Prepared according to Global Harmonized System (GHS) standards

SECTION 1 CHEMICAL PRODUCT IDENTIFICATION

MTD, LLC
P.O. Box 368022
Cleveland, OH 44136

Product Trade Name: **MTD SAE 10W30 Engine Oil**

CAS Number:	Mixture
Synonyms/Other:	N/A
Recommended Use:	Engine Oil
Restrictions on Use:	Not Determined
Created Date:	2/9/2016
Preparation/Revision Date:	9/6/2019
Emergency Phone Number:	1-800-424-9300 (CHEMTREC)
SDS CODE:	13851

SECTION 2 HAZARD IDENTIFICATION

Appearance:	Amber/brown liquid
Odor:	Mild petroleum
Classification:	This material is not considered to be hazardous according to the Globally Harmonized System of Classification and Labelling Chemicals (GHS).
Target Organs:	Not applicable.
Pictogram(s):	None required.
Signal Word:	None required.
Hazard Statement:	Not required.
Other Hazards:	Not determined.
Prevention:	None required.
Response:	None required.
Storage Procedures:	None required.
Disposal:	None required.
Other:	See section 11 for complete health hazard information.

SECTION 3 COMPOSITION OF INGREDIENTS

Components: No Hazardous Substance(s) or Complex Substance(s) required for disclosure.

SECTION 4 FIRST AID MEASURES

Eye Contact:	If irritation occurs, cautiously rinse eyes with lukewarm, gently flowing water for 5 minutes, while holding the eyelids open. If eye irritation persists: Get medical advice/attention.
Skin Contact:	Call a doctor if you feel unwell.
Inhalation:	Get medical advice or attention if you feel unwell or are concerned.
Ingestion:	If you feel unwell or concerned: Get medical advice/attention. Rinse mouth. Do NOT induce vomiting. If vomiting occurs naturally, lie on your side, in the recovery position.
Other:	No additional information

SECTION 5 FIRE FIGHTING MEASURES

Flash Point:	223°C by Cleveland Open Cup Tester.
Flammable limits:	Not determined.
Extinguishing media:	Use dry chemical, alcohol foam, all purpose AFFF or carbon dioxide to extinguish fire.
Special firefighting procedures:	DO NOT direct a solid stream of water or foam into hot, burning pools of liquid since this may cause frothing and increase fire intensity. Frothing can be violent and possibly endanger any firefighter standing too close to the burning liquid. Use water spray to cool fire exposed containers and structures until fire is out if it can be done with minimal risk. Avoid spreading burning material with water used for cooling purposes. Wear full firefighting turn-out gear (full Bunker gear), and respiratory protection (SCBA).
Unusual fire & explosion hazards:	Dense smoke may be generated while burning. Toxic fumes, gases or vapors may evolve on burning. High temperatures may create heavy flammable vapors that may settle along ground level and low spots to create an invisible fire hazard.
Byproducts of combustion:	Fires involving this product may release oxides of carbon, phosphorus, nitrogen and sulfur; reactive hydrocarbons and irritating vapors.
Autoignition temperature:	Not determined.
Explosion data:	Not determined. Care should always be exercised in dust/mist areas.
Other:	Dispose of fire debris and contaminated extinguishing water in accordance with official regulations.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Spill control procedures (land):	Immediately turn off or isolate any source of ignition (pilot lights, electrical equipment, flames, heaters, etc.). Evacuate area and ventilate. Personnel wearing proper protective equipment should contain spill immediately with inert materials (sand, earth, chemical spill pads of cotton) by forming dikes. Dikes should be placed to contain spill in a manner that will prevent material from entering sewers and waterways. Large spill, once contained, may be picked up using explosion proof, non-sparking vacuum pumps, shovels, or buckets, and disposed of in suitable containers for disposal. If a large spill occurs notify appropriate authorities. In case of road spill or accident contact Chem-Trec (800-424-9300)
Spill control procedures (water):	Try to contain large spills with floating booms to prevent spill from spreading. Remove from surface by skimming or with suitable adsorbents. If a large spill occurs notify appropriate authorities (normally the National Response Center or Coast Guard at 800-424-8802).
Waste disposal method:	Do not empty into drains. All disposals must comply with federal, state, and local regulations. The material, if spilled or discarded may be a regulated waste. Refer to state and local regulations. Department of Transportation (DOT) regulations may apply for transporting this material when spilled. See Section 14.
Other:	CAUTION - If spilled material is cleaned up using a regulated solvent, the resulting waste mixture will be regulated.

SECTION 7 HANDLING AND STORAGE

Handling procedures: Keep containers closed when not in use. Do not transfer to unmarked containers. Empty containers retain product residue which may exhibit hazards of material, therefore do not pressurize, cut, glaze, weld, or use for any other purposes. Return drums to reclamation centers for proper cleaning and reuse.
Handling temperatures should not exceed 60°C (140°F) to minimize danger of burns. Open containers carefully in a well ventilated area or use appropriate respiratory protection. Wash thoroughly after handling.

Storage procedures: Store containers away from heat, sparks, open flame, or oxidizing materials. Extended storage at excessive temperatures may produce odorous and toxic fumes from product decomposition.

Additional information: No additional information.

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure limits/standards for materials that can be formed when handling this product:

	OSHA TWA	OSHA STEL	ACGIH TWA
Contains highly refined petroleum oil	*5 mg/m³ (PEL)	*10 mg/m³	*5 mg/m³ (TLV)

* Exposure limits not defined. Limits used are for, "oil mist".

TWA – Time Weighted Average is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week which shall not be exceeded.
STEL – Short Term Exposure Limit is the employee's 15-minute time weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified.

All base oils, including additive carriers, contain <3.0% DMSO extractable material.

Personal protection: Applicable mainly to persons in repeated contact situations such as packaging of product, service/maintenance, and cleanup/spill control personnel.

Respiratory protection: None required if ventilation is adequate. Otherwise a respiratory protection program meeting OSHA 1910.134 and ANSI Z88.2 requirements must be followed. Where misting may occur, wear an MSHA/NIOSH approved (or equivalent) half-mask form dust/mist air purifying respirator.

Eye protection: Eye protection is strongly recommended. Wear safety glasses with side shields or vented/splash proof goggles (ANSI Z87.1 or approved equivalent).

Hand protection: Impervious, chemically resistant gloves such as neoprene or nitrile rubber to avoid skin sensitization and absorption.

Other protection: Use of an apron and overboots of chemically impervious materials such as neoprene or nitrile rubber is recommended based on level of activity and exposure. If handling hot material use insulated protective equipment. Launder soiled clothes. Properly dispose of contaminated leather articles and other materials which cannot be decontaminated.

Local control measures: Use adequate ventilation when working with material in an enclosed area. Mechanical methods such as fume hoods or area fans may be used to reduce localized vapor/mist areas. If vapor or mist is generated when the material handled, adequate ventilation in accordance with good engineering practice must be provided to maintain concentrations below the specified exposure. Eyewash stations and showers should be available in areas where this material is used and stored.

Other: Consumption of food and drink should be avoided in work areas where product is present. Always wash hands and face with soap and water before eating, drinking or smoking.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Amber/brown liquid
Odor:	Mild petroleum
Odor threshold:	Not determined.
pH:	Not applicable.
Melting/Freezing point:	Not determined.
Initial boiling point:	Not determined.
Boiling range:	Not determined.
Flash point:	223°C.
Evaporation rate:	Not determined.
Flammability:	Not determined.
Upper flammable limit:	Not determined.
Lower flammable limit:	Not determined.
Vapor pressure:	Not determined.
Vapor density:	Not determined.
Relative density:	0.86
Solubility:	Negligible in water, miscible in most petroleum solvents.
Partition Coefficient:	Not determined.
Auto-ignition temperature:	Not determined.
Decomposition temperature:	Not determined.
Viscosity:	66 cSt at 40°C.
Other	Not applicable.

SECTION 10 STABILITY AND REACTIVITY

Reactivity	
Chemical stability:	Material is chemically stable at room temperatures and pressure.
Hazardous polymerization:	Will not occur.
Conditions to avoid:	Avoid high temperatures and product contamination.
Incompatibility with other materials:	Avoid contact with acids and strong oxidizing materials.
Decomposition products:	Smoke, carbon monoxide, carbon dioxide, and other aldehydes of incomplete combustion. Oxides of carbon, nitrogen, and sulfur; reactive hydrocarbons and irritating vapors.
Other:	Not applicable.

SECTION 11 TOXICOLOGICAL INFORMATION

Acute toxicity (LD50) *See note at the bottom of the section

Oral:	>5000 mg/kg
Dermal:	>5000 mg/kg
Inhalation:	>20.0 mg/l
Skin irritation:	Non-irritant
Eye irritation:	Non-irritant
Dermal sensitization:	Not expected to have a sensitizing effect.
Respiratory sensitization:	Not expected to have a sensitizing effect.
Aspiration Hazard:	Not applicable

Chronic Toxicity

Mutagenicity:	Not suspected of causing genetic defects
Carcinogenicity:	Not suspected of causing cancer.
Reproductive toxicity:	Not expected to have adverse effects on reproduction.
STOT-single exposure:	Not expected to have adverse effects.
STOT-repeated exposure:	Not expected to have long term adverse effects.
Other:	*All data in this section is based off calculations from Part 3 of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) utilizing information from the constituent components.

SECTION 12 ECOLOGICAL INFORMATION

Environmental toxicity

Fish:	> 100 mg/l.
Invertebrates:	> 100 mg/l.
Aquatic plants:	> 100 mg/l.
Microorganism:	> 100 mg/l.
Persistence/Degradability:	This product is not expected to be readily biodegradable.
Bioaccumulation:	Not determined.
Mobility in soil:	Not determined.
Other:	All classifications are based on calculations in Part 4 of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) utilizing information from the constituent components.

SECTION 13 DISPOSAL CONSIDERATIONS

Waste disposal:	This product unadulterated by other materials can be classified as a non-hazardous waste. Depending on use, used product may be regulated. Dispose of in a licensed facility. Do not discharge product in to sewer system. Dispose of containers by crushing or puncturing, so as to prevent unauthorized use of used containers. Waste management should be in full compliance with federal, state, and local laws.
Other	The transportation, storage, treatment and disposal of RCRA waste material must be conducted in compliance with 40 CFR 262, 263, 264, 268 and 270. Chemical additions, processing or otherwise altering this material may make the waste management information presented in this SDS incomplete, inaccurate or otherwise inappropriate.

SECTION 14 TRANSPORT INFORMATION

Land Transport (DOT):	Not regulated for land transport.
Proper Shipping Name:	Not applicable.
Land Transport (TDG):	Not regulated for land transport.
Proper Shipping Name:	Not applicable.
Sea Transport (IMDG):	Not regulated for sea transport.
Proper Shipping Name:	Not applicable.
Air Transport (IATA):	Not regulated for air transport.
Proper Shipping Name:	Not applicable.
Other:	Not applicable.

SECTION 15 REGULATORY INFORMATION

Federal Regulation

Clean water act/oil: Under Section 311 of the Clean Water Act (40 CFR 110) and the Oil Pollution Control Act of 1990, this material is considered an oil. Any spill or discharges that produce a visible sheen or film on surface of water, or in waterways, ditches, or sewers leading to surface water must be reported. Contact the National Response Center at 800-424-8802.

TSCA: All components of this material are listed in the U.S. TSCA Inventory.

Other TSCA: Not applicable.

SARA title III: Section 302/304 extremely hazardous substances:

None.

Section 311, 312 hazard categorization:

Acute (immediate health effects):	NO
Chronic (delayed health effects):	NO
Fire (hazard):	NO
Reactivity (hazard):	NO
Pressure (sudden release hazard):	NO

Section 313 toxic chemicals:

No components present are at or greater than the de minimis (minimum reportable) concentration requirements for reporting.

CERCLA: For stationary/moving sources – reportable quantity (due to): Not hazardous due to the petroleum exclusion.

State Regulations

Right-to-know Not determined.

Other: A release of this product, as supplied, is exempt from reporting under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). However, releases may be reportable to the Nation Response Center under the Clean Water Act, 33 U.S.C. 1321(b)(3) and (5) - see head of Section 15. Failure to report may result in substantial civil and criminal penalties.

Recommend contacting the local authorities in the event of any type of spill to determine local reporting requirements and also to aid in the cleanup.

SECTION 16 OTHER INFORMATION

	NFPA 704	NPCA-HMIS	KEY
HEALTH:	1	1	0 = Minimal
FIRE:	1	1	1 = Slight
REACTIVITY:	0	0	2 = Moderate
SPECIFIC HAZARD:	None	N/A	3 = Serious
PROTECTION INDEX:	N/A	B	4 = Severe

Version: II

Revisions / Comments: Converted to GHS SDS. 05/30/15
Document review. 09/06/19

Internal use only: OB19-KJ

NexSys™

POWER WHEN YOU NEED IT

Section 25.30 - NexSys® Batteries

TECHNICIAN'S MANUAL

Important Safety,
Installation,
Operation,
Maintenance,
Troubleshooting and
Service Instructions

EnerSys®

Power/Full Solutions

www.enersys.com

CONTENTS

INTRODUCTION

Since its introduction in the early 1990s, Thin Plate Pure Lead (TPPL) batteries have been established as a premium high performance battery suitable for a wide range of demanding applications. Today, TPPL technology can be found in applications as diverse as emergency power, avionics, medical, military and consumer equipment.

NexSys® batteries utilize the principles of advanced TPPL technology, to achieve exceptionally high performance, energy density and cycling capability. These characteristics make the NexSys battery range ideal for use in motive power applications such as floor-care, pallet trucks, AGVs, personnel carriers and utility vehicles.

This manual describes the NexSys battery range, physical characteristics and the basic information on storage, operation and maintenance.

SAFETY PRECAUTIONS

Motive power batteries for small traction Valve Regulated Lead Acid (VRLA) monoblocs NexSys series: TPPL technology.

NexSys batteries are designed using proven gas recombination technology, which removes the need for regular water addition. The use of gas recombination technology for lead acid batteries has completely changed the concept for motive power. This new technology gives the user greater freedom to use VRLA in a much wider range of applications.

The minimal level of gas emissions from this type of battery allows the battery to be utilized in applications where previous restrictions might have been enforced. The NexSys battery range is considered to be maintenance free, therefore there is no need for any routine water refilling to be carried out on the battery.

- Pay attention to the operating instructions and keep them close to the battery.
- Work on batteries must only be carried out by skilled personnel.

- Use protective glasses and wear safety clothing when working on batteries.
- Adhere to the current accident prevention rules in the country where the battery is used or EN 50272-3, EN 50110-1.

- No smoking.
- Do not expose batteries to naked flames, glowing embers or sparks, as it may cause the battery to explode.
- Avoid sparks from cables or electrical apparatus as well as electrostatic discharges.

- Acid splashes into the eyes or on the skin must be washed immediately with an abundance of clean water. After abundant flushing consult a doctor immediately.
- Clothing contaminated by acid should be washed in water.

- Risk of explosion and fire
- Avoid short circuits: do not use non-insulated tools, do not place or drop metal objects on top of the battery. Remove rings, wristwatches and articles of clothing with metal parts that might come into contact with the battery terminals.

- Electrolyte is highly corrosive.
- In the normal operation of this battery, contact with acid isn't possible. If the cell containers are damaged, the immobilized electrolyte (absorbed in the separator) is corrosive like liquid electrolyte.

- Batteries and monoblocs are heavy. Ensure secure installation! Use only suitable handling equipment.
- Lifting hooks must not damage the blocs, connectors or cables.
- Do not place batteries in direct sunlight without protection.
- Discharged batteries can freeze. For that reason, always store in a frost-free zone.

- Dangerous electrical voltage.
- Avoid short circuits: NexSys batteries are capable of high short circuit currents.
- Caution - metal parts of the battery are always live: do not place tools or other objects on the battery.

- Pay attention to the hazards that can be caused by batteries

Warning: Do not use any type of oil, organic solvent, alcohol, detergent, strong acid, strong alkali or petroleum based solvent or ammonia solution to clean the monoblocs. Such materials may cause permanent damage to the monobloc casing.

RECOMBINATION TECHNOLOGY

How gas recombination works:

When a charge current flows through a fully charged conventional lead acid cell, electrolysis of water occurs to produce hydrogen from the negative electrode and oxygen from the positive electrode. This means that water is lost from the cell and regular topping up is needed.

However, evolution of oxygen gas and hydrogen gas does not occur simultaneously, because the efficiency of recharge of the positive electrode is not as good as the negative electrode. This means that oxygen is evolved from the positive plate before hydrogen is evolved from the negative plate.

At the same time that oxygen is evolved from the positive electrode, a substantial amount of highly active spongy lead exists on the negative electrode before it commences hydrogen evolution.

Therefore, provided oxygen can be transported to the negative electrode, conditions are ideal for a rapid reaction between lead and oxygen:

i.e. This oxygen is electrochemically reduced on the negative electrode according to the following scheme,

$$2e^- + 2H^+ + {}^1/_2\,O_2 \rightarrow H_2O$$

and the final product is water…….

The current flowing through the negative electrode drives this reaction instead of hydrogen generation which would occur in a flooded cell.

This process is called gas recombination. If this process was 100% efficient, no water would be lost from the cell. By careful design of the constituents within the cell, gas recombination up to 99% is achieved.

Principle of the oxygen reduction cycle

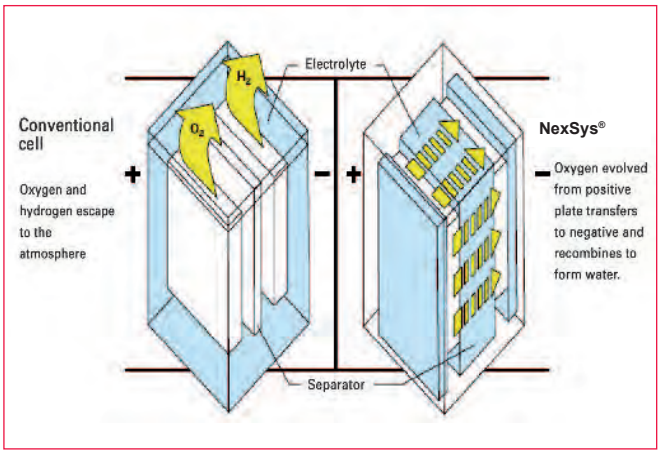


Figure 1 - Principle of the oxygen reduction cycle

RECOMBINATION EFFICIENCY

Recombination efficiency is determined under specific conditions by measuring the volume of hydrogen emitted from the battery and converting this into its amp hour equivalent. This equivalent value is then subtracted from the total amp hours taken by the battery during the test period and the remainder is the battery's recombination efficiency which is usually expressed as a percentage. As recombination is never 100%, some hydrogen gas is emitted from NexSys® batteries through the self-regulating valve; the I_{gas} value for this technology of battery is 1A/100 Ah C_6.

RANGE SUMMARY

Terminal layout 1

Terminal layout 2

RANGE SUMMARY AVAILABLE.

ORIENTATION

NexSys blocs can be mounted in any orientation except inverted.

BATTERY CONFIGURATIONS

NexSys blocs may be configured into a battery comprising series/parallel arrays, with the maximum number of parallel strings limited to three. It is paramount that the cable lengths within each string are equal.

Only EnerSys® approved components / parts may be used in conjunction with the NexSys battery product.

Monobloc Type	Nominal Voltage [V]	Nominal Capacity [C_6]	KW rating	Dimensions				Weight[1] [lbs]	No. of cycles[2]	Terminal Type	Terminal Layout
				L [in]	W [in]	Box Height (in)	Terminal Height [in]				
12NXS26	12	26	0.057	9.84	3.82	5.79	5.67	21.1	1200	M6 Female (3)	1
12NXS36	12	36	0.081	9.84	3.82	7.76	7.64	29.0	1200	M6 Female (3)	1
12NXS38	12	38	0.096	7.74	6.5	6.69	6.37	38.4	1200	M6 Female (3)	1
12NXS50	12	50	0.111	8.66	4.76	9.92	9.76	41.1	1200	M6 Female (3)	1
12NXS61	12	61	0.135	11.02	3.82	10.39	9.76	42.0	1200	M8 Female (3)	1
12NXS62	12	62	0.146	12.95	6.54	6.85	6.54	53.2	1200	M6 Female (3)	1
12NXS85	12	85	0.188	15.55	4.13	10.39	9.76	60.0	1200	M8 Female (4)	2
12NXS89	12	89	0.215	12.99	6.79	8.43	8.62	77.4	1200	3/8 - 16" Female	1
12NXS120	12	120	0.270	13.31	6.81	10.71	10.75	94.8	1200	M6 Female (4)	1
12NXS137	12	137	0.320	16.90	6.79	9.36	9.36	105.0	1200	M6 Female (4)	2
12NXS158	12	158	0.365	16.90	6.79	10.75	10.75	117.0	1200	M6 Female (4)	2
12NXS166	12	166	0.367	22.09	4.92	11.14	10.35	113.3	1200	M8 Female (4)	2
12NXS186	12	186	0.411	22.09	4.92	12.48	11.69	131.1	1200	M8 Female (4)	2

(1) Approximate (2) 60% Depth of discharge max (3) Can be fitted with SAE terminal (4) Can be fitted with M6 front terminal

Table 1 – NexSys® battery specifications

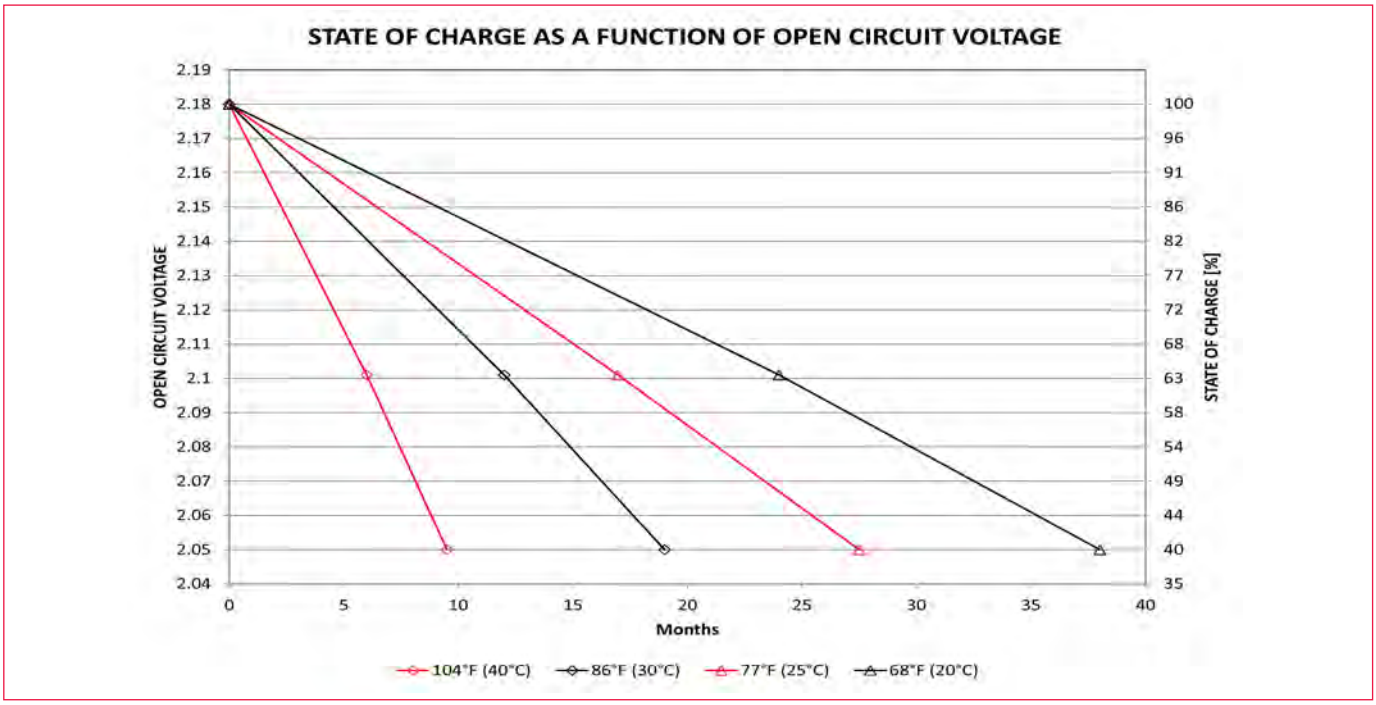


Figure 2 – Open circuit voltages state of charge

STATE OF CHARGE

The open circuit voltage of the individual NexSys® bloc prior to installation can be used as an approximate guide to the state of charge (SOC) of the bloc. Figure 2 also shows the influence of storage temperature on the charge retention characteristics.

CAPACITY

The capacity of the NexSys battery or bloc series is rated in amp-hours at the 1, 3 and 6 hour rate [Ah]. Table 2 provides available capacity as a function of discharge rate.

Monobloc Type	Nominal Capacity [Ah] 77°F (25°C)		
	C1	C3	C6
12NXS26	19.3	22.6	26
12NXS36	28.5	32.3	36
12NXS38	32.3	38.5	38
12NXS50	36.5	44.0	50
12NXS61	46.1	53.9	61
12NXS62	51.2	58.9	62
12NXS85	60.9	74.0	85
12NXS89	74.6	86.5	89
12NXS120	85.2	106.2	120
12NXS137	108.5	128.6	137
12NXS158	117.0	145.5	158
12NXS166	116.6	144.3	166
12NXS186	129.8	161.5	186

Table 2 – Capacity at different discharge rates

TRANSPORTATION

NexSys batteries are classified as “non-spillable wet electric storage batteries” and may be shipped by air or ground transportation without restriction.

NexSys batteries are in compliance with requirements of:

1. US Dept of Transportation - 49 CFR Section 173.159 para d
2. ICAO/IATA Packing Instruction 872, Special Provision A67
3. IMDG Class 8, UN ID 2800 special provisions 238
4. ADR 2011 and RID 2011 Special Provisions 238, 295 and 598 and are classified as non-spillable and exempt from hazardous goods regulations when securely packed and protected against short circuits.

STORAGE – INDIVIDUAL NEXSYS® BLOCS

The data in this section only applies to batteries in storage.

Batteries are dispatched from the manufacturer in a fully charged state. The state of charge will decrease with storage. All batteries lose their stored energy when allowed to stand open-circuit, due to parasitic chemical reactions.

Self-discharge is also strongly influenced by temperature; high temperatures greatly reduce storage life (See Figure 2 above). It is recommended that the fully charged battery should be stored in a cool dry place, ideally below 68°F (20°C).

The battery has a maximum inspection-free storage life of two years, if stored at or below 68°F (20°C), after which a refresh charge should be administered. However, it is advisable to conduct an inspection and open circuit voltage check after 12 months. If the open circuit voltage falls below 12.6 volts the battery should be recharged using an approved EnerSys® charger.

The battery may be stored for up to five years without degradation of performance provided that an Open Circuit Voltage (OCV) check is conducted every 12 months. When stored in temperatures in excess of 86°F (30°C), the battery should be OCV checked every six months.

STORAGE – NEXSYS® BLOCS INSTALLED IN EQUIPMENT

Some equipment will continue to draw very low power loads from the battery when not in service resulting in a battery discharge rate greater than shown in Figure 2 and described in the previous section. Consequently all sources of electrical power drain must be removed from the battery while in transit, storage or extended periods of time out of service. This includes disconnecting the Wi-iQ® device (if fitted) from the battery.

Failure to comply with the above will result in premature battery failure. Also, refer to comments in the opportunity charging section relating to short storage periods between equipment usage.

COMMISSIONING

The NexSys® blocs are supplied in a charged state. The battery should be inspected to ensure it is free from defects.

Check:

1. The battery cleanliness. Before installing, the battery compartment also has to be cleaned.
2. All cables and crimped connectors are in good condition to support high electrical currents.
3. The battery and cables have a good contact to terminals and the polarity is correct. Otherwise the battery, vehicle or charger could be severely damaged.
4. Ensure that all insulation covers are fitted correctly.
5. It is extremely important to ensure the integrity of battery connections. Multi-point crimping must be used.

NOTE: Flexible cable or braid connectors must be used for all bloc connections. Appropriate fastener kits and approved parts must be used. These can be supplied in EnerSys® approved accessory kits. Integral to the fasteners system is an appropriate locking washer. Spring-flat washers must not be used.

Connectors must be adequately fastened (see Table 3) with the locking washer in place to maintain contact integrity when exposed to operational shock/vibrations.

Monobloc Type	Standard Terminal	Terminal Torque [in/lbs]	Terminal Adapter	Terminal Torque [in/lbs]
12NXS26 12NXS36 12NXS38 12NXS50 12NXS62 12NXS120	M6 Female	60	SAE	60
12NXS61 12NXS85	M8 Female	80	N/A	N/A
12NXS89	3/8 - 16" Female	60	SAE	60
12NXS137 12NXS158	M6 Female	80	M6 Front Terminal	80
12NXS166 12NXS186	M8 Female	80	M6 Front Terminal	80

Table 3 – Torque settings

Use a special coding system for NexSys TPPL blocs for the charging plug-and-socket devices to prevent accidental connection to the wrong type of charger. Never directly connect an electrical appliance (ie: warning beacon) to a part of the battery. This could lead to an imbalance of the cells during the recharge, (i.e. a loss of capacity, the risk of insufficient discharge time, damage to the cells and VOIDS THE BATTERY WARRANTY.)

Charge the battery before commissioning. Only blocs with the same state of charge should be connected together.

The specified torque loading for the bolts/screws of the end cables and connectors are detailed in the Table 3.

OPERATION

EN 50272-3 "Safety requirements for secondary batteries and battery installations. Part 3 traction batteries" is applicable to this product range. The nominal operating temperature is 77°F (25°C). The optimum lifetime of the battery depends on the operating conditions (temperature and depth of discharge). The ambient temperature range of use for the battery is between 50°F (10°C) and 113°F (45°C). Temperatures outside of this range must be approved by the EnerSys Technical Department. Optimal battery life is obtained at a temperature of 77°F (25°C). Higher temperatures shorten the life of the battery (according to IEC1431 technical report); lower temperatures reduce the available capacity. It is mandatory that the depth of discharge does not exceed 80% of the nominal C_6 capacity.

Figures 5 and 6 show the relationship between depth of discharge and cycle life.

The battery obtains its full capacity after about three charging and discharging cycles.

OPERATING TEMPERATURE

NexSys® batteries and EnerSys approved chargers are designed for use within an ambient temperature range of 50°F (10°C) to 113°F (45°C). For use outside this range, you should consult with EnerSys Technical Department. Applications outside the recommended temperature range will be considered, but it will be mandatory to use an EnerSys charger with communication capability and the battery must be equipped with Wi-iQ® monitoring device to manage the charge profile in accordance with the battery temperature. The upper temperature limit is 113°F (45°C) and batteries should not be operated above this temperature.

DISCHARGING

The valves on the top of the battery must not be sealed or covered. Electrical connections (i.e. lugs) must only be made or broken in the open circuit condition. Discharges over 80% of the rated capacity are categorized as deep discharges and are not acceptable as they considerably reduce the life expectancy of the battery. Discharged batteries MUST be recharged immediately and MUST not be left in a discharged condition.

Note: The following statement only applies to partially discharged batteries.

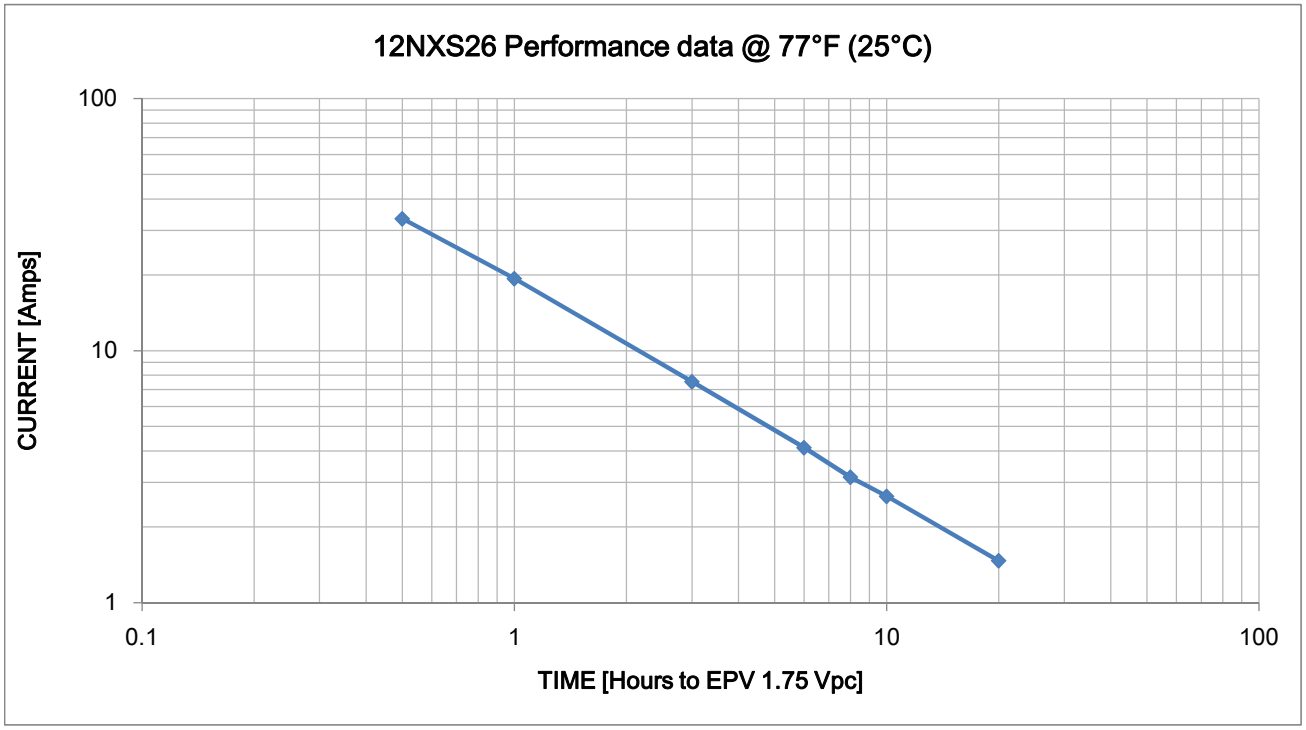
Partially discharged and fully discharged batteries can freeze. Limit the discharge to 80% DOD. The presence of a Protection from Over Discharge (POD) device is mandatory and cut-off voltage must be set at the value detailed in Table 4, when discharging with currents in the range of I1 to I5. At lower currents, please seek advice from the EnerSys Application Engineering Authority.

	Cut-off voltage setting [Vpc]
60% DOD	1.96 V
80% DOD	1.92 V

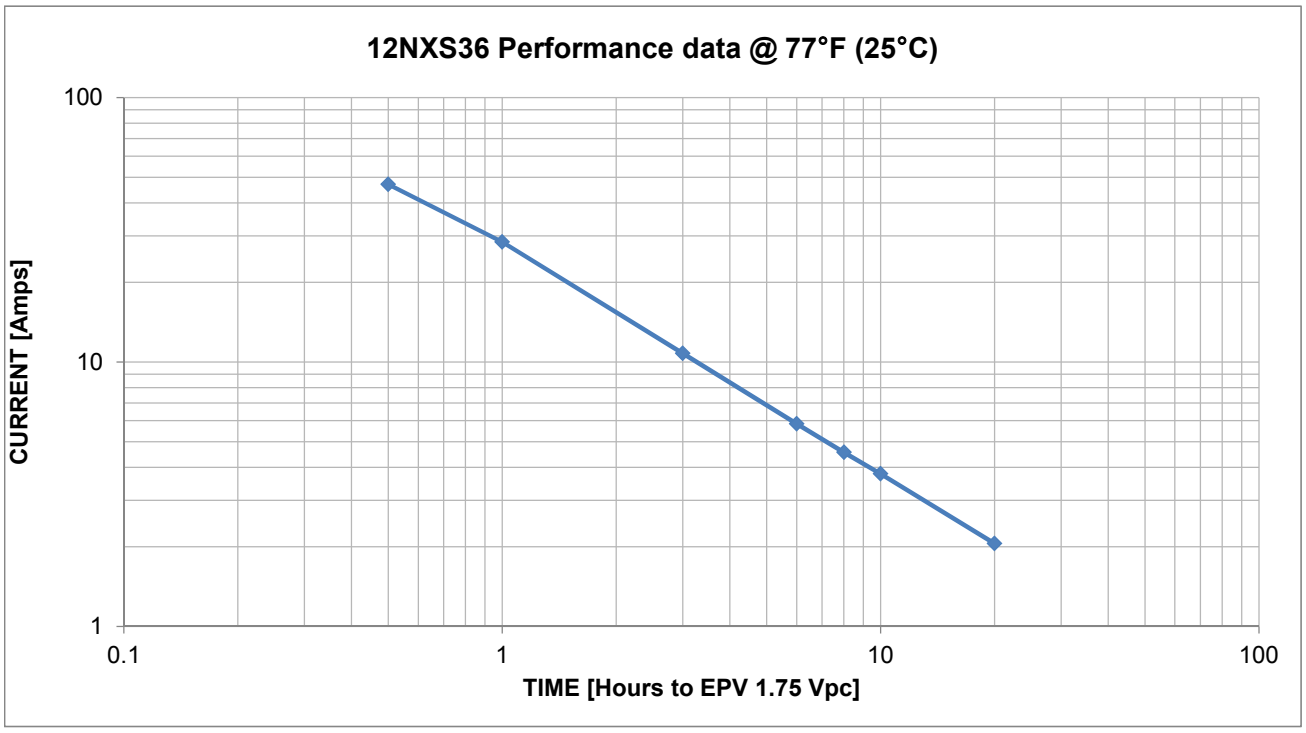
Table 4 - Cut-off voltage limits

DISCHARGE CHARACTERISTICS

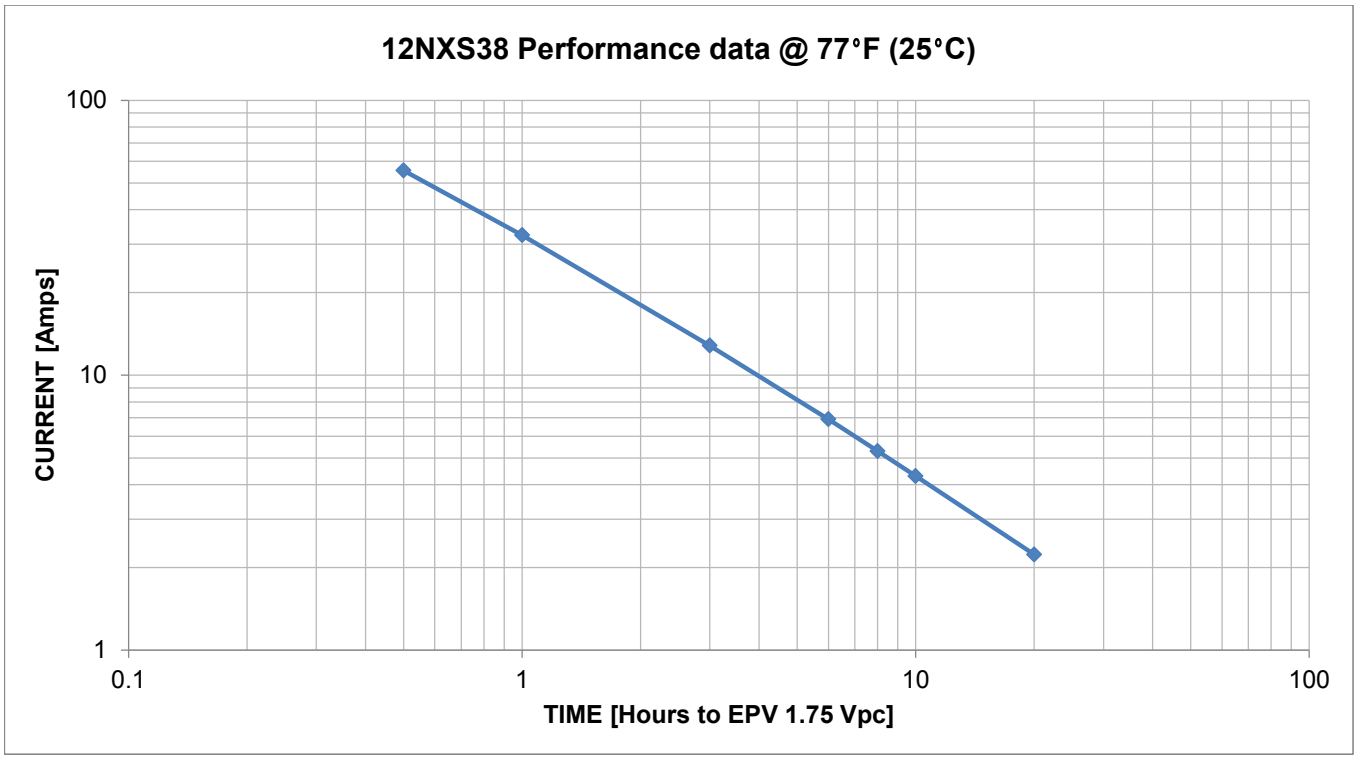
The following graphs show detailed discharge characteristics of the NexSys® battery or bloc range to an end point voltage of 1.75Vpc @ 77°F (25°C)



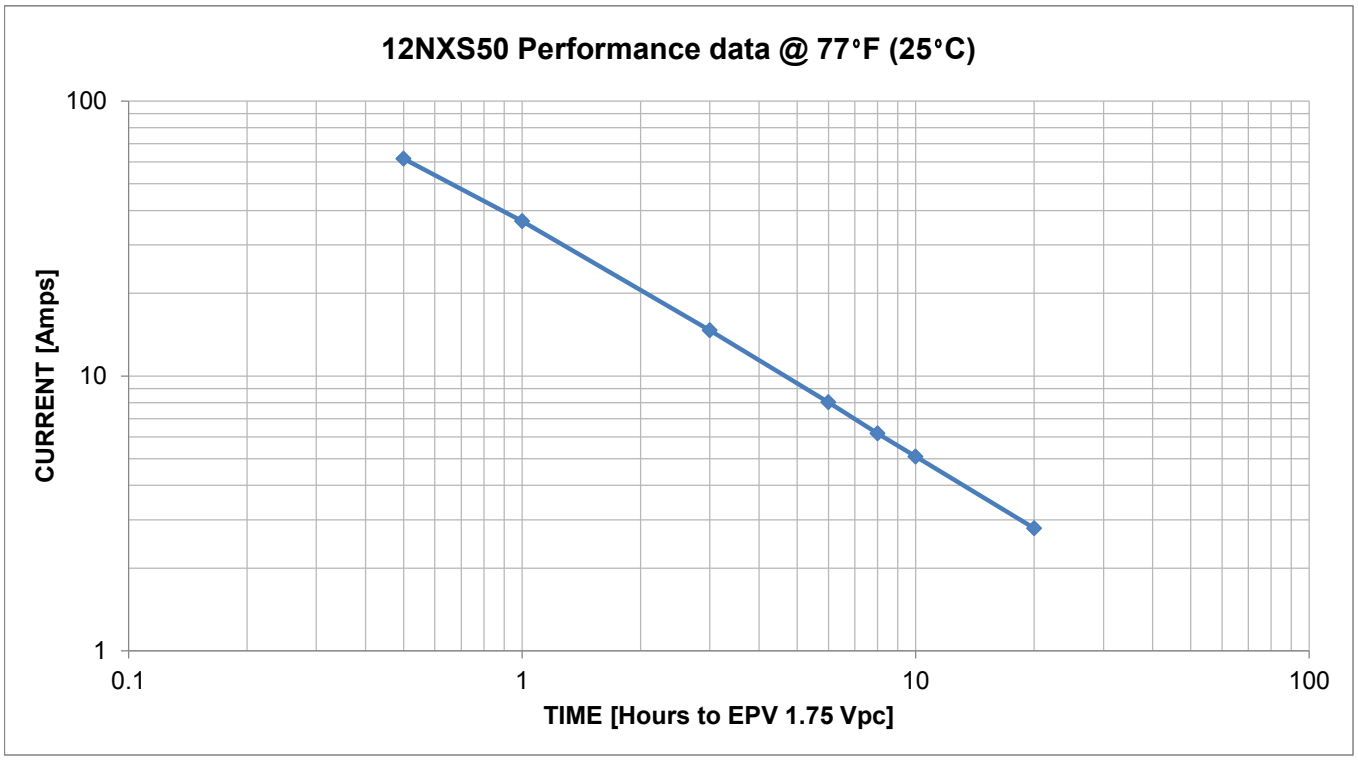
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	33.43	19.34	7.54	4.13	3.15	2.64	1.47



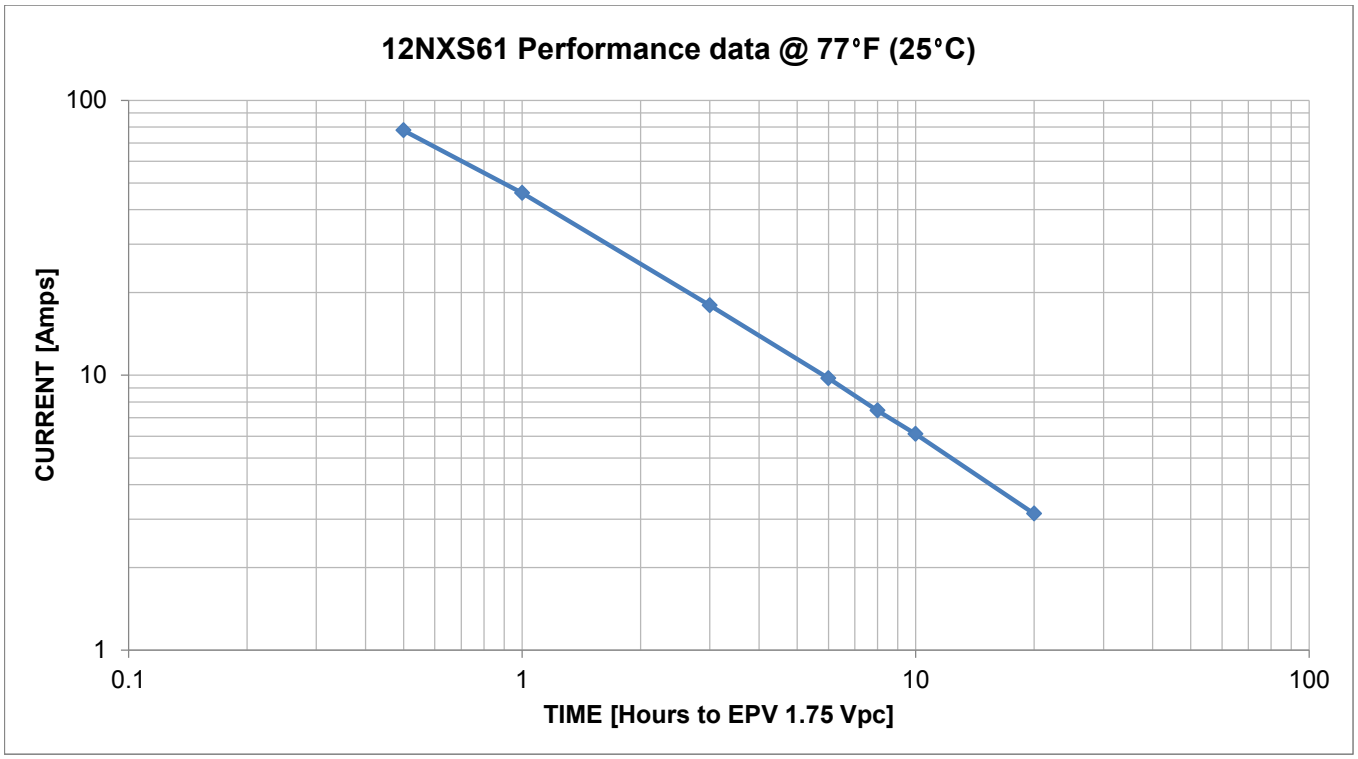
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	47.01	28.48	10.78	5.84	4.56	3.78	2.06



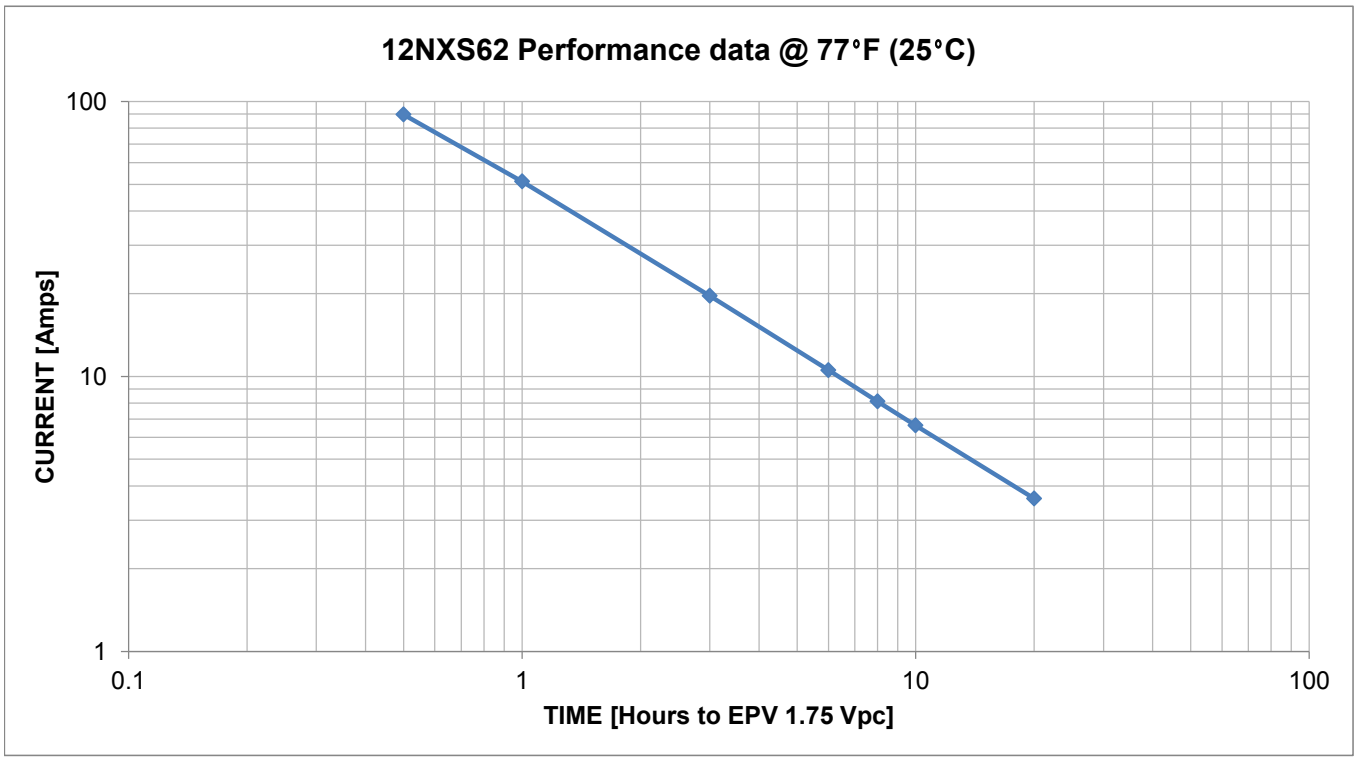
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	55.52	32.34	12.82	6.92	5.30	4.30	2.23



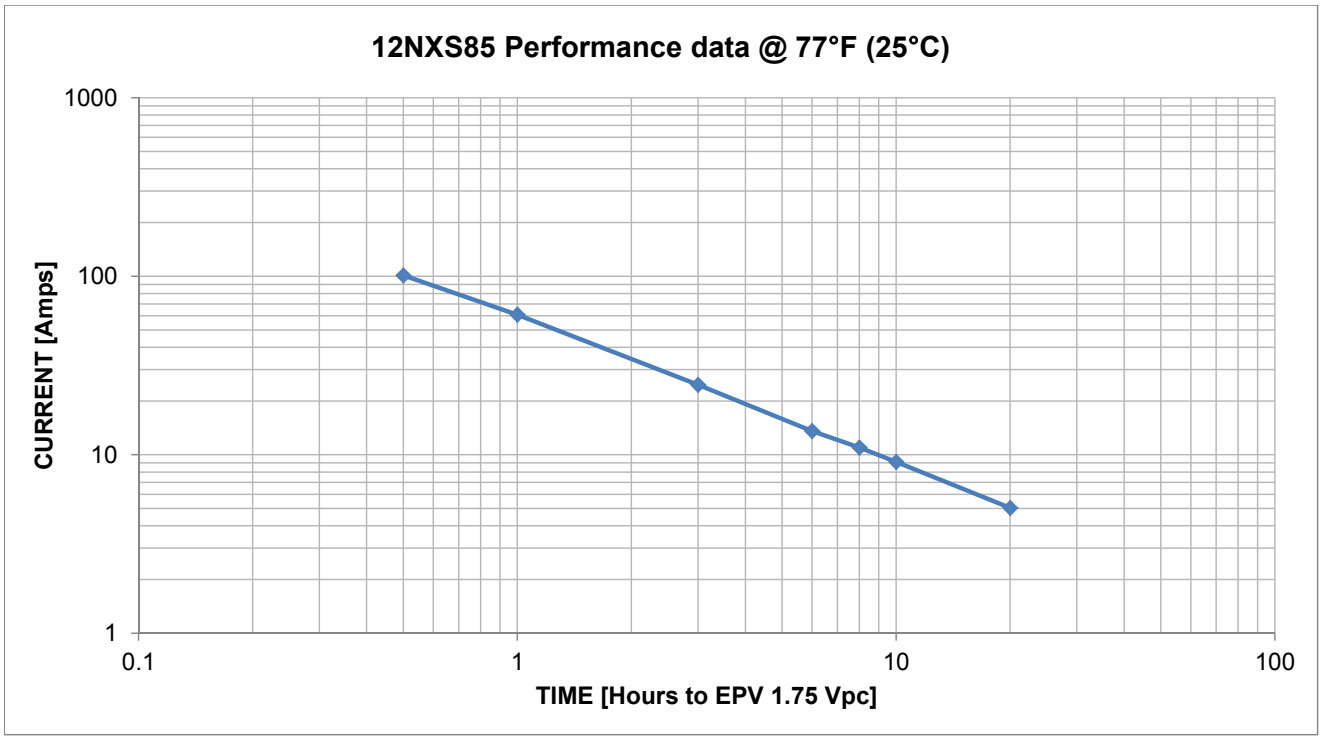
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	61.65	36.55	14.67	8.03	6.19	5.09	2.79



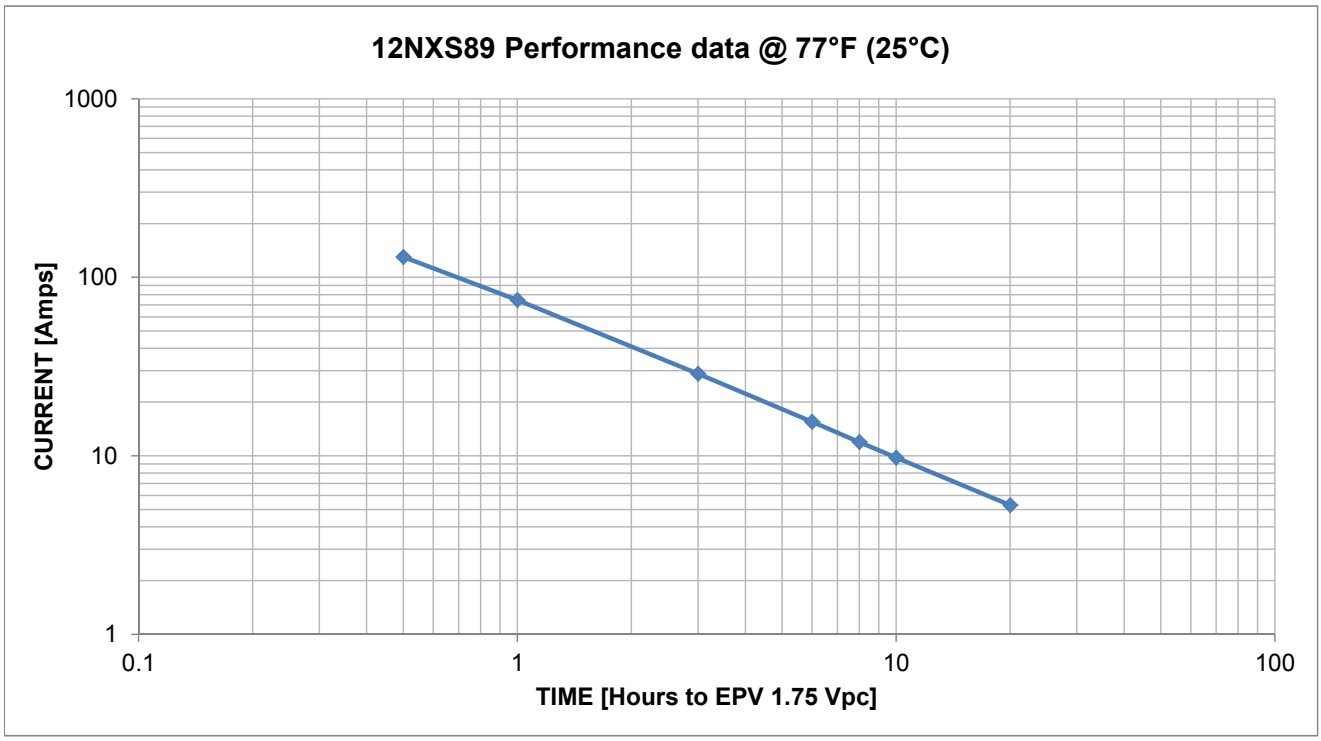
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	77.74	46.07	17.97	9.75	7.44	6.12	3.14



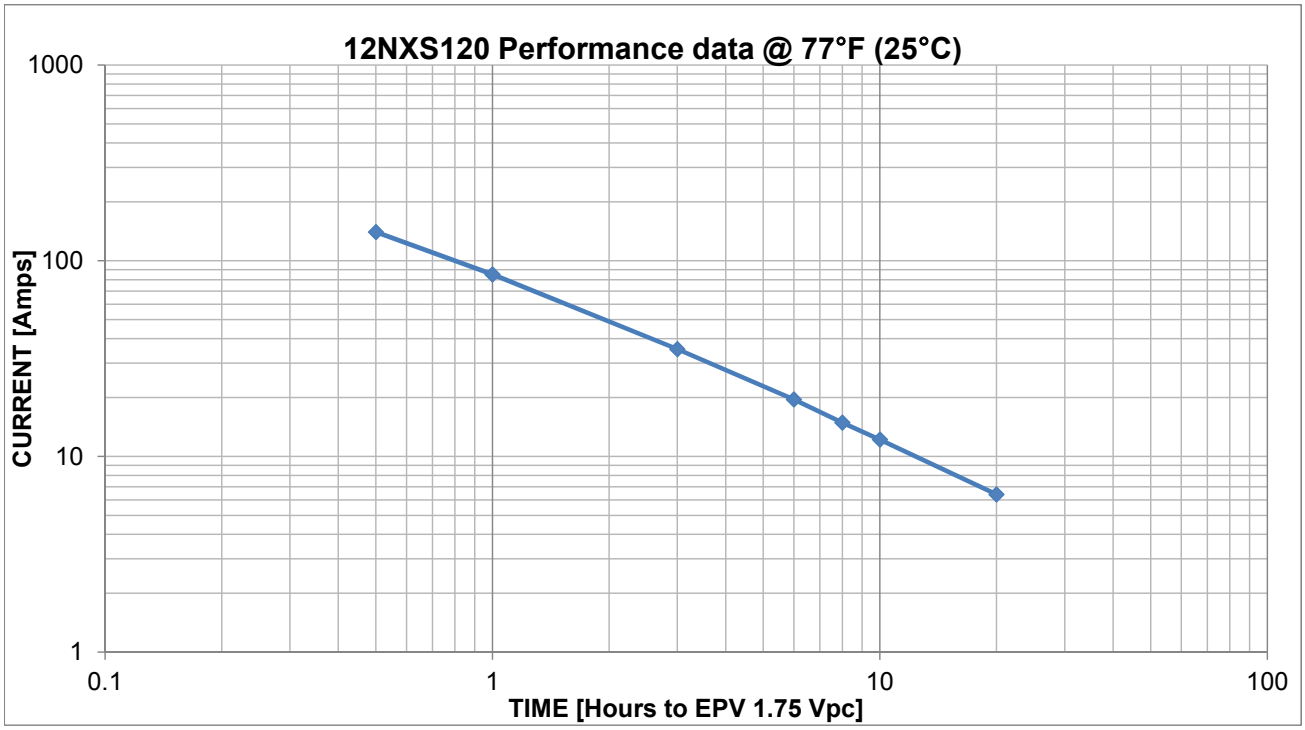
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	89.70	51.17	19.64	10.54	8.11	6.64	3.60



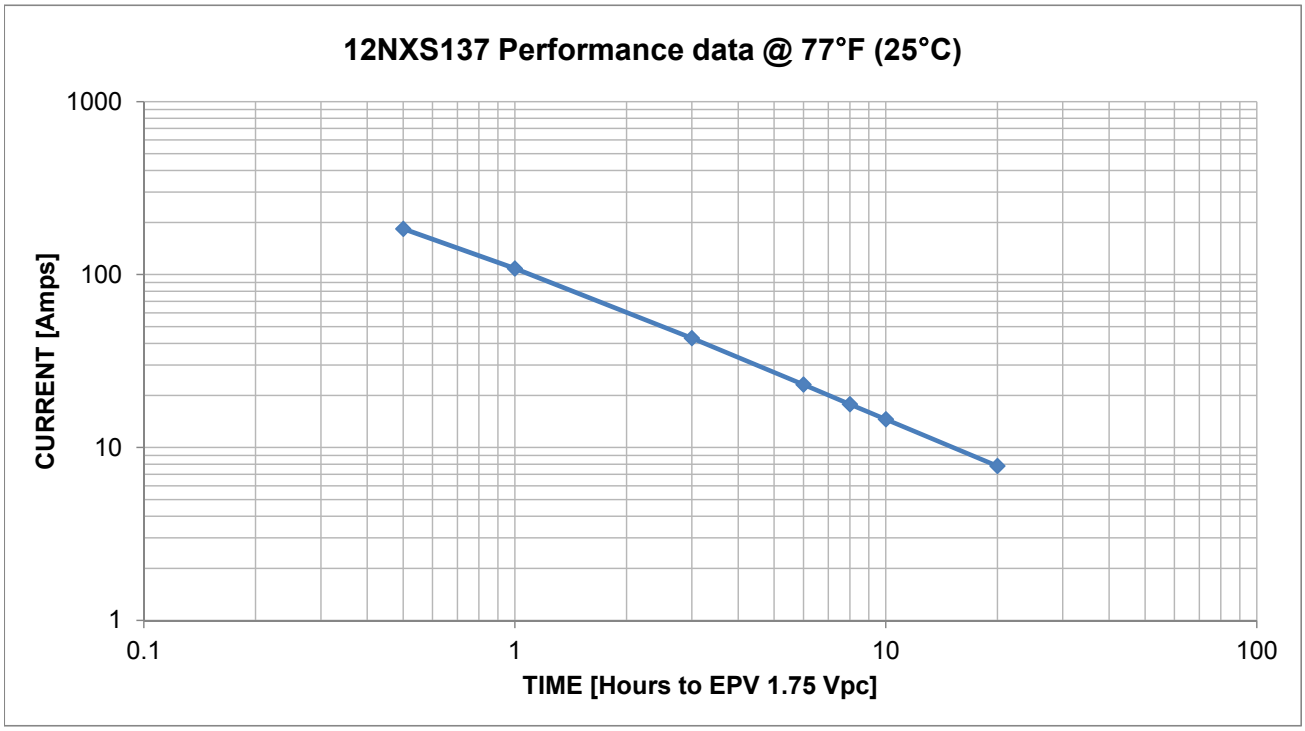
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	101.15	60.94	24.67	13.59	10.98	9.12	5.04



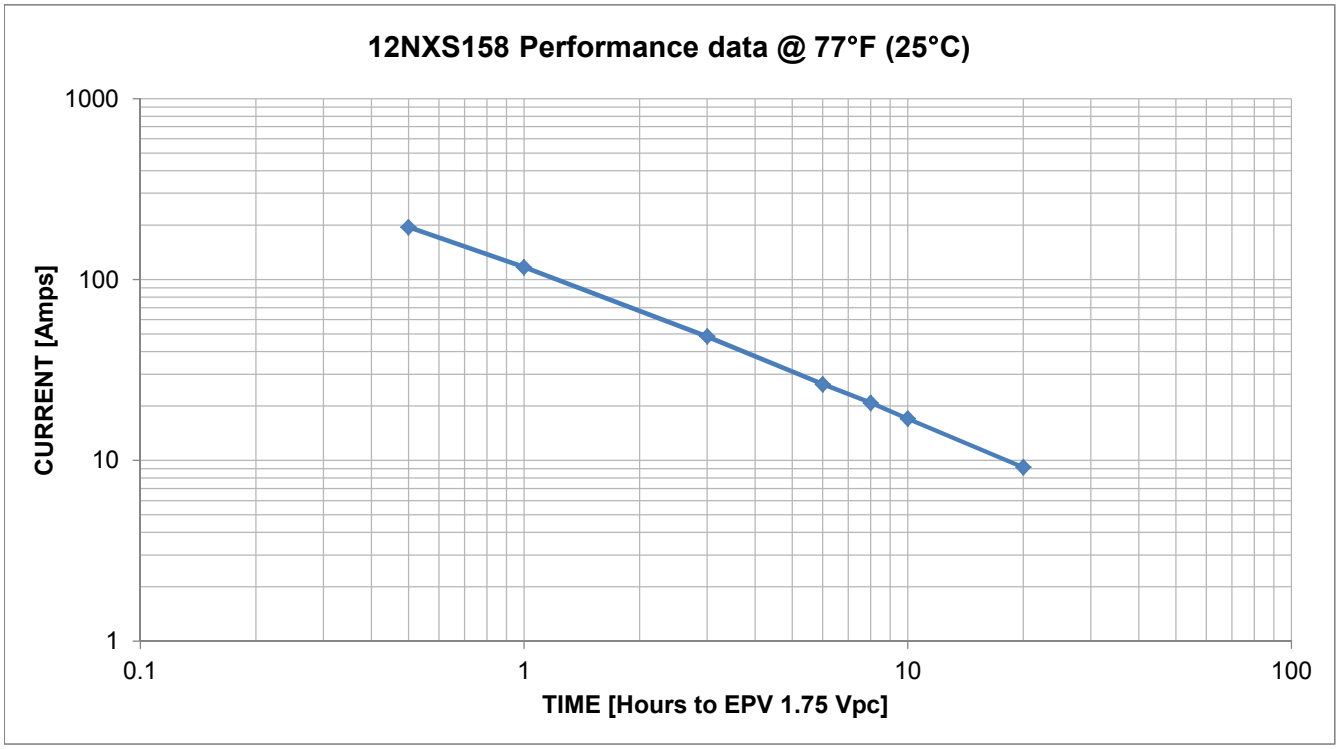
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	129.96	74.59	28.84	15.51	11.95	9.78	5.30



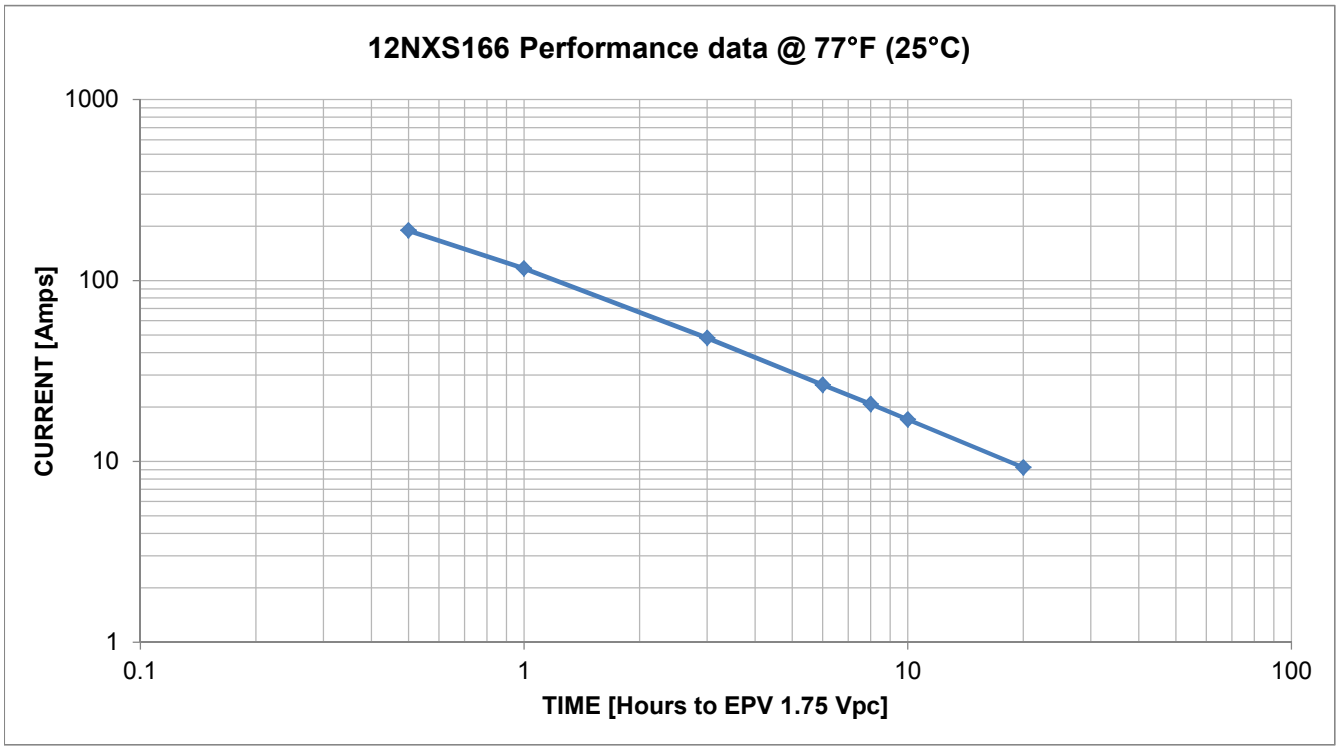
Discharge rate (hrs)	0.5	1	3	6	8	10	20
Constant current Discharge [A]	140.30	85.20	35.40	19.55	14.90	12.20	6.40



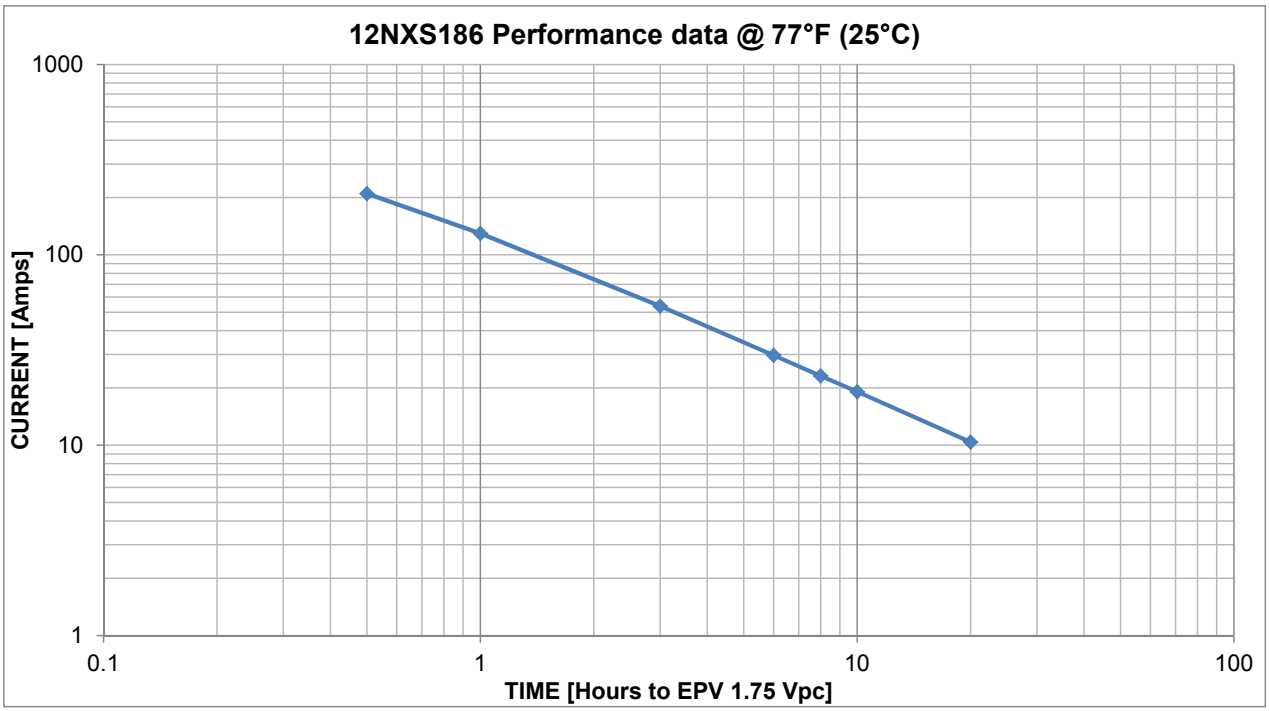
Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	184.06	108.52	42.87	23.12	17.80	14.55	7.82



Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	195.00	117.00	48.50	26.35	20.80	17.03	9.16



Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	188.90	116.64	48.09	26.51	20.69	17.03	9.26



Discharge Rate (hrs)	0.5	1	3	6	8	10	20
Constant Current Discharge [A]	209.90	129.76	53.82	29.68	23.15	19.11	10.40

CHARGING

Charging NexSys® batteries correctly is a critical factor to their life expectancy and performance. To ensure that the NexSys batteries are correctly charged, EnerSys® has developed a fast charge algorithm for cyclic applications to rapidly and safely charge TPPL batteries. EnerSys has a full range of chargers available that can be purchased. Only EnerSys chargers with a TPPL charge algorithm are permitted to charge NexSys blocs. Using any other charger will void the warranty.

Charging must only be carried out where adequate ventilation is available and must not be carried out in confined spaces.

NexSys batteries can be quickly charged with an EnerSys charger. Figures 3 and 4 below show their exceptional fast charge characteristics at varying levels of DOD and charge rates.

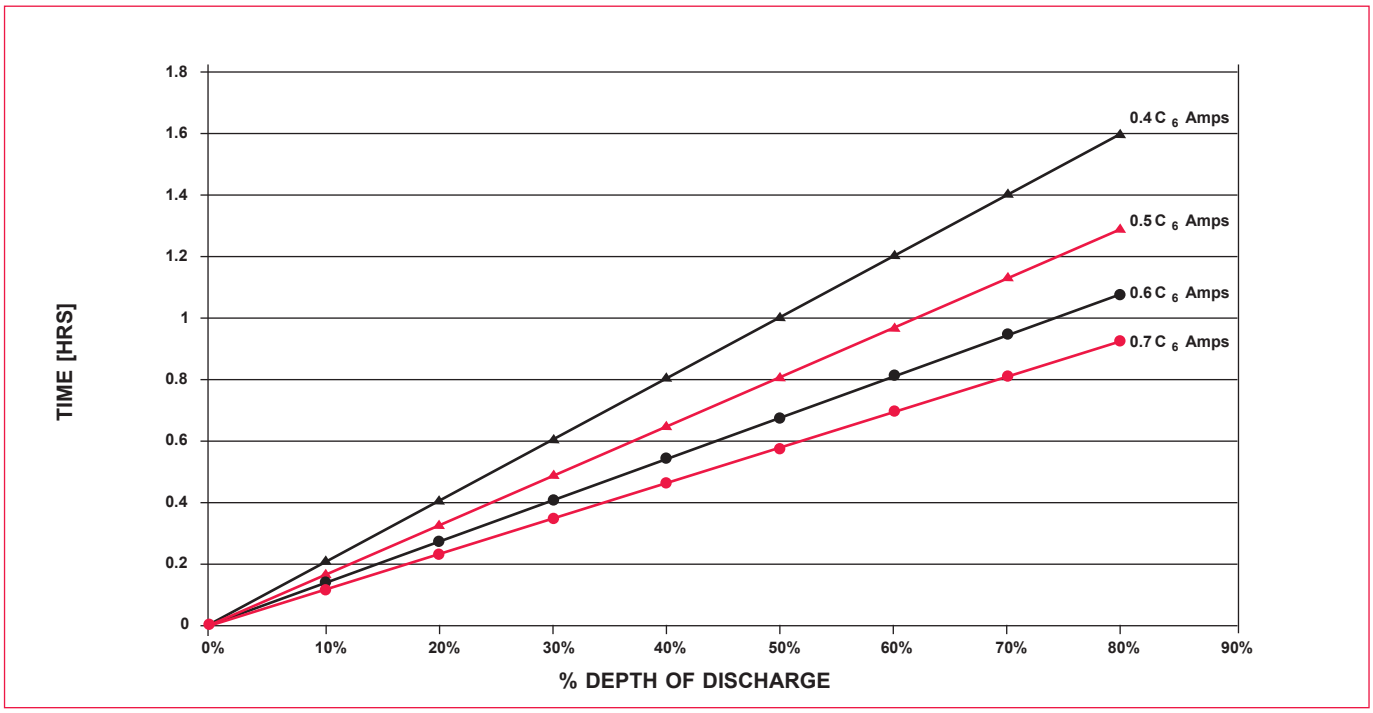


Figure 3 – Recharge time – return 80% of discharged Ah's

As an example, consider a 100Ah battery discharged by 60Ah (to 60% Depth of Discharge), leaving residual capacity of 40Ah. 48Ah returned after 0.8hrs of charge with a $0.6C_6A$ charge rate. Battery state of charge after 0.8 hours will be approximately 86% as the recharge process is not 100% efficient.

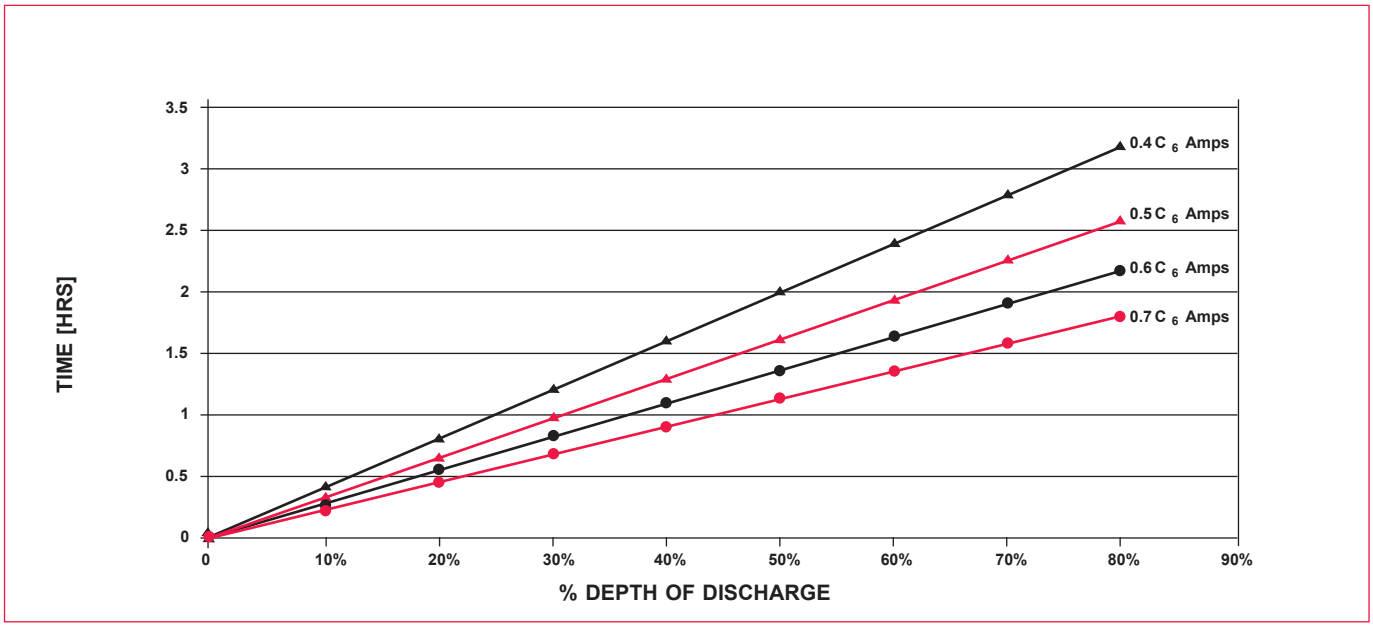


Figure 4 – Recharge time – return 100% of discharged Ah's

IMPORTANT

NexSys® batteries are designed to be charged with charging rates in range $0.32C_6$ to $0.7C_6$. Charging at rates outside this range can affect the performance and life expectancy of the battery. Contact EnerSys® before using rates outside this range.

As another example, consider a 100Ah battery discharged by 80Ah (to 80% DOD), then recharged with a $0.5C_6$ start current, 100% of the discharged Ah (80Ah) will be returned after approximately 2.5h recharge. Increasing inrush current to $0.7C_6$ reduces this to 1.8 hours recharge. The recharge process is not 100% efficient and the battery will achieve approximately 97% state of charge following the above recharge procedure. A short absorption phase after recharging the 100% discharged Ahs is required to ensure full battery recovery. EnerSys® chargers are programmed to achieve such recovery and deliver the recharge capabilities shown in Figures 3 and 4.

OPPORTUNITY CHARGING

NexSys® batteries are suitable for partial state of charge operation, however the depth of discharge must not exceed 80% of the rated C_6 capacity and opportunity charging must be applied whenever the batteries are not being discharged (i.e. break / lunch times, shift handover, etc).

Equipment may continue to draw low power loads when not in service, which will reduce the available battery capacity. To counter this, EnerSys recommends that the battery/charger remain connected to the main power supply between equipment usage periods. EnerSys approved chargers are designed to counter low power draw and preserve battery state of charge.

The electrochemistry of the NexSys series allows the battery to be recharged in a relatively short period of time with high inrush currents with no detrimental effect. This is possible as a result of its low internal impedance and exceptional charge acceptance.

With these attributes, the SOC of the NexSys battery can be maintained at almost 100% throughout the working day.

It is imperative that the battery receives a complete charge (returning the battery to 100% of its rated C_6 capacity) at least once per week. Failure to do so will have a detrimental effect on the performance and cycle life of the battery.

CYCLE LIFE

The life expectancy of the NexSys batteries depends on the application and its duty cycle.

While several factors affect the life of a battery, cycle life depends primarily on the DOD.

Depth of Discharge	Cycles
40% DOD	2200
50% DOD	1500
60% DOD	1200
80% DOD	700

Figures 5 and 6 illustrate this relationship between DOD and cycle life from full state of charge.

DISPOSAL

NexSys® batteries are recyclable. Scrap batteries must be packaged and transported in accordance with prevailing transportation rules and regulations. Scrap batteries must be disposed of in compliance with local and national laws by a licensed or certified lead acid battery recycler.

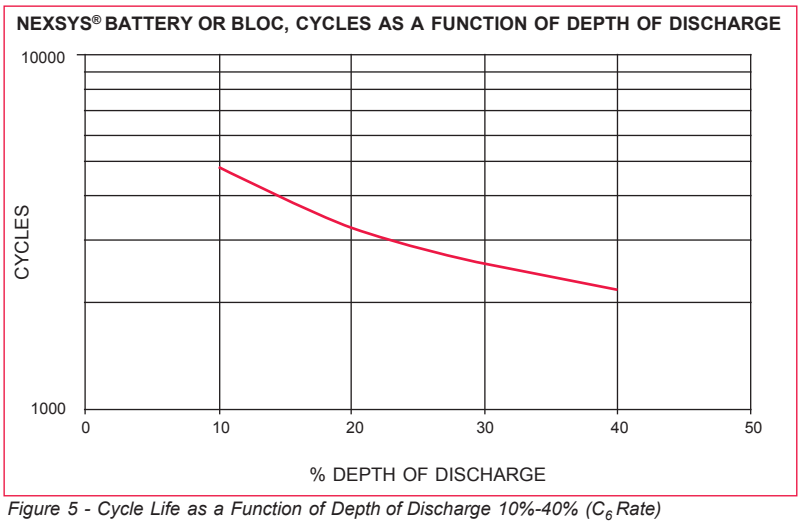


Figure 5 - Cycle Life as a Function of Depth of Discharge 10%-40% (C_6 Rate)

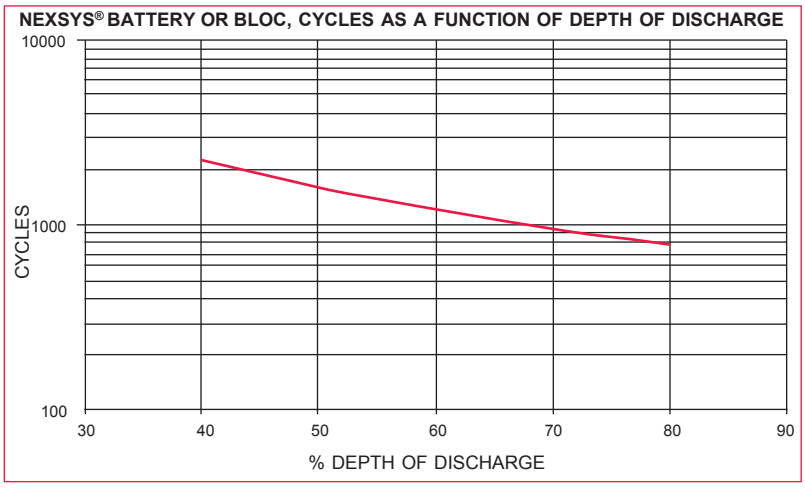


Figure 6 - Cycle Life as a Function of Depth of Discharge 40%-80% (C_6 Rate)

NOTES

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