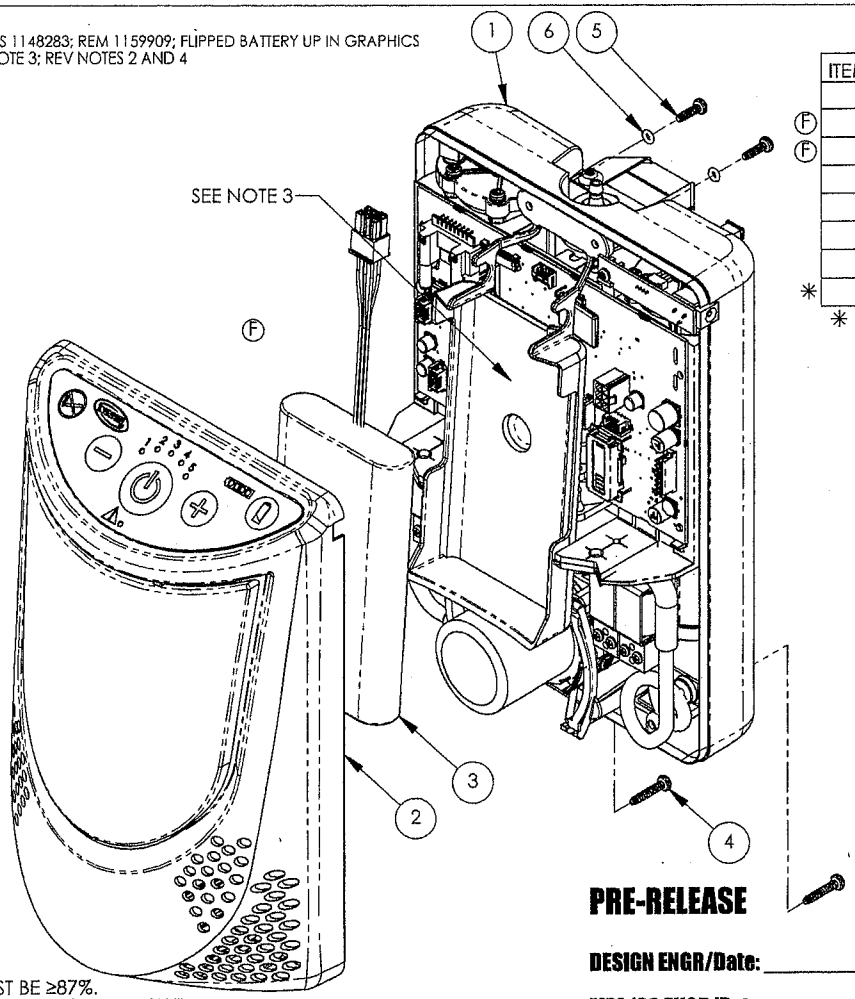
Good Cause for Adoption of This Final Rule Without Notice and Comment

As stated above, SFAR 106 was published on July 12, 2005. We stated in the preamble of that final rule that

REVISIONS: (1321003)
00. 2/25/14 SW 1184860 WAS 1151580; 1183927 WAS 1148283; REM 1159909; FLIPPED BATTERY UP IN GRAPHICS
01. 3/10/14 SW REV SPEC. NOTE 2; ADDED SPEC. NOTE 3; REV NOTES 2 AND 4
02. 7/2/14 SW REV CONTROL PANEL GRAPHICS

PART NO. 1148300

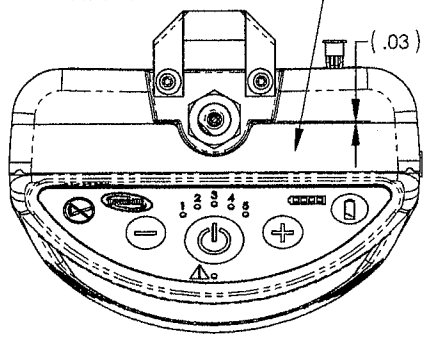




ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	1151575	ASM, REAR XPO2	1
Ⓕ 2	1184860	ASM, FRONT XPO2	1
Ⓕ 3	1183927	ASM, BATTERY PACK INTERNAL XP02	1
4	1151831	SCREW, 6-19 X .75 TORX PAN HD PLASTITE	2
5	1151560	SCREW, 6-19 X .50 TORX PAN HD PLASTITE	2
6	1148328	O-RING, .114 ID X .070	2
7	1151839	SEAL/NOTICE, XPO2	1
✳ 8	1147000	FERRITE, SNAPON	1

✳ NOT SHOWN

SEAL/NOTICE TO BE APPLIED TO ASSEMBLED UNIT, POSITIONED AS SHOWN. SEE NOTE 2.



NOTES:
1. TORQUE SCREWS (ITEMS 4 & 5) TO 3 IN-LBS.
2. PRIOR TO APPLYING SEAL (ITEM 7) CLEAN SURFACES TO WHICH SEAL WILL ADHERE THOROGHLY WITH ALCOHOL WIPE(S).
3. REMOVE PROTECTIVE COVER/FILM PRIOR TO INSTALLING BATTERY.
4. INSTALL FERRITE (ITEM 8) ON RED AND BLACK WIRE OF BATTERY (ITEM 3).

SPECIFICATIONS:
1. THE OXYGEN PURITY DELIVERED MUST BE ≥87%.
Ⓕ 2. OXYGEN WETTED SURFACES ARE TO BE BIOCOMPATIBLE.
Ⓕ 3. THE OXYGEN GAS MUST MEET THE REQUIREMENTS OF USP 93 EXCEPT FOR THE OXYGEN PERCENTAGE REQUIREMENT BEING GREATER THAN OR EQUAL TO 87%.
Ⓕ 4. THE XPO2 MUST BE FREE OF LEAKS IN OXYGEN WETTED PATHWAY.

PRE-RELEASE

DESIGN ENGR/Date: _____

MFG/SQ ENGR/Date: _____

QUALITY/Date: _____

▷ = CRITICAL QUALITY ATTRIBUTE

▲ = KEY CHARACTERISTIC IDENTIFICATION

ANSI/ASME Y14.5M-1994
UNLESS OTHERWISE SPECIFIED

REV LTR	C/R NO.	REVISION	DATE	BY	CK	ENG.	ENG.
F	1321003	PENDING OUTCOME OF PRELIM CHANGES	XX/XX/XX				
E	1421004	ADDED SPECIFICATIONS	3/14/14				
D	1121049	REVISION LEVEL RELEASED IN ERROR	10/7/11				
C	1121004	REV; ADDED 1147000 QTY1; ADDED NOTE 4	01/27/11				

FINISH:

MATERIAL NO:

MATERIAL DESCRIPTION:

AMT PER PC:

SCALE: 1:2 DATE: 11/16/07

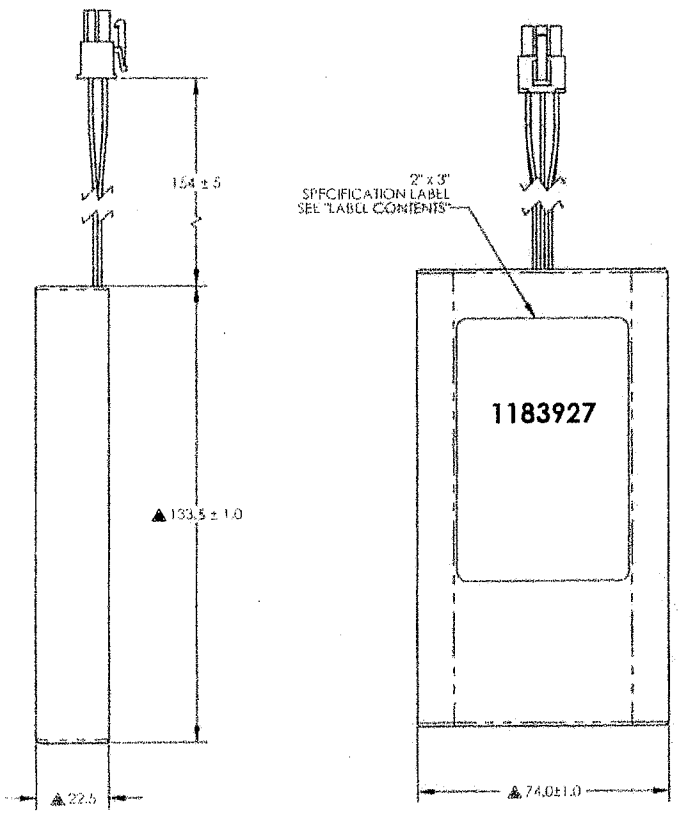
DRAWN BY: HODOS

PART DESCRIPTION: ASM, CONCENTRATOR XPO2

DRAWING SIZE: B

INVACARE CORP. ELYRIA OHIO

PART NO. 1148300



Cell Protection:
- Overcharge detection: 4.3 +/-0.05V
  (1 sec delay, resume 4.1 +/-0.05V)
- Overdischarge detection: 2.7 +/-0.05V
  (1 sec delay, resume 3.0 +/-0.05V)
- First tier over current discharge protection ≥ 6 AMPS(2 second delay)
- Second tier over current discharge protection ≥ 6.6 AMPS(1 second delay)
- Hardware over current discharge protection ≥ 7.5 AMPS(15 millisecond delay)
- Short circuit condition will be set at 25 Amps for 549 Micro seconds

Ambient Conditions/ Temp range:
- Charge 10 to 60 deg C
- Discharge 25 to 70 deg C

Charge retention / storage (%)
- 1 year @ -20 to +20 C > 70%
- 3 months @ -20 to +45 C > 70%
- 1 month @ -20 to +60 C > 70%

Humidity: 65 +/-20% RH

Environmental and Safety
1. Cell is approved according to UL1642 and IEC62133
2. Battery assembly is RoHS compliant
3. ELC of assembly = 6.96g
4. Battery pack must meet all IATA requirements
5. Watt-hour rating of 83.5Whr

Label Requirements
Label to be of Polypropylene material and marked with permanent text and graphics with tamper resistant adhesive backing.

Label contents
Label information to include at a minimum:
- Invacare and Mfgs P/N's
- The phrase "Lithium Ion" accompanied by electrical specs and series/parallel info
- Watt hour rating
- Cell Manufacturer P/N
- Name and location of assembler
- WEEE ANNEX iV symbol
- Serial number formatted MMYY-XXXXX
  - MMYY= month / year of assembly
  - XXXXX = sequential assembly starting at 00001 beginning each month
- The phrase "Lithium Ion Battery" bolded
- The phrases
  - Do Not Incinerate
  - Do Not Disassemble
  - Do Not Short Terminals
  - Do Not Expose to High Temperatures (140F / 60C)
- Warning symbol
- Current Software Revision

Specifications
-Lilon battery (4S2P) w/ shrink sleeve & safety circuit w/ fuel gauge based on TI# BQ20Z95.
- Cell: Panasonic NCR18650
- PCM: Vecture # VC4126. - Thermistor: 10K ohm
- Weight: 410g
- Rated Capacity: 5500mAh min., 5800mAh typical
-Nominal Voltage: 14.4V
-Charging Method:Constant current+constant voltage
-Max charge voltage: 16.80V (+/-0.2V)
-Max continuous charge current: 3A
-Rec charge cutoff: 160mA or by time 4h
-Max continuous discharge current: 6A
-Rec. discharge cutoff: 12V
-Internal Impedance: Approx. 180mOhm
-Exp. Life cycle: >300 cycles>70% of initial cap.
-Thermostat operating temperature:
  Opening temp. (off): 77°C ±5°C
  Closing temp. (on): 45°C Appox.
  Differential: Approx 6°C
-Min state of charge: 30%. Place battery in "Shut Down" mode

NOTES
-Visible surfaces to be free of scratches, marks and foreign substances.
-Label S/N to consist of: MMYY followed by incremental 5 digit number.
IE: 0310-00001 = March, 2010 - First pack of that P/N shipped.
-Software Version: 05

Connector Molex 39-01-2060				
Pin 1	SMBus Clock	Yellow	AWG22	UL1061
Pin 2	SMBus Data	Green	AWG22	UL1061
Pin 3	Thermistor 10K ohm	White	AWG22	UL1061
Pin 4	Batt -	Black	AWG20	UL1061
Pin 5	NC	-----	-----	-----
Pin 6	Batt +	Red	AWG20	UL1061

PRE-RELEASE

SIGNATURE ON FILE SEE DISTRIBUTION #038

DESIGN ENGR/Date: _____

MFG/SQ ENGR/Date: _____

QUALITY/Date: _____

▷ = CRITICAL QUALITY ATTRIBUTE

⚠ = KEY CHARACTERISTIC IDENTIFICATION

	ASM, BATTERY PACK INTERNAL XP02		C
	INVACARE CORP.		1183927

Panasonic
ideas for life

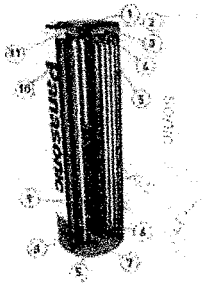
NCR-18650

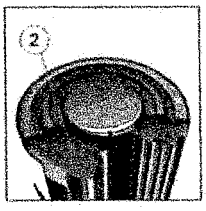
LITHIUM-ION / NNP + HRL TECHNOLOGY

Panasonic is one of the leading Lithium-Ion battery manufacturers in the world. A perfect combination of high energy density, safety and long life shows what is possible with this battery technology. A continuous co-development with electronical companies all over the world has led to outstandingly good results. Panasonic especially focuses on enhancing safety technologies such as PSS and HRL in order to always guarantee people's safety. On the top of this we have invented our so called NNP technology which gives us the possibility to achieve eminently high battery capacities. Excellent battery safety on one hand, and superior battery performance on the other: this is what Panasonic stands for.

LI-ION • 3D ILLUSTRATION

1 Positive pole
2 PTC (positive temperature coefficient device)
3 Gasket
4 Collector
5 Insulator
6 Cathode
7 Anode
8 Negative pole (cell can)
9 Separator
10 CID (current interrupt device)
11 Exhaust gas hole



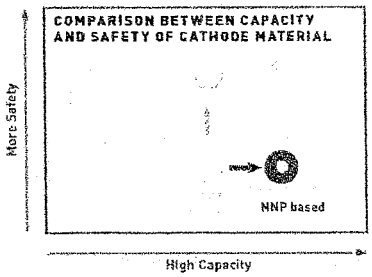


NNP TECHNOLOGY

Li-Ion battery cells have become indispensable as a power source for cordless equipment, such as laptops, that supports a ubiquitous society. As cordless devices become more sophisticated and powerful, they require more robust battery cells. Panasonic has responded to these challenges with the new battery cells, employing its unique high capacity nickel based positive electrode technology as well as its material and processing technology which prevents deformation of the alloy-based negative electrode when subjected to repeated charge and discharge. This new battery technology is called **Nickel Oxide based New Platform.***1

Characteristics of the new Panasonic NNP Technology:

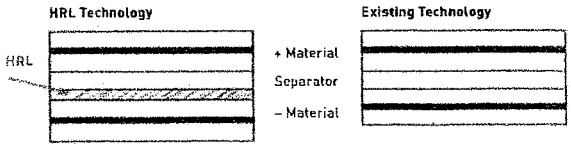
- → Superior cycle life performance
- → High energy density contributes to downsizing and weight reduction
- → The new nickel positive electrode exceeds regarding durability in actual use and charge retention
- → Excellent shelf-life due to low self-discharge performance



HRL TECHNOLOGY

As a power source for mobile and digital equipment essential for a ubiquitous networking society, demand for Lithium-Ion batteries has grown fast. As such equipment including notebook PCs, mobile phones, medical equipment and power-tools become more powerful, sophisticated and feature-laden, they require more robust and safer batteries. Increasing energy-density, however, raises the risk of overheating and igniting due to short-circuiting. Panasonic employs the **HRL (Heat Resistance Layer)** Technology to improve the safety of Lithium-Ion batteries significantly. This heat resistance layer consist of an insulating metal oxide on the surface of the electrodes which leads the battery not to overheat even if a short-circuit occurs.

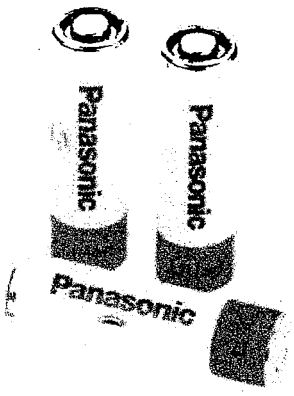
Safety is the base for everything. Higher Energy can be established based on safety technology.



Panasonic
Quality is ot

Panasonic Batteries

LITHIUM ION



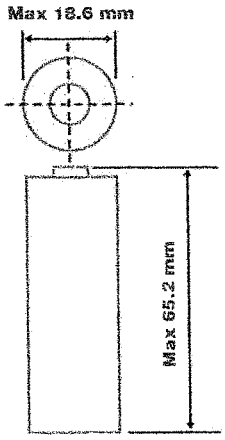
Features & Benefits

- High energy density and voltage
- Long stable power with flat discharge voltage
- Ideal for portable communications, portable computing and robotics

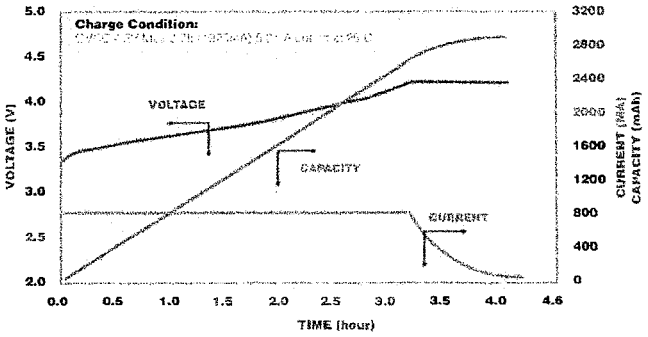
Specifications

Capacity:	2.9Ah Typical (Charge: CVCC, 4.2V, max. 1925mA, 50mA cutoff, 25°C) (Discharge: CC, 550mA, 2.5V cutoff, 25°C)
Nominal Voltage:	3.6V
Weight:	Approximately 44.5g

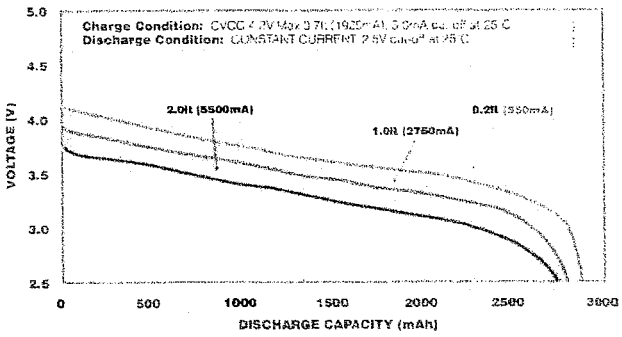
Dimensions



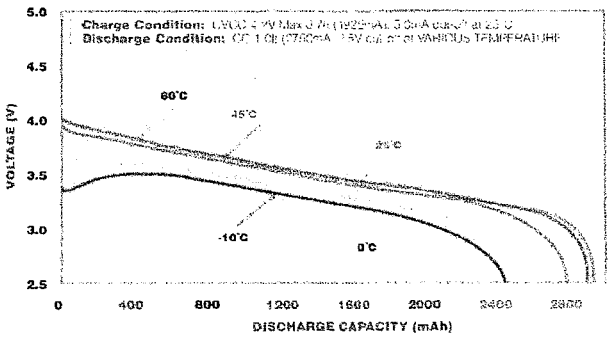
Charge Characteristics



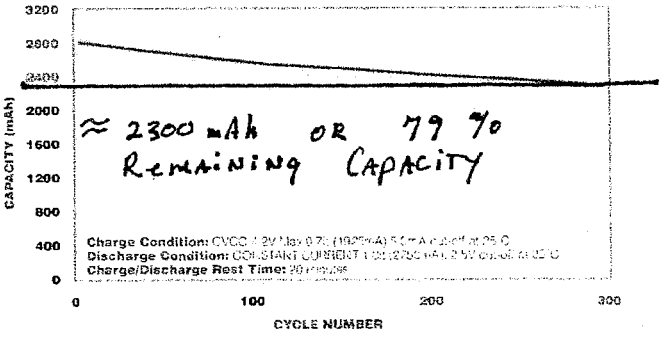
Discharge Characteristics



Discharge Characteristics



Cycle Life Characteristics (25°C)



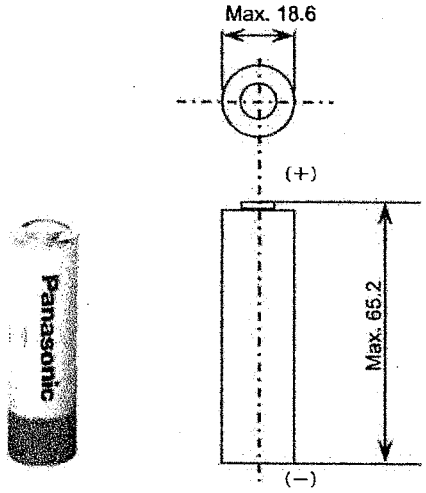
The data in this document is for descriptive purposes only and is not intended to make or imply any guarantee or warranty.

Panasonic ideas for life

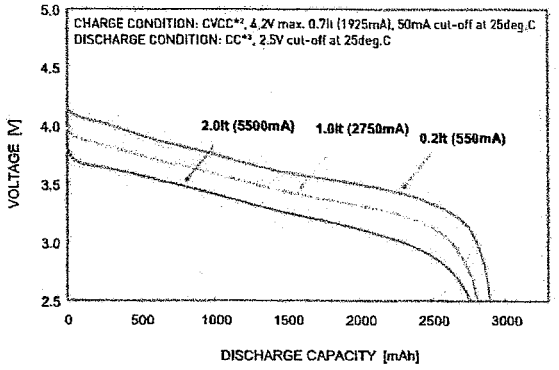
For more information on how Panasonic can assist you with your battery power solution needs call **877-726-2228**, visit **www.panasonic.com/industrial/batteries-oem** or e-mail **oembatteries@us.panasonic.com**

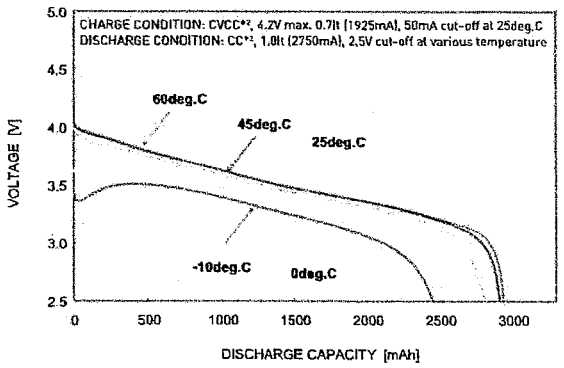
NCR-18650

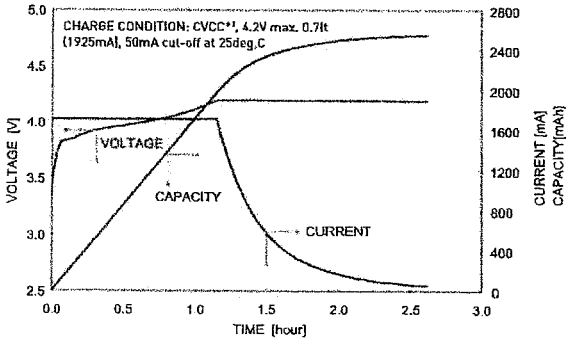
LITHIUM-ION / NNP + HRL TECHNOLOGY

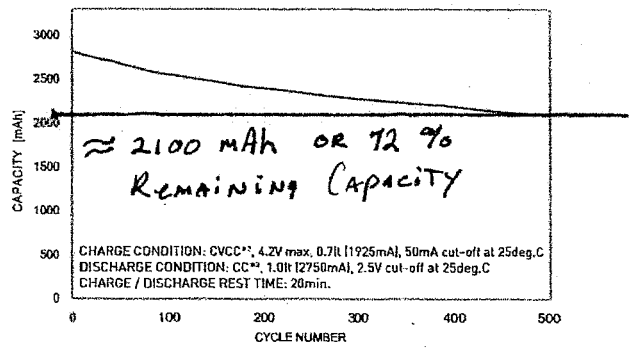


SPECIFICATIONS	
Model Number	NCR-18650
Nominal voltage (V)	3.6
Nominal capacity*1 - Minimum (mAh)	2,750
Nominal capacity*1 - Typical (mAh)	2,900
Dimensions - Diameter (mm)	max. 18.6
Dimensions - Height (mm)	max. 65.2
Approx. Weight (g)	45









⚠ Notice to Readers

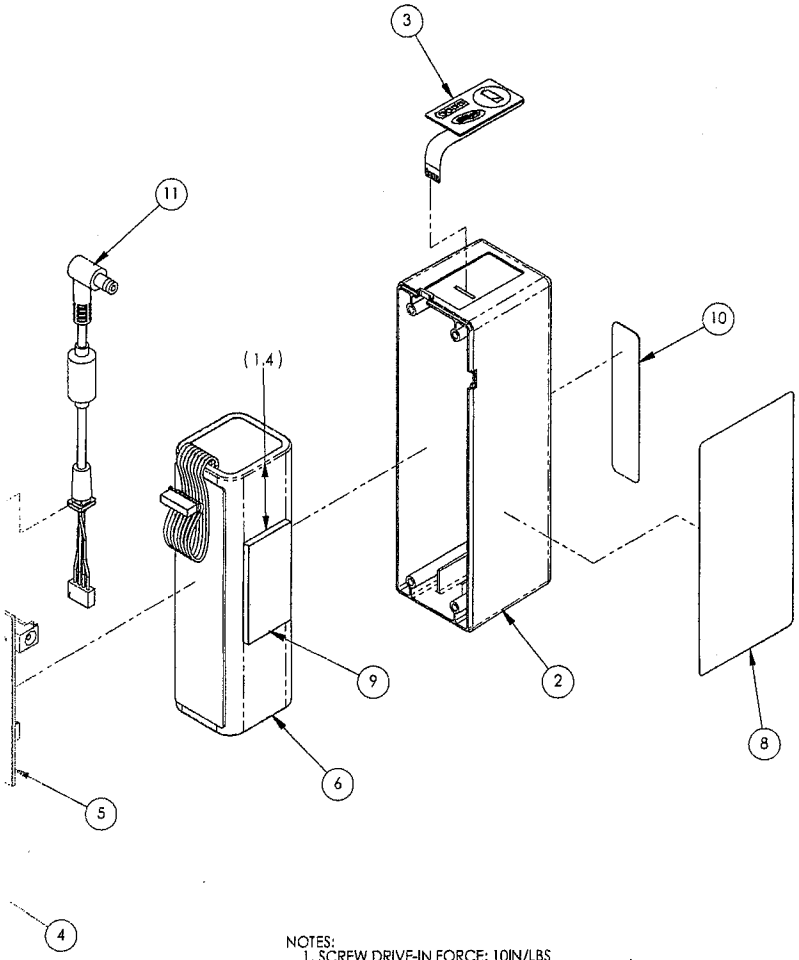
We are unable to support single cell business or accept orders from consumers. We design Lithium-Ion battery packs including a suitable safety unit device based on the technical specification of the customer. Due to the need for careful review when selecting Lithium-Ion battery solutions please contact your local Panasonic Sales Office. In order to avoid a lack of supply please check the battery availability with your Panasonic sales team before design-in.

Panasonic

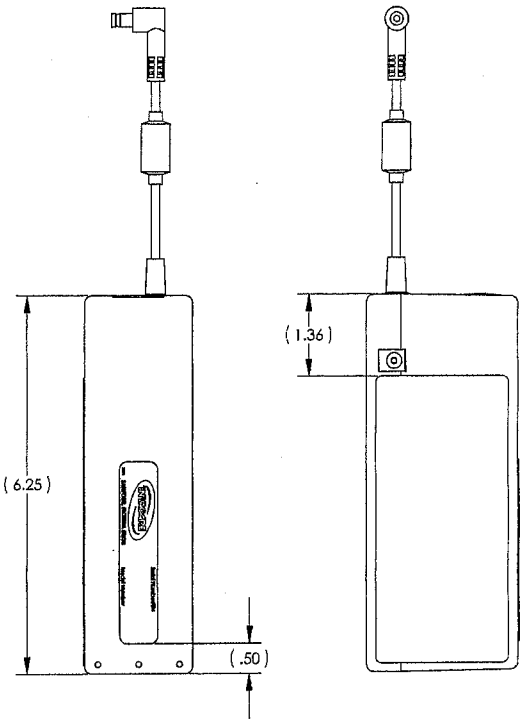
Panasonic Industrial Europe GmbH I Winsbergring 15 I 22525 Hamburg I Website: http://industrial.panasonic.com/eu

PART NO. 1184859

ITEM NO.	PART NO.	DESCRIPTION	QTY.
1	1148322	SHELL, EXTERNAL BATTERY FRONT XPO2	1
2	1148323	SHELL, EXTERNAL BATTERY REAR XPO2	1
3	1148321	SWITCH, MEMBRANE EXTERNAL BATTERY XPO2	1
4	1148324	BRACE, EXTERNAL BATTERY XPO2	1
5	1180060	ASM, PCB EXTERNAL BATTERY XPO2	1
6	1184130	BATTERY PACK, EXTERNAL BATTERY XPO2	1
7	1151560	SCREW, 6-19 X .50 TORX PAN HD PLASTITE	4
8	1184854	LABEL, WARNING XPO2 SUPPLEMENTAL BATTERY	1
9	1152766	FOAM, OPEN CELL 1/4 X 1 X 2 W/ PSA	1
10	1153701	LABEL, SERIAL NUMBER (SANFORD RESPIRATORY)	0
11	1180059	ASM, CABLE EXTERNAL BATTERY XPO2	1
12	1182067	MFG REQUIREMENTS, ESD	0



NOTES:
1. SCREW DRIVE-IN FORCE: 10IN/LBS
2. ON ITEM #1 & #9 REMOVE PAPER BACKING TO EXPOSE PSA AND ALIGN PER DIMENSIONS ABOVE
3. CENTER AND ADHERE 1152766 ON 1184130 AS SHOWN
4. POSITION ANY UNUSED WIRES ALONG THE FOAM PIECE WITH ANY CONNECTOR FACING UP



LABEL LOCATION VIEWS

▷ = CRITICAL QUALITY ATTRIBUTE

▲ = KEY CHARACTERISTIC IDENTIFICATION

MATERIAL NO:	
MATERIAL DESCRIPTION:	
AMT PER PO:	
SCALE: 1:1	DATE: 4/16/13
FINISH:	DRAWN BY: B. KUSHNER

PART DESCRIPTION: ASM, EXTERNAL BATTERY XPO2

DRAWING SIZE: C

INVACARE CORP. ELYRIA OHIO

PART NO. 1184859

DATE	BY	CK	ENG.	ENG.	ENG.	REV LTR	C/N NO.	REVISION	DATE	BY	CK	ENG.	ENG.

[illegible]

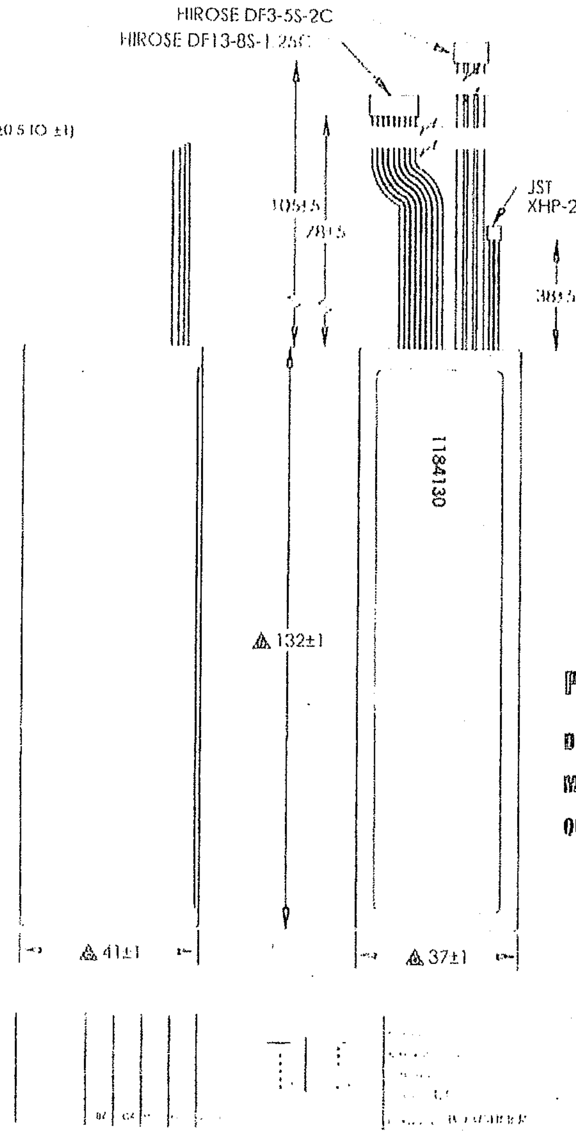
Label Requirements
Label to be of Polypropylene material and marked with permanent text and graphics with tamper resistant adhesive backing.

Label contents (4.39" x 1.00")
Label information to include at a minimum:
- Invacare and Mfg's P/N's
- The phrase "Lithium Ion" accompanied by electrical specs and [illegible]
- Watt hour rating
- Cell Manufacturer P/N
- Name and location of assembler
- WEEE ANNEX IV symbol
- Serial number formatted MMYY-XXXXX
  - o MMYY= month / year of assembly
  - o XXXXX = sequential assembly starting at 00001 beginning each month
- The phrase "Lithium Ion Battery" bolded
- The phrases
  - o Do Not Incinerate
  - o Do Not Disassemble
  - o Do Not Short Terminals
  - o Do Not Expose to High Temperatures (140F / 60C)
- Warning symbol
- Current Software Revision

Cell Protection:
Overcharge detection: 4.3 +/ 0.05V
(1 sec delay, resume 4.1 +/ 0.05V)
Overdischarge detection: 2.7 +/ 0.05V
(1 sec delay, resume 3.0 +/ 0.05V)
[illegible] over current discharge protection = 6 AMPS(2 second delay)
[illegible] over current discharge protection = 6.6 AMPS(1 second delay)
Hardware over current discharge protection = 7.5 AMPS(15 millisecond delay)
Short circuit condition will be set at 25 Amps for 549 Micro seconds

1"x4.375" SPECIFICATION LABEL: SEE "LABEL CONTENTS"

[illegible]



1184130

Specifications
[illegible] battery (4S2P) w/ shrink sleeve & safety circuit w/ fuel gauge
[illegible]
Cell: Panasonic NCR18650
- PCM [illegible] VC4126 Thermistor 10K ohm
Weight [illegible]
- Rated Capacity [illegible]
Nominal Voltage 14.4V
Charging Method Constant current constant voltage
Max charge voltage [illegible]
Max continuous charge current [illegible]
Max charge cutoff [illegible]
Max continuous discharge current [illegible]
Max discharge cutoff [illegible]
Internal Impedance Approx. [illegible]
Exp. Life cycle [illegible]
Thermostat operating temperature
Opening temp (off) [illegible]
Closing temp (on) [illegible] Approx
Differential Approx [illegible]
Max state of charge 30% Place battery in "shut down" mode
NOTES
Visible surfaces to be free of scratches, marks and foreign substances
Label S/N to consist of MMYY followed by incremental [illegible]
[illegible]
Software code [illegible]

Ambient Conditional Temp range,
Charge [illegible]
Discharge [illegible]
[illegible] storage [illegible]
[illegible]
[illegible]
[illegible]
Humidity [illegible]

Environmental and Safety
1 [illegible]
2 Battery assembly is RoHS compliant
3 [illegible]
4 Battery pack must meet all IATA requirements
5 Watt hour rating of [illegible]Wh

Connector Hsg
JST # XHP-2
Terminal
SXH-001T-P0.6
Wire
26 awg UL1007

PRE-RELEASE

DESIGN ENGR/Date: [signature] 5/23/2014

MFG/SQ ENGR/Date: [signature] 6-2-14

QUALITY/Date:

▷ = CRITICAL QUALITY ATTRIBUTE
△ = KEY CHARACTERISTIC IDENTIFICATION

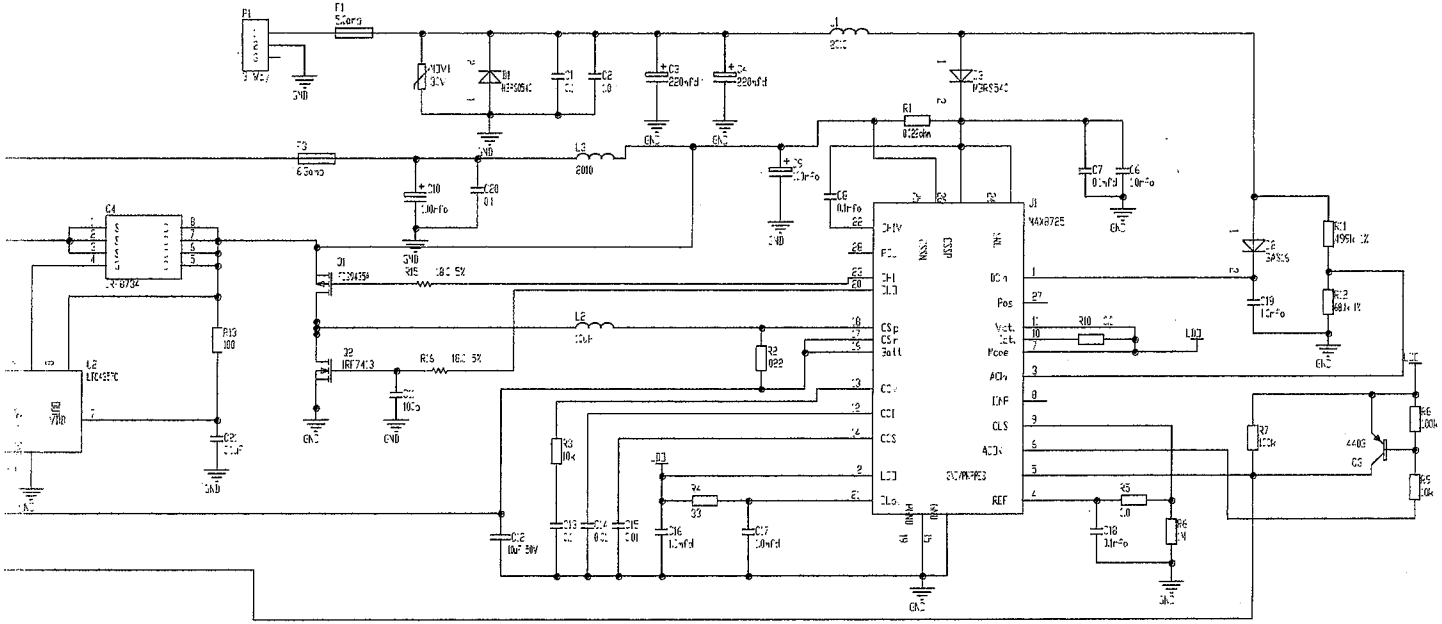
BATTERY PACK, EXTERNAL
BATTERY XPO2

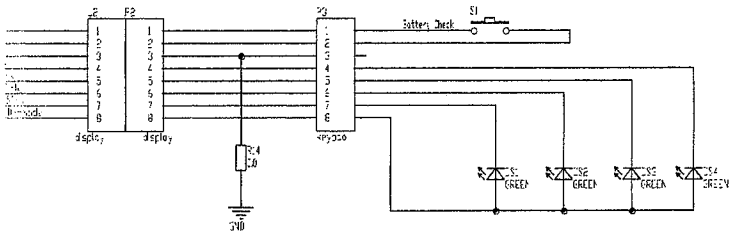
INVACARE CORP. ELYRIA OHIO

B

1184130

PART NO.
1185335





PRE-RELEASE

SIGNATURE ON FILE
SEE DISTRIBUTION #032

DESIGN ENGR/Date: _____

MFG/SQ ENGR/Date: _____

QUALITY/Date: _____

▷ = CRITICAL QUALITY ATTRIBUTE

▲ = KEY CHARACTERISTIC IDENTIFICATION

MARK	BY	CK	ENG.	ENG.	ENG.	REV LTR	C/N NO.	REVISION	DATE	BY	CK	ENG.	ENG.

MATERIAL NO:

MATERIAL DESCRIPTION:

AMT PER PC:

SCALE: 1.375:1 DATE: 11/21/13

FINISH: DRAWN BY: S. WEINMAN

PART DESCRIPTION: SCHEMATIC, EXTERNAL BATTERY XPO2

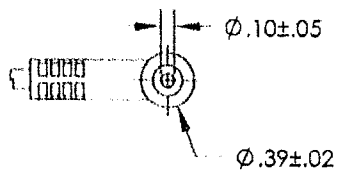
DRAWING SIZE: C

INVACARE CORP. ELYRIA OHIO

PART NO. 1185335

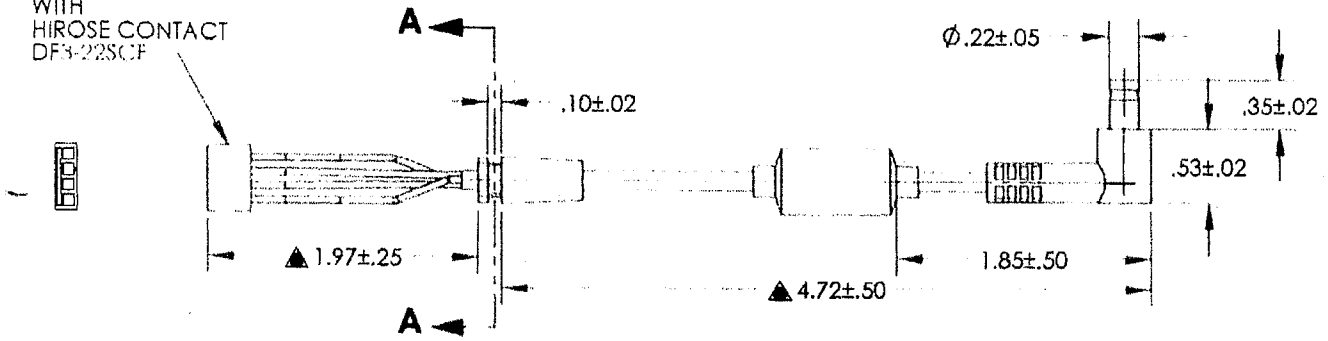
REVISIONS (1321003):
00. 03/06/12 TH - CREATED DRAWING
01. 03/20/12 TH - ADDED SECTION A-A AND MOUNTING PANEL GAP (.102) DIMENSION, CHGED VENDOR AND ADDED VENDOR P/N
02. 03/29/12 TH - CORRECTED MFG P/N
03. 04/10/12 TH - ADDED PIN OUT COLOR CODE TABLE
04. 05/09/12 JMK - CANCEL 1221025, CHANGE TO 1221019
05. 07/07/12 TH - CHANGE SPECIFICATION TO MATCH PROTEK PRINT
06. 08/07/12 BK - CHG DIM .10±.02 WAS .102
07. 06/18/13 BK - CHG DC# WAS 1221019; UPDATE TITLE BLOCK AND PRE-RELEASE STAMP
08. 2/20/14 SW REV DESC.

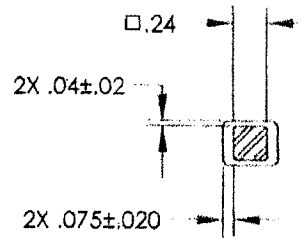
1180059



HIROSE DF3-4S-2C		
PIN 1	RED	V+
PIN 2	BLACK	V+
PIN 3	BLUE	V-
PIN 4	WHITE	V-

▲ HIROSE SOCKET
DF3-4S-2C (PITCH 2mm)
WITH
HIROSE CONTACT
DF3-22SCF





SECTION A-A

PRE-RELEASE

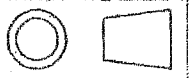
DESIGN ENGR/Date: Faiza Ahmad 2/20/2013

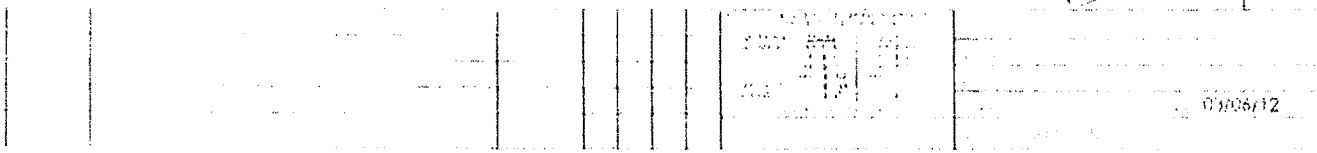
MFG/SQ ENGR/Date: [signature] 2/26/14

QUALITY/Date: Tom Petry 4/24/14

NOTES:
▲ 1. MANUFACTURER: PROTEK POWER, P/N 120314-01R

▷ = CRITICAL QUALITY ATTRIBUTE
▲ = KEY CHARACTERISTIC IDENTIFICATION





ASM, CABLE EXTERNAL BATTERY XPO2

INVACARE CORP. ELYRIA OHIO

A

1180059

F2 Labs
16740 Peters Road
Middlefield, Ohio 44062
United States of America
www.f2labs.com

EMC TEST REPORT

Manufacturer:	**Invacare Corporation** **One Invacare Way** **Elyria, Ohio 44036** **United States of America**
Product:	**Portable Oxygen Concentrator**
Models:	**XPO100B*; XPO100** **Denotes actual model tested. Refer to Section 2.1 of this Test Report for more details.*
Testing Commenced:	**Apr. 4, 2014**
Testing Ended:	**Apr. 4, 2014**
Summary of Test Results:	**Page 4**
Deviations (if applicable):	**N/A**

Standards:
RTCA DO-160G – Environmental Conditions and Test Procedures for Airborne Equipment Testing Section 21, Category M

Order Number: F2LQ6037

Client: Invacare Corporation
Models: XPO100B & XPO100

Evaluation Conducted by: _____
Joe Knepper, EMC Proj. Eng.

Report Reviewed by: _____
Ken Littell, EMC Tech. Mgr.

F2 Labs
26501 Ridge Road
Damascus, MD 20872
Ph 301.253.4500
Fax 301.253.5179

F2 Labs
16740 Peters Road
Middlefield, OH 44062
Ph 440.632.5541
Fax 440.632.5542

TABLE OF CONTENTS

Order Number: F2LQ6037

Client: Invacare Corporation
Models: XPO100B & XPO100

GENERAL REPORT SUMMARY

This electromagnetic emission test report was generated by F2 Labs. The test report is based on testing performed by F2 Labs personnel according to the measurement procedures described in the test specifications given below and in the Test Procedures section of this report.

SECTION	TEST	RESULTS
6	Radiated Emissions: Internal Battery Power External Power Supply	 Pass Pass
7	Conducted Emissions: External AC/DC Power Supply	 Pass

Note: Pass/Fail criteria are based upon the following condition: Where the results are compared to published test standard or manufacturer specified limits, the PASS or FAIL opinion is considered without applying the laboratory stated measurement uncertainty.

Reports noted as a revision replace all previously issued reports and/or antecedent report revisions issued under this job number.