LAK

INSTRUCTION MANUAL
FOR
60 CELLS NCX-2550 BATTERY
ASSEMBLED ON 2-S07-074710-006

± 125V CONTROL STORAGE BATTERY
FOR
LONG ISLAND LIGHTING COMPANY
HICKSVILLE, NEW YORK

ENGINEER: STONE & WEBSTER ENGINEERING CORP.
BOSTON, MASSACHUSETTS
FOR SHOREHAM NUCLEAR POWER STATION UNIT #1
BROOKHAVEN TWP., L.I., N.Y.

P.O. #310610
S&W J.O. #11600.02
SPEC. #SH1-116
SERIAL #KHA-087E; KHA-088C; KHA-089A; & KHA-090E
GOULD ORDER #T-12574 (BATT.)
L-12575 (RACK)

TABLE OF CONTENTS



Gould Inc. - Industrail Battery Div.
Langhorne, Pa.

068298-018
K-12574 (Item #5)
11-18-75

GOULD INDUSTRIAL BATTERY DIV.

This is to certify that this drawing indicates correct information relative to MANUAL SUBMITTAL

to be supplied on Customer P.O. No. 310610

☐ For Approval Gould Order No. T-12574 & L-12575

☐ SPEC. No. SHI-116

☐ FINAL GOULD INC. Date 12-11-75

LANGHORNE, PA. 19047 Per W.L.W.

| | |
|---|---|
| GOULD INC INDUSTRIAL BATTERY DIV HAS PROPRIETARY RIGHTS IN THIS MATERIAL | GOULD |
| TOLERANCES & SPECS UNLESS OTHERWISE NOTED | TITLE INSTRUCTION MANUAL FOR LONG ISLAND LIGHTING CO. SHOREHAM NUCLEAR POWER STATION UNIT # 1 |
| DEC ± ; FRACTIONS ± | DRN. ; CHKD ; APPD ; DATE ; MOLD NO OR PART CLASS ; PLANT ; DEPT. |
| | SHEET OF ; 068798-018 |

INSTRUCTION MANUAL
FOR
60 CELLS NCX-2550 BATTERY
ASSEMBLED ON 2-S07-074710-806

± 125V CONTROL STORAGE BATTERY
FOR
LONG ISLAND LIGHTING COMPANY
HICKSVILLE, NEW YORK

ENGINEER: STONE & WEBSTER ENGINEERING CORP.
BOSTON, MASSACHUSETTS
FOR SHOREHAM NUCLEAR POWER STATION UNIT #1
BROOKHAVEN TWP., L.I., N.Y.

P.O. #310610
S&W J.O. #11600.02
SPEC. #SH1-116
SERIAL #KHA-087E; KHA-088C; KHA-089A; & KHA-090E
GOULD ORDER #T-12574 (BATT.)
L-12575 (RACK)

TABLE OF CONTENTS



Gould Inc. - Industrail Battery Div.
Langhorne, Pa.

068298-018
K-12574 (Item #5)
11-18-75

# GOULD

## BILL OF MATERIAL

GOULD INC.
INDUSTRIAL BATTERY DIVISION
Plant Dept.

| LINE No. | PART DESCRIPTION | | MAT'L | PART No. | DRAWING No. | No. PER BATT. | KEY PUNCH |
|---|---|---|---|---|---|---|---|
| 1 | [illegible]-2550 | | | M01-[illegible] | [illegible]328 | [illegible] | [illegible] |
| 2 | 5/16-18 Hex. Hd. Conn. Bolt [illegible] | SS | | M02-[illegible]-005 | | 240 | [illegible] |
| 3 | 5/16-18 Hex. Nut | SS | | M06-105753 | | [illegible] | 264 |
| 4 | 5/16 Washer | SS | | M03-1[illegible]523-003 | | 430 | 430 |
| 5 | | | | | | | |
| 6 | Intercell Conn.-Cop., [illegible] | | | L03-0[illegible]64-[illegible] | [illegible]40 | 11[illegible] | 11[illegible] |
| 7 | Intercell Conn.-Cop., [illegible] | | | L03-086065-[illegible] | [illegible]065[illegible] | 112 | 11[illegible] |
| 8 | Intercell Cable Conn. | | | L06-087[illegible] | 042-350 | 12 | 1[illegible] |
| 9 | #350 MCM Wire | CA | [illegible] | L04-0[illegible]040 | | | |
| 10 | Lug-Cop., [illegible] | | 2 | L07-036[illegible] | | | 600 |
| 11 | 5/16-18 Hex. Hd. Bolt 1 [illegible] Lg. SS | | | M02-105737 | | [illegible] | 24 |
| 12 | 5/16-18 Hex. Nut | SS | | M06-105753 | | 24 | |
| 13 | 5/16 Washer | SS | | M03-105750 | | 40 | 4[illegible] |
| 14 | Term. & Cable Conn. [illegible]-Cop., [illegible] | | | L[illegible]-087400 | [illegible]A | 16 | 16 |
| 15 | | | | | | | |
| 16 | [illegible] | | | | | | |
| 17 | [illegible] Plate | PL | [illegible] | [illegible]-07[illegible] | | 1 | 1 |
| 18 | [illegible] | PL | | [illegible]-0[illegible]021 | [illegible]021A | 1 | 1 |
| 19 | [illegible] Wrench | | | [illegible] | [illegible] | 1 | 1 |
| 20 | [illegible] | | | [illegible]-[illegible] | [illegible] | 1 | 1 |
| 21 | [illegible] Holder | | | [illegible]-[illegible]A | [illegible] | 1 | 1 |
| 22 | [illegible] | | | [illegible] | [illegible] | 1 | 1 |
| 23 | [illegible] | | | [illegible] | [illegible] | 1 | 1 |
| 24 | [illegible] | | | [illegible] | [illegible] | 1 | 1 |
| 25 | | WD | | [illegible]7-[illegible]7072-001 | [illegible] | 1 | 1 |

PLATE CENTERS ______ MTG. HT. ______ CELL ASSY. ______ BATTERY DWG(S) [illegible]

CAP [illegible] A.H. at [illegible] HR. RATE. FINISHING RATE ______ AMPS. SP. GR. [illegible]

NOTATIONS Two Step, [illegible] SPECIAL TERMINALS, No Lugs

REVISIONS

| UNIT TYPE | Made by | Chkd. by | B/M | sheet |
|---|---|---|---|---|
| [illegible] Cells [illegible]-2550 | [illegible] | [illegible] | | |

GOULD

# BILL OF MATERIAL

GOULD INC.
INDUSTRIAL BATTERY DIVIS[illegible]
Plant . Dept.

| LINE No. | PART DESCRIPTION | MAT'L. | PART No. | DRAWING No. | No. PER BATT. | P[illegible] |
|---|---|---|---|---|---|---|
| 1 | Steel Support | ST | S01-065??7-0?0 | 065?97C | 9 | 9 |
| 2 | Steel Support | ST | S01-065807-019 | 065?97C | 9 | 9 |
| 3 | Steel Stringer | ST | S02-074565 | 043301A | 6 | 6 |
| 4 | Steel Side Stringer | ST | S02-043301-050 | 043301A | 4 | 4 |
| 5 | Steel End Stringer | ST | S02-043301-024 | 043301A | 4 | 4 |
| 6 | Steel Brace | ST | S03-074?40-106 | 074?40A | 16 | 16 |
| 7 | Steel Brace | ST | S03-074940-024 | 074940A | 16 | 16 |
| 8 | Steel Tubing | ST | S05-078947-0?0 | 078?47C | 4 | 9 |
| 9 | Steel Tubing | ST | S05-078947-03? | 078?47C | 9 | 9 |
| 10 | Steel Tubing | ST | S05-078947-0?? | 078?47? | [illegible] | [illegible] |
| 11 | Steel Corner Fitting | ST | S04-0745?6 | 07459?A | 16 | 16 |
| 12 | Bracing Clamp Pads | [illegible] | S05-074??0-??? | 07??3?A | 16 | [illegible] |
| 13 | Bracing Clamping Pads | [illegible] | S05-074???-??? | 074?30A | 16 | 16 |
| 14 | Plastic Cell Strip ??t.Lg. | [illegible] | S?5-10??1?-??? | 1???4?A | 14 | 14 |
| 15 | Plastic Cell Strip ?t. Lg. | [illegible] | ??-106340-??? | 10634?A | 2? | 2? |
| 16 | Plastic Cell Strip ??. Lg. | [illegible] | ??-106340-??? | 10?3?? | 2 | 2 |
| 17 | ?-1? Hex. Hd. Bolt 1 ? Lg. | [illegible] | ?02-005??? | | [illegible] | [illegible] |
| 18 | ?-1? Hex. Hd. Bolt 2 ? Lg. | [illegible] | ?02-071?0? | | [illegible] | [illegible] |
| 19 | ?-1? Hex. Hd. Bolt ? ?/? ? | [illegible] | [illegible] | | 5? | 5? |
| 20 | ?-1? Hex. Hd. Bolt 4 ?? | [illegible] | ??-?-?0? | | [illegible] | [illegible] |
| 21 | ?-1? ?? ?? Bolt 1 3/4 ?. | [illegible] | [illegible] | | [illegible] | [illegible] |
| 22 | ? Split Lockwasher | [illegible] | ?0?-00?0?? | | 2?4 | 2?4 |
| 23 | Bracing Clamping Nut | [illegible] | ?02-?00?24 | 07??5?? | 12? | 12? |
| 24 | ?-? ??, ?? | | [illegible] | | 12? | [illegible] |
| 25 | Steel ?????? Washers | | ??-65? ???? | [illegible] | [illegible] | [illegible] |
| 26 | Plastic Cell Spacers | [illegible] | [illegible] | [illegible] | [illegible] | 2? |
| 27 | ?????? | | ??-?7??? | | 6 | [illegible] |
| 28 | | | | | | |
| 29 | ??? ????, stringers with cell ???? ??????? [illegible] | | | | | |
| 30 | ?? ?? ????????????? ?? ? [illegible] | | | | | |
| 31 | Bolts, nuts, washers & cell ???? ?? ?? ordered for ??? ????. | | | | | |
| 32 | | | | | | |
| 33 | ???? material required for 1-??? ???? - ?? ?? ??? ??? ??-?? ????. | | | | | |
| 34 | | | | | | |
| 35 | | | | | | |
| 36 | | | | | | |
| 37 | | | | | | |
| 38 | | | | | | |
| 39 | | | | | | |
| 40 | | | | | | |
| 41 | | | | | | |
| 42 | | | | | | |
| 43 | | | | | | |
| 44 | | | | | | |
| 45 | | | | | | |

PLATE CENTERS ______ MTG. HT. ______ CELL ASSY. ______ BATTERY DWG(S) [illegible]

CAP ______ A.H. at ______ HR. RATE. FINISHING RATE ______ AMPS. SP. GR. ______

NOTATIONS 366 Bracing for ???/??-???? ,1??-2559

REVISIONS

REV. 'A' — 7-1-75 — LINE #2 SUPPORT PT NO. WAS -109 (ERROR)

UNIT TYPE 1,S07-074710-006

Made by ______ Date 6-1?-75

Ch'd. by [illegible] Date [illegible]

B/M S07-074710-006

sheet ______ of ______

GOULD

Stationary Power Cells (Calcium)

# TYPE: NCX

## CAPACITIES—600 A.H. TO 2550 A.H. @ 8 HOUR RATE TO 1.75 V.P.C. AVERAGE

### SPECIFICATIONS

**Container**—Styrene-Acrylonitrile Plastic.

**Cover**—Acryl.-Buta.-Styr. Terpolym. Plastic.

**Separators**—Microporous Material.

**Retainers**—Fiberglass Mats.

**Posts**—See Below.①

**Post Seals**—Floating O-Ring—Seal Nut.

**Vents**—Screw Type—Spray Proof.②

**Level Lines**—High and Low—All Jar Faces.

**Electrolyte**—Height Above Plates—2-3/4".

**Electrolyte Withdrawal Tube**—Each Cell.

**Sediment Space**—1-1/16".

**Specific Gravity**—1.215 @ 77°F. (25°C.).

**Inter-Cell Connectors**—Lead Plated Copper.

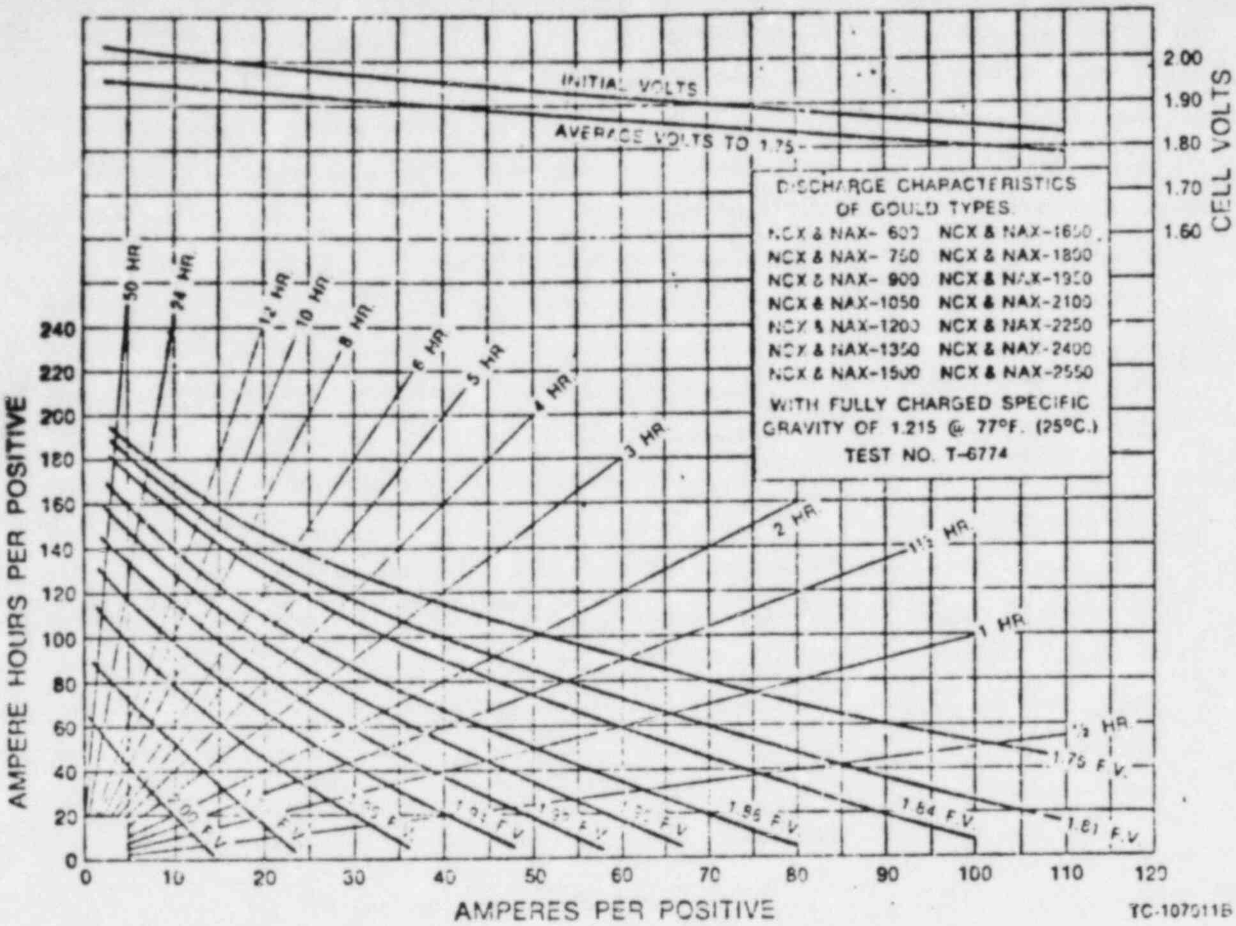
| Plate Dimensions | Height | Width | Thickness |
|---|---|---|---|
| Positive Plate | 15" | 12½" | .320 |
| Negative Plate | 15" | 12½" | .215 |

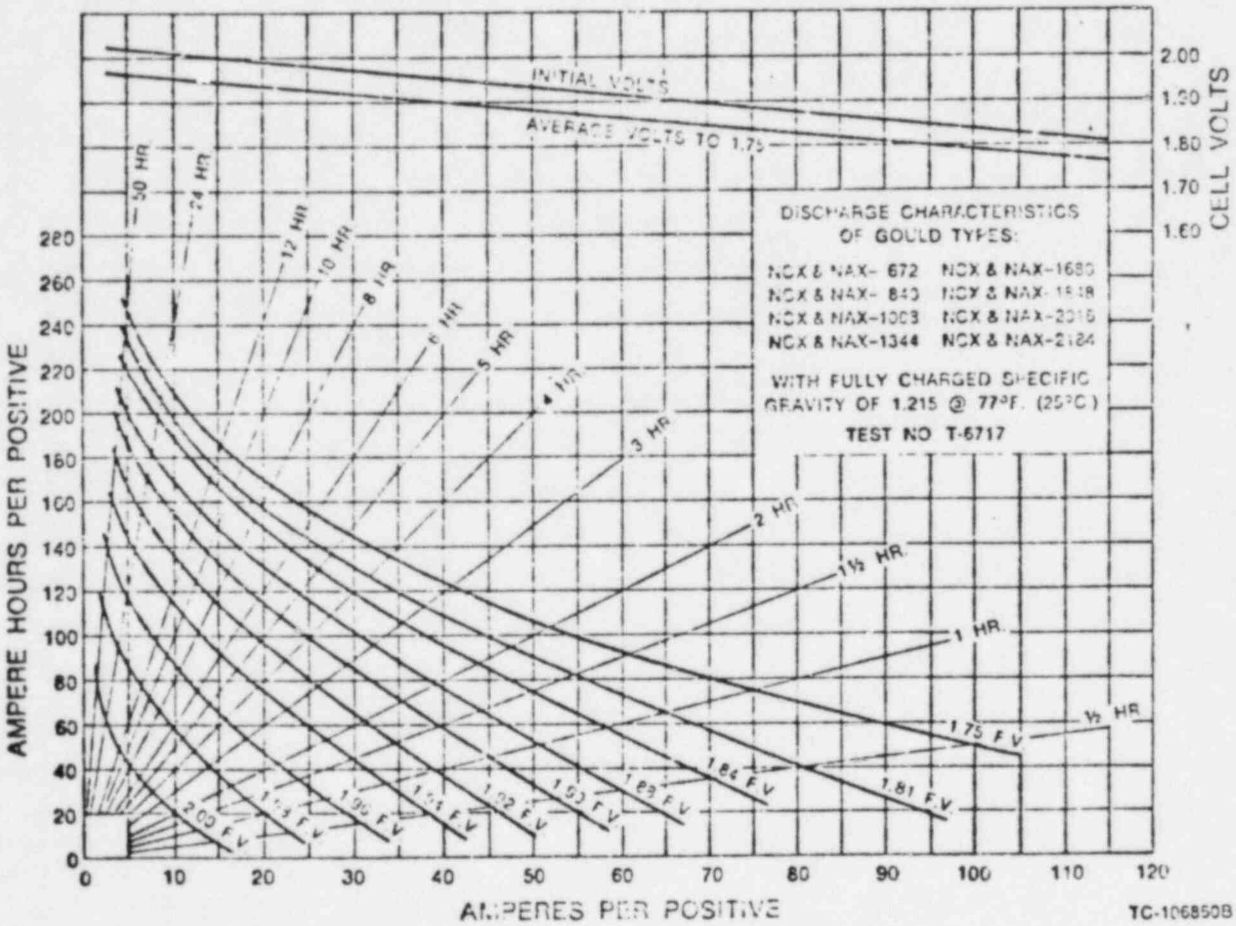
① Posts—600 A.H. to 1200 A.H. Two—1½" square. 1344 A.H. to 1950 A.H. Four—1" square. (Except 1848 A.H.) 1848 A.H. to 2550 A.H. Four—1½" square.

② Combined Filling Funnel—Explosion resistant vent is available at additional cost. Specify Gould "Pre-Vent".**

| Type | Plates Per Cell | Ampere Hour Capacities to 1.75 V.P.C. Average* | | | | 1 Minute Rate in Amperes* | | Overall Dimensions in inches | | | Approximate Wgt. in Lbs. | | Elect. Gals. Per Cell |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 8 Hr. | 5 Hr. | 3 Hr. | 1 Hr. | To 1.75 V.P.C. Avg | To 1.50 V.P.C. Avg. | L | W | H | Net Wgt. | Packed Wgt. | |
| NCX-600 | 9 | 600 | 540 | 468 | 300 | 712 | 1355 | 7-3/8 | 14-1/2 | 22-1/8 | 177 | 189 | 6.0 |
| NCX-672 | 9 | 672 | 588 | 492 | 300 | 636 | 1210 | 7-3/8 | 14-1/2 | 22-1/8 | 178 | 190 | 6.0 |
| NCX-750 | 11 | 750 | 675 | 585 | 375 | 880 | 1675 | 7-3/8 | 14-1/2 | 22-1/8 | 195 | 207 | 5.6 |
| NCX-840 | 11 | 840 | 735 | 615 | 375 | 790 | 1500 | 7-3/8 | 14-1/2 | 22-1/8 | 196 | 208 | 5.6 |
| NCX-900 | 13 | 900 | 810 | 702 | 450 | 1044 | 1985 | 7-3/8 | 14-1/2 | 22-1/8 | 213 | 225 | 5.1 |
| NCX-1008 | 13 | 1008 | 882 | 738 | 450 | 942 | 1790 | 7-3/8 | 14-1/2 | 22-1/8 | 214 | 226 | 5.1 |
| NCX-1050 | 15 | 1050 | 945 | 819 | 525 | 1204 | 2290 | 7-3/8 | 14-1/2 | 22-1/8 | 231 | 243 | 4.9 |
| NCX-1200 | 17 | 1200 | 1080 | 936 | 600 | 1360 | 2585 | 7-3/8 | 14-1/2 | 22-1/8 | 249 | 261 | 5.0 |
| NCX-1344 | 17 | 1344 | 1176 | 984 | 600 | 1240 | 2360 | 9-1/4 | 14-1/2 | 22-1/2 | 268 | 280 | 6.8 |
| NCX-1350 | 19 | 1350 | 1215 | 1053 | 675 | 1494 | 2840 | 9-1/4 | 14-1/2 | 22-1/2 | 282 | 294 | 6.3 |
| NCX-1500 | 21 | 1500 | 1350 | 1170 | 750 | 1620 | 3080 | 9-1/4 | 14-1/2 | 22-1/2 | 301 | 313 | 6.0 |
| NCX-1650 | 23 | 1650 | 1485 | 1287 | 825 | 1782 | 3390 | 11-3/8 | 14-1/2 | 22-1/2 | 348 | 366 | 8.0 |
| NCX-1680 | 21 | 1680 | 1470 | 1230 | 750 | 1530 | 2910 | 11-3/8 | 14-1/2 | 22-1/2 | 332 | 350 | 8.3 |
| NCX-1800 | 25 | 1800 | 1620 | 1404 | 900 | 1932 | 3675 | 11-3/8 | 14-1/2 | 22-1/2 | 364 | 382 | 7.6 |
| NCX-1848 | 23 | 1848 | 1617 | 1353 | 825 | 1661 | 3160 | 14-9/16 | 14-1/2 | 22-1/2 | 397 | 415 | 12.6 |
| NCX-1950 | 27 | 1950 | 1755 | 1521 | 975 | 2080 | 3955 | 11-3/8 | 14-1/2 | 22-1/2 | 380 | 398 | 7.3 |
| NCX-2016 | 25 | 2016 | 1764 | 1476 | 900 | 1788 | 3400 | 14-9/16 | 14-1/2 | 22-1/2 | 415 | 433 | 12.1 |
| NCX-2100 | 29 | 2100 | 1890 | 1638 | 1050 | 2240 | 4260 | 14-9/16 | 14-1/2 | 22-1/2 | 446 | 464 | 11.5 |
| NCX-2184 | 27 | 2184 | 1911 | 1599 | 975 | 1924 | 3660 | 14-9/16 | 14-1/2 | 22-1/2 | 433 | 451 | 11.5 |
| NCX-2250 | 31 | 2250 | 2025 | 1755 | 1125 | 2400 | 4565 | 14-9/16 | 14-1/2 | 22-1/2 | 462 | 480 | 10.9 |
| NCX-2400 | 33 | 2400 | 2160 | 1872 | 1200 | 2560 | 4865 | 14-9/16 | 14-1/2 | 22-1/2 | 479 | 497 | 10.3 |
| NCX-2550 | 35 | 2550 | 2295 | 1989 | 1275 | 2720 | 5170 | 14-9/16 | 14-1/2 | 22-1/2 | 496 | 514 | 9.7 |

* Includes voltage drop across intercell connections used in standard layouts. ** TMGould, Inc.




**Gould Inc., Industrial Battery Division**
457 Calhoun Street, Trenton, N.J. 08607
Telephone (609) 392-3111

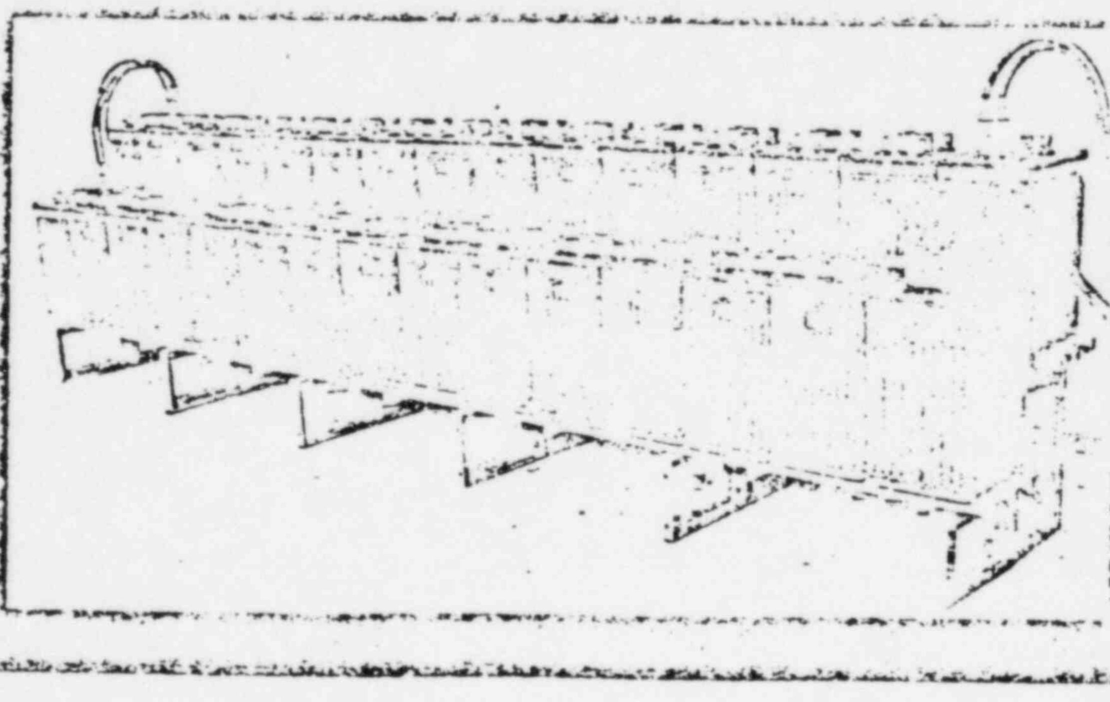
GOULD

# Stationary Battery Installation and Operating Instructions

Lead Antimony Types

Lead Calcium Types

Planté Types



GOULD

# STATIONARY BATTERY INSTALLATION AND OPERATING INSTRUCTIONS

LEAD-ANTIMONY TYPES

LEAD-CALCIUM TYPES

PLANTÉ TYPES

Gould Inc., Industrial Battery Division
2050 Cabot Boulevard West, Langhorne, Pa. 19047
Telephone (215) 752-0555

GOULD

# INDEX

# SECTION I

## 1.0 GENERAL INFORMATION

Caution! Before proceeding with the unpacking, handling, installation and operation of this lead-acid storage battery, the following general information should be reviewed together with the recommended safety precautions.

A lead-acid battery is an electro-chemical device containing an electrolyte which is a dilute solution of sulfuric acid and water. This electrolyte is corrosive and can cause injury.

Lead-acid batteries, when installed, are capable of high voltage which can cause electrical shocks to personnel.

All lead-acid batteries, in the course of normal operation, generate gases which can be explosive.

# SECTION II

## 2.0 SAFETY PRECAUTIONS

A. Wear rubber apron, gloves and safety goggles (or face shield) when handling, installing or working with batteries. This will help prevent injury due to splashing or spillage of sulfuric acid.

B. Prohibit smoking. Keep flames and sparks of all kinds away from vicinity of storage batteries as liberated or entrapped hydrogen gas in the cells may be exploded, causing injury to personnel and damage to cells.

C. Never place metal tools on top of cells, since sparks due to shorting across cell terminals may result in an explosion of hydrogen gas in or near the cells. Insulate tool handles to protect against shorting.

D. When preparing electrolyte, always pour acid into water, NEVER water into acid. Failure to follow this precaution will result in excess heat and violent chemical reaction which may cause serious injury to personnel.

E. If electrolyte comes into contact with skin or clothing, immediately wash with water and neutralize with a solution of baking soda and water. Secure medical treatment. If electrolyte comes into contact with the eyes, wash or flush with plenty of clean water. Secure medical treatment immediately.

F. Exercise care when handling cells. When lifting straps and strap spreaders are provided, use them with appropriate mechanical equipment to safely handle cells and avoid injury to personnel.

G. Promptly neutralize and remove any electrolyte spilled when handling or installing cells. Use a baking soda/water solution (1 lb. per gallon of water) to prevent possible injury to personnel.

H. Make sure that all battery connections are properly prepared and tightened to prevent possible injury to personnel or failure of system.

I. Familiarize personnel with battery installation, charging and maintenance procedures. Restrict access to battery area, permitting trained personnel only, to reduce the possibility of injury.

J. Whenever possible, when making repairs to charging equipment and/or batteries, interrupt AC and DC circuits to reduce the possibility of injury to personnel and damage to system equipment.

**NOTE**

If the foregoing precautions are not fully understood, clarification should be obtained from your nearest Gould representative. Local conditions may introduce situations not covered by Gould Safety Precautions. Here again, contact the nearest Gould representative for guidance with your particular safety problem; also refer to applicable federal, state and local regulations as well as industry standards.

## SECTION III

### 3.0 RECEIPT OF SHIPMENT

Immediately upon delivery by the carrier, examine for possible damage caused in transit. Damaged packing material or staining from leaking electrolyte would indicate rough handling. If such conditions are found, make descriptive notation on delivery receipt before signing. If cell damage is found, request an inspection by the carrier and file a damage claim.

### 3.1 CONCEALED DAMAGE

Shortly after receipt (within 15 days), examine all cells for concealed damage. Pay particular attention to packing material exhibiting damage or electrolyte staining. Cells with electrolyte levels more than 1/2" below top of plates have suffered probable permanent damage due to plate exposure to air. If this condition or other cell damage is found, request an inspection by the carrier immediately and file a concealed damage claim.

### 3.2 ELECTROLYTE LEVELS

Cells are shipped with electrolyte levels about 1/8" below the high level line. During shipment, the levels drop due to the loss of gases from internal cell components. The amount of drop in level will vary with each type of cell. Electrolyte levels, when received, may range from the high level line to slightly below the low level line. If this condition exists, make no addition of electrolyte or water at this time *(see Section 8.3)*. If certain cells have low electrolyte levels, with less than 1/2" of plates exposed to air, add battery grade sulphuric acid of the same specific gravity as the remaining cells; thus bringing low level cells up to the average level of other cells.

## SECTION IV

### 4.0 STORAGE PRIOR TO INSTALLATION

### 4.1 STORAGE LOCATION

If the battery is not to be installed at the time of receipt, it is recommended that it be stored indoors in a cool [60°F (15.6°C) to 90°F (32°C)], clean, dry location. Do not tier pallets or possible cell damage may occur.

### 4.2 STORAGE INTERVAL

The following storage intervals from date of shipment to date of installation and initial charge should not be exceeded:

Lead-Antimony & Planté types:
Three (3) months

Lead-Calcium types:
Six (6) months

Storage beyond the above stated periods can result in sulphated plates which can be detrimental to battery life and performance.

The battery should be given its initial charge *(see Section 8.0)* before the end of the above stated storage intervals and repeated for each additional storage interval.

## SECTION V

### 5.0 RACK ASSEMBLY

Assembly of the battery rack should be completed in accordance with the Gould drawing and/or instructions included with the rack.

## SECTION VI

### 6.0 UNPACKING AND HANDLING

Most cells are packed in individual corrugated cartons. Some smaller size cells are packed in a master carton containing 2 (two) or 3 (three) cells. Cartons are shipped on wood pallets. Remove material holding cartons to pallets, exercising care when cutting banding material to prevent injury. If individual cells are to be moved to another location, do not remove carton at this time. Exercise caution if using a two-wheeled hand truck and, to prevent spillage of electrolyte, do not tilt cell more than 25 degrees from vertical. When cells have been brought to the installation site, remove carton sleeve and top corrugated spacers.

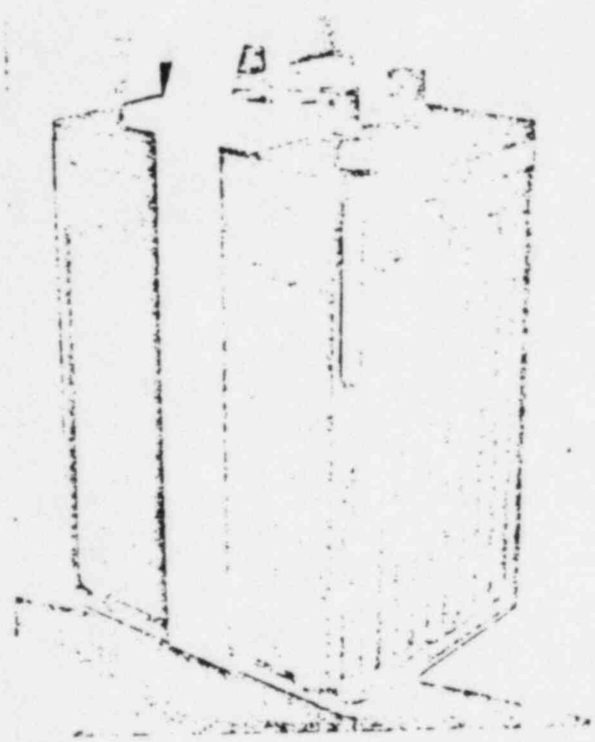


FIGURE 1

DO NOT LIFT CELLS BY THEIR TERMINAL POSTS. Support the cells from the bottom when handling and unpacking. In general, units weighing less than 75 pounds are handled manually, being supported from the bottom.

After removal of outer carton and top spacers, the cell should still be resting in the bottom corrugated tray. This tray is designed to be easily broken away to permit positioning of a lifting strap under the cell with a minimal amount of cell tilting.

A lifting strap and a strap spreader are furnished for use with mechanical lifting devices, when cells weigh 75 pounds or more. See *Figure 1* which shows typical positioning of strap and spreader.

Always use lifting straps and spreaders, when provided, together with suitable mechanical lifting devices to prevent injury to personnel or damage to cells.

Never slide cells across rough surfaces as severe scratching of plastic container bottom may result in stressing and rupturing of the jar with subsequent loss of electrolyte. At all times, exercise care when handling cells to prevent scratching of plastic jars and covers.

## SECTION VII

### 7.0 INSTALLATION

### 7.1 BATTERY LOCATION

It is recommended that the battery be installed in a clean, cool, dry location. Cells should not be exposed to heating units, strip heaters, radiators, steam pipes or sunshine through a window.

### 7.2 TEMPERATURE

A battery location having an ambient temperature of 75°F (24°C) to 77°F (25°C) will result in optimum battery life. Batteries operated in high ambient temperatures will result in reduced life. Therefore, for longer life and ease of maintenance, locations having cooler ambient temperatures are recommended.

## 7.3 TEMPERATURE VARIATION

The location or rack arrangement should result in no greater than 5°F (2.78°C) variation in cell temperatures of a series string at any given time. If a greater variation is found, steps should be taken to correct the condition. When uniform cell temperature is maintained, the need for equalizing charges may be eliminated or reduced in frequency.

## 7.4 VENTILATION

Ventilation should be provided in the battery room or area to prevent hydrogen, liberated from the cells in service, from exceeding a 2% concentration. Concentrations about this percentage can result in an explosive mixture, which could be ignited by sparks from adjacent electrical equipment as well as accidental sparks or open flames introduced by personnel. All air moved by ventilation in the battery room or area should be exhausted into the outside atmosphere and should not be allowed to recirculate into other confined areas.

## 7.5 PLACEMENT OF CELLS

It is assumed at this point that the battery rack has been assembled. Study the rack layout and wiring drawings to determine proper location of the positive and negative terminals of the battery; this will establish correct positioning of the initial cell on each rack row. Cells are normally installed with plate edges perpendicular to rack length.

Measure and mark the center of the rack stringer length. Determine the number of cells to be placed in each row. When an odd number of cells are in the row, place the center of the initial cell at the center point of the rack stringer length.

When an even number of cells are in the row, locate the initial cells so that the center of the space between cells coincides with the center mark of the stringer length.

When installing cells on the rack, start at the lower step or tier for stability and safety reasons.

Place cells on the rack so that the positive terminal (marked "+") of each cell adjoins the negative terminal (marked "-") of the next cell. The standard spacing between cells is 1/2" at the top of the jars.

Adjacent cells should not touch; nor should any cell contact the metal rack supports or metal cable conduits. Check for proper alignment and 1/2" spacing between cells. Adjust cell position where necessary. This should be completed before installation of intercell connectors.

The cell post surfaces have a coating of No-Ox-Id "A"* grease applied at the factory. Do not remove any grease from posts. Re-coat any surfaces that may have been exposed during handling of the cells.

## 7.6 CELL TERMINAL HARDWARE

On Gould "D", "E", and "F" type cells, two lead-covered brass nuts are used in conjunction with a brass stud on each post. These are pre-greased at the factory with No-Ox-Id "A" grease and are shipped installed on cell posts. During installation of the intercell connectors (*see Section 7.7*), exercise care to provide equal extension of the brass stud past each connector. Hold one end of the stud and install one of the lead-covered nuts finger tight. Install second nut while holding first nut. This will provide equal engagement of the nuts and stud.

On Gould "M" and "N" type cells, pre-greased stainless steel bolts, nuts and washers are supplied for cell terminals.

## 7.7 CONNECTING CELLS

Refer to the cell arrangement drawing to determine the quantity, size and correct positioning of the intercell connectors. On the "N" type cells using 1-1/4" wide connectors, the bolt holes are located off-center. Position connector so that the lesser dimension faces downward on the cell post.

*Trademark of the Dearborn Chemical Co.

Gently clean contact surfaces only, of the lead plated intercell connectors, terminal plates and cable lugs using a brass suede brush or #00 grade sandpaper. Caution: Do not use powered wire brush or coarse abrasives, as lead plating may be removed exposing copper.

As contact surfaces are cleaned, apply a thin coating of No-Ox-Id "A" grease to these surfaces only.

Starting at center of the cell row, install connectors per wiring diagram and cell arrangement drawing.

On cells using stainless steel bolts, washers and nuts, make sure a washer is placed between the bolt head and connector as well as between the nut and connector.

**CAUTION**

> When installing terminal hardware, do not permit any items to fall into cell. If such material remains in the cell, contamination will result; requiring replacement of the cell.

As intercell connectors are installed, adjust them to a level position and finger tighten hardware.

All terminal hardware installed on connectors should now be tightened as outlined in the following table:

<u>"D" type single cells</u> –
(2 lead-covered nuts with 1/4" stud.)
Tighten to 75 inch pounds.

<u>"E" and "F" type cells</u> –
(2 lead-covered nuts with 5/16" stud.)
Tighten to 100 inch pounds.

<u>"M" type cells</u> –
(Stainless steel hardware). Tighten to 100 inch pounds.

<u>"N" type cells</u> –
(Stainless steel hardware). *See Figure 2.*

**NOTE**

Torque both lead-covered nuts as well as the bolt head and nut of stainless steel hardware to their prescribed torque values. Torquing only one side of either combination will not provide the desired tightness.

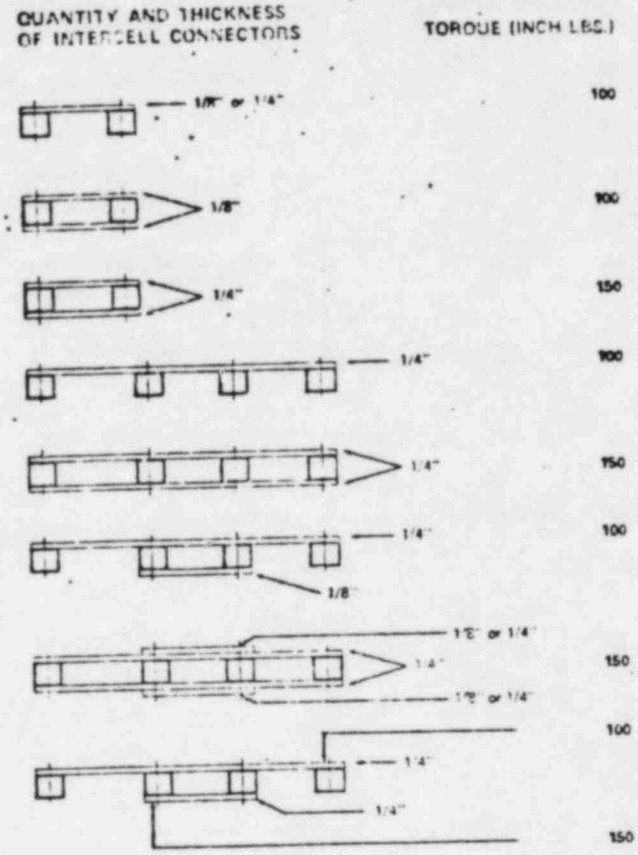



FIGURE 2

Following the torquing of stainless steel hardware, apply a thin coating of No-Ox-Id "A" grease to bolts, washers and nuts using a 1" paint brush.

Complete connecting of cells by installing necessary inter-row, inter-tier or inter-rack cable connectors. <u>Do not</u> connect battery to charger at this time.

Re-check to be certain that the cells are connected positive (+) to negative (-) throughout the battery string. Measure the total voltage at the battery terminals. The voltage should be equal to the number of cells times the voltage of one of the cells. Example: 60 cells times 2.05 volts = 123 volts.

## 7.8 COMPLETING INSTALLATION

Cells of 1200 ampere hours or less may have been shipped with Gould Pre-Vent ™ vent/filling funnels in place as an optional accessory. These vents have flexible plastic caps installed for shipping purposes. These caps may be removed and discarded, or they may be left in place if the battery environment is dusty. *(See Figure 3).*

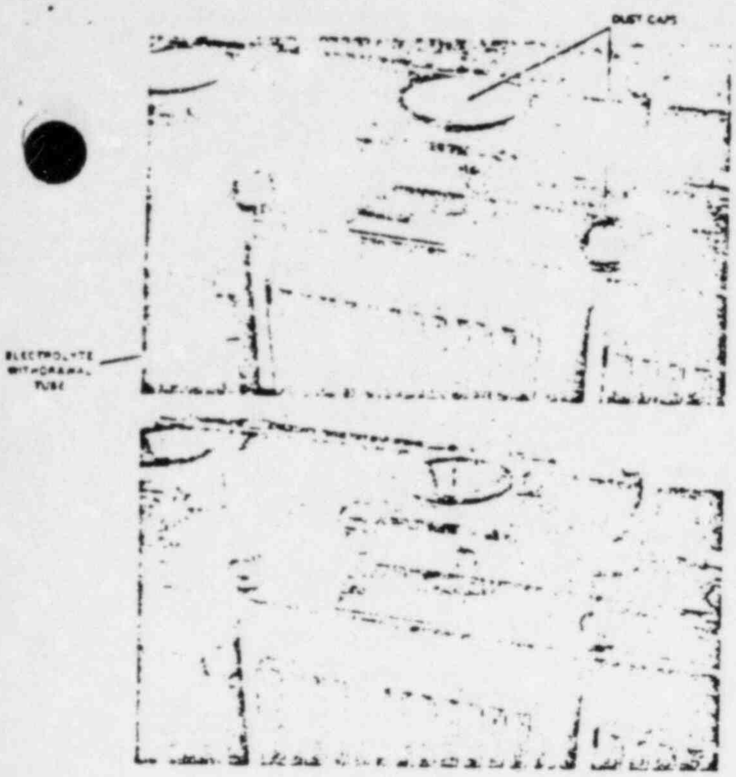



FIGURE 3

FIGURE 4

Cells from 1344 ampere hours up through 2550 ampere hours may have been supplied with a Gould Pre-Vent as an optional accessory. For this size cell, the Pre-Vent units are not shipped in place. A standard screw-type vent is used for shipping purposes. If Pre-Vent units were specified, they would have been packed separately with other accessories. Remove the screw-type shipping vent one-at-a-time and install a Pre-Vent unit. Discard the shipping vent.

Other type cells may have separate explosion resistant vents installed at time of shipment. Separate plastic filling funnels are supplied along with this type vent. These funnels also have flexible plastic shipping caps. Here again, these may be removed and discarded or left in place if environment is dusty.

The Gould Pre-Vent assembly and other explosion resistant vents are designed to prevent external sparks or flames from igniting and exploding internal cell gases. *(See Figure 4).*

**CAUTION**

Before disposing of flexible plastic caps or screw-type shipping caps, neutralize any electrolyte on them in a baking soda – water solution to prevent injury to anyone handling these discarded items.

Electrolyte Withdrawal Tubes

Certain calcium type cells are equipped with an electrolyte withdrawal tube. These permit the taking of specific gravity readings at a point one third down from the top of the plates *(See Section 11.1)*. Refer to Figure 3.

The withdrawal tube may be installed in either diagonal corner of the cell by exchanging its position with a dummy plug supplied; thus providing the most accessible location. When exchanging location, first remove flexible shipping cap to reduce retention of electrolyte in the tube and spillage during transfer. The flexible cap may be reinstalled as a dust cap or discarded after neutralizing.

**Plastic Numerals**

Plastic cell numerals and battery terminal polarity labels are provided for 12-cell batteries of 40 ampere hours and over. These should be installed per instructions included with the numerals. The positive terminal cell is usually designated as cell #1 in the series string.

**Battery-to-Charger Connection**

The positive (+) terminal of the battery should be connected to the positive (+) terminal of the charger and the negative (-) terminal of the battery to the negative (-) terminal of the charger.

# SECTION VIII

## 8.0 INITIAL CHARGE

Batteries lose some charge during shipment as well as during the period prior to installation. The battery should be installed and given its initial charge as soon after receipt as possible. *(See Section 4.0).*

## 8.1 CONSTANT VOLTAGE METHOD

Constant voltage is the principal method to give the initial charge, as most modern chargers are of the constant voltage design. In addition, some systems have equipment with voltage limitations making the use of constant current charging undesirable.

Determine the maximum voltage that may be applied to the system equipment. This voltage divided by the number of cells connected in series will establish the maximum voltage per cell that may be used.

**Establish** whether the battery is of lead-antimony, Planté or lead-calcium construction by referring to type on cell name plate and compare this with the cell type listings on pages 14 and 15.

For lead-antimony and Planté types, refer to Table A and for lead-calcium types refer to Table B to obtain various voltages and associated time periods recommended. Select the highest voltage the system will allow, to perform the initial charge in the shortest period of time.

### INITIAL CHARGE

Recommended Voltages and Time Periods

**TABLE A**

Lead-Antimony and Planté Types

| Cell Volts | Time-Hrs. |
|---|---|
| 2.24 | 200 |
| 2.27 | 150 |
| 2.30 | 120 |
| 2.33 | 90 |
| 2.36 | 75 |
| 2.39 | 60 |

**TABLE B**

Lead-Calcium Types

| Cell Volts | Time-Hrs. |
|---|---|
| 2.24 | 624 |
| 2.27 | 480 |
| 2.30 | 384 |
| 2.33 | 288 |
| 2.36 | 240 |
| 2.39 | 192 |

**NOTE**

Time periods listed in Tables A and B are for cell temperatures from 70°F (21°C) to 90°F (32°C). For temperatures 55°F (13°C) to 69°F (20.5°C) double the number of hours. For temperatures 40°F (4°C) to 54°F (12°C) use four times the number of hours.

The above recommended time periods are considered minimum. Raise the voltage to the maximum value permitted by the system equipment. When charging current has tapered and stabilized (no further reduction for 3 hours), charge for the hours shown in the appropriate table and for the battery temperature, at the time of stabilization, until the lowest cell voltage ceases to rise. Monitoring of cell voltages should be started during the latter 10% of the applicable time period to determine lowest cell in battery.

## 8.2 CONSTANT CURRENT METHOD

If there is no limitation to the voltage that may be applied to the system equipment, constant current charging may be used for the initial charge. Charge the battery at its finish rate listed in the Tables on pages 14 and 15. Continue to charge at this value until the lowest cell specific gravity remains stable over a 5 hour period. If the ampere charge rate used is below the listed finish rate, increase the 5 hour stable period proportionately. For example, if the charge rate is 1/2 the finish rate, increase the stable period from 5 hours to 10 hours. Where high ambient temperatures prevail, cell temperatures should be monitored so that 110°F (43°C) is not exceeded. A reduction in the charge rate or temporary suspension of the charge should be made to permit cells to cool. Resume charging when cell temperatures are at 90°F (32°C) or below.

## 8.3 INITIAL CHARGE – ELECTROLYTE LEVELS

During the initial charge, there will be an increase in the electrolyte levels and they may go above the high level mark. *(See Section 3.2).* This is due to gases, that were lost during transportation or standing in storage, being restored to the cells. Do not remove any electrolyte even though levels may be above high level. When battery is placed on floating charge *(See Section 9 2)*, the electrolyte levels should return close to the high level line.

# SECTION IX

## 9.0 OPERATION

## 9.1 FLOATING CHARGE METHOD

In this type of operation, the battery is connected in parallel with a constant voltage charger and the critical load circuits. The charger should be capable of maintaining the required constant voltage at battery terminals and also supply a normal connected load where applicable. This will then sustain the battery in a fully charged condition and also make it available to assume the emergency power requirements, in the event of an AC power interruption or charger failure.

## 9.2 FLOAT CHARGE - FLOAT VOLTAGES

The following are the float voltage ranges recommended for the various types of batteries. Use only the voltage range listed for that particular type. Do not interchange voltage ranges from one type to another.

TABLE C

Recommended Float Voltages

| | |
|---|---|
| Lead-Antimony Types | 2.15 to 2.17 volts per cell |
| Plantê Types | 2.17 to 2.19 volts per cell |
| Lead-Calcium Types | 2.17 to 2.25 volts per cell |

Modern constant voltage output charging equipment is recommended for the floating charger method of operation of Gould stationary type batteries. This type of charger, properly adjusted to the recommended float voltages, together with adherence to recommended maintenance procedures, will assist in obtaining consistent serviceability and optimum life.

After the battery has been given its initial charge *(see Section 8.0)*, the charger should be adjusted to provide the recommended float voltage *(see Table C)* at the battery terminals. For example, a 60-cell lead-antimony battery should have 130 volts maintained at its terminals ... 60 cells x 2.17 volts per cell (V.P.C.) = 130 volts.

Do not use float voltages for lead-antimony or Plantê types higher than shown in Table C, as excessive water consumption and reduced battery life will result.

Lead-calcium types may have float voltages of 2.17 V.P.C. to 2.25 V.P.C. maintained across the battery terminals. The lower 2.17 V.P.C. value is used where system equipment voltage limitations will not tolerate higher values. In addition, if high ambient temperatures prevail, the use of 2.20 to 2.25 V.P.C. float voltage may result in reduced battery life.

### 9.3 VOLTMETER CALIBRATION

Panel and portable voltmeters used to indicate battery float voltages should be accurate at the operating voltage value. The same holds true for portable meters used to read individual cell voltages. These meters should be checked against a standard every six months and calibrated when necessary.

### 9.4 CYCLE METHOD OF OPERATION

This method is recommended for lead-antimony and Planté type cells only. Lead-calcium cells should not be cycle operated.

In cycle operation, the degree of discharge will vary for various applications. Therefore, the frequency of recharging will also vary. The recharge is conducted by manually starting the charge, generally using the normal finish rate listed on pages [illegible] and 15. The amount of charge nece[illegible] depends on the number of ampere h[illegible]harge. If a shorter recharge peric[illegible]esired, higher charge rates equal to the e[illegible]-hour rate of discharge may be used when the battery is more than 25% discharged and the cell voltage on charge is below 2.33 volts. When the cell voltage reaches 2.33, the charge rate should be reduced to the normal finish charge rate. The charge should be stopped when the specific gravity is ten (.010) points below the normal fully charged value.

The battery is now available for the next discharge requirement. The battery should be given an equalizing charge monthly by continuing the regular charge until there is no increase in specific gravity of the pilot cell for three hours, when using the finish charge rate.

### 9.5 RECHARGE

All batteries should be recharged as soon as possible following a discharge. With constant voltage chargers, this will be accomplished automatically. However, to recharge in the shortest period of time, raise the charger output voltage to the highest value which the connected system will permit. Do not exceed those voltage values listed in Table D or Table E on page 10.

## SECTION X

### 10.0 EQUALIZING CHARGE

An equalizing charge is a special charge given a battery when non-uniformity in voltage or specific gravity has developed between cells. It is given to restore all cells to a fully charged condition using a charging voltage higher than the normal float voltage and for a specified number of hours, as determined by the voltage used.

Non-uniformity of cells may result from low floating voltage due to improper adjustment of the charger or a panel voltmeter which reads incorrect (higher) output voltage. Also, variations in cell temperatures greater than 5°F (2.78°C) in the series string at a given time, due to environmental conditions or rack arrangement, can cause low cells.

### 10.1 EQUALIZING FREQUENCY

The following guidelines cover lead-antimony, Planté and lead-calcium types. Recommendations not applying to all types will be so designated.

A. An equalizing charge should be given quarterly or as required by conditions in the following paragraphs. (Note: lead-calcium types floated at 2.20 V.P.C. to 2.25 V.P.C. may not require equalizing charges).

B. Equalize when the temperature corrected specific gravity of the pilot cell (or any cell for the quarterly reading) is more than 10 points below its full charge value. *(See Section 11.2).*

C. Equalize when the floating voltage for the pilot cell (or any cell for the quarterly reading) is below 2.13 volts or more than .04 volts below the average for the battery

D. Equalize to complete a recharge of the battery in a minimum length of time following an emergency discharge.

E. If accurate quarterly records are maintained *(See Section 14.0)* and the individual cell voltages and temperature corrected specific gravities show no increase in spread from the previous quarterly readings, equalizing may be deferred. *(See Section 11.2).*

F. Equalize once a year even though preceding conditions made it unnecessary. (Lead-calcium types floated at 2.20 V.P.C. to 2.25 V.P.C, may not require annual equalizing).

### 10.2 EQUALIZING CHARGE METHOD

Constant voltage charging is the preferred method for giving an equalizing charge. Determine the maximum voltage that may be applied to the system equipment. This voltage, divided by the number of cells connected in series, will establish the maximum voltage per cell that may be used to perform the equalizing charge in the shortest period of time.

For lead-antimony and Planté types, refer to Table D and for lead-calcium types, refer to Table E to obtain various voltage and associated time periods recommended.

EQUALIZING CHARGE

Recommended Voltages and Time Periods

TABLE D

Lead-Antimony & Planté Types

| Cell Volts | Time-Hrs. |
|---|---|
| 2.24 | 80 |
| 2.27 | 60 |
| 2.30 | 48 |
| 2.33 | 36 |
| 2.36 | 30 |
| 2.39 | 24 |

TABLE E

Lead-Calcium Types

| Cell Volts | Time-Hrs. |
|---|---|
| 2.24 | 310 |
| 2.27 | 240 |
| 2.30 | 190 |
| 2.33 | 145 |
| 2.36 | 120 |
| 2.39 | 95 |

NOTE

Time periods listed in Tables D and E are for cell temperatures from 70°F (21°C) to 90°F (32°C). For temperatures 55°F (13°C) to 69°F (20.5°C) double the number of hours. For temperatures 40°F (4°C) to 54°F (12°C) use four times the number of hours.

The above recommended time periods are considered minimum. Raise the voltage to the maximum value permitted by the system equipment. When charging current has tapered and stabilized (no further reduction for 3 hours), charge for the hours shown in the appropriate table and for the battery temperature at the time of stabilization, until the lowest cell voltage ceases to rise. Monitoring of cell voltages should be started during the latter 10% of the applicable time period to determine lowest cell in battery.

## SECTION XI

### 11.0 SPECIFIC GRAVITY

In a lead-acid cell, the electrolyte is a dilute solution of water and sulfuric acid. Specific gravity is a measure of the weight of acid in the electrolyte as compared to an equal volume of water. Therefore, electrolyte with a specific gravity of 1.215 means it is 1.215 times heavier than an equal volume of water which has a specific gravity of 1.000.

### 11.1 HYDROMETER READINGS

Specific gravity is used in determining a cell's state of charge. It decreases as the cell discharges and increases as the cell is charged; reaching its original value when the cell is fully charged. Specific gravity is expressed to the third decimal place (1.215) and is measured by a hydrometer float enclosed in a glass barrel/rubber bulb syringe. Draw sufficient electrolyte into the barrel, holding the syringe vertical and with no hand pressure on bulb, so that float is freely floating without touching sides or top of syringe.

The gravity is read on the hydrometer scale at the flat surface of the electrolyte. *(See Figure 5).*

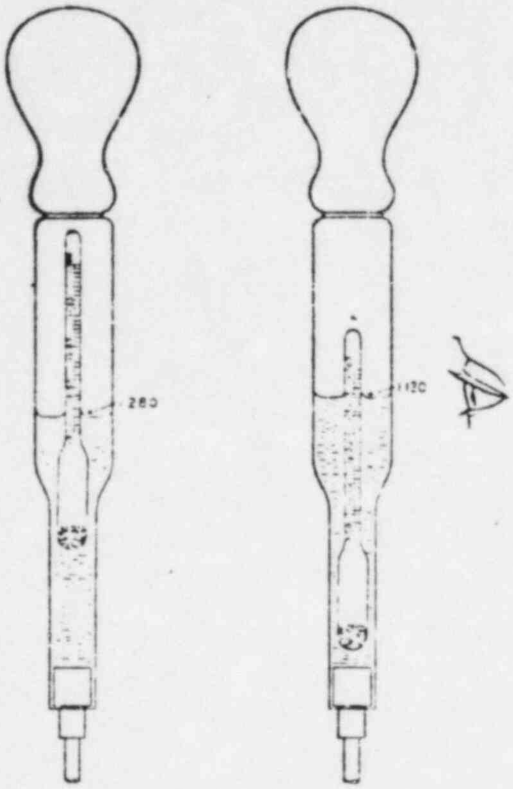


FIGURE 5

Clean the hydrometer glass barrel and float with soap and water as required for ease of reading and float accuracy.

When recharging a lead-calcium cell, the specific gravity reading lags behind the ampere hour input due mainly to the very low end of charge currents. Mixing of the electrolyte is slow due to the small amount of gas generated; so the gravity readings do not reflect the actual state of charge. A similar condition exists after water additions. Therefore, meaningful gravity readings can only be obtained at the top of the cell after an equalizing charge or after six weeks on float.

For this reason, most Gould lead-calcium cells have electrolyte withdrawal tubes to permit sampling of the electrolyte at a point one third down from the top of the plates. A long rubber tip on the hydrometer is inserted into the tube to provide an average value of cell specific gravity and a more accurate indication on the state of charge.

When taking a hydrometer reading, the base of the hydrometer syringe should be pressed firmly against the tube opening to prevent back splash of electrolyte. Fill and empty the hydrometer at least once in each cell before reading. This will give a more accurate reading of electrolyte within the tube.

## 11.2 CORRECTION FOR TEMPERATURE

When taking specific gravity readings, corrections must be made for variations in temperature of the electrolyte. For each 3°F (1.67°C) in temperature of the electrolyte above 77°F (25°C) add one point (.001) in specific gravity to the observed hydrometer readings; and for each 3°F (1.67°C) in temperature below 77°F (25°C) subtract one (.001) in specific gravity from the observed hydrometer reading.

EXAMPLE:

| Hydrometer Reading | Cell Temperature | Correction | Reading Corrected to 77°F (25°C) |
|---|---|---|---|
| 1.213 sp. gr. | 68°F (20°C) | -.003 points = | 1.210 sp. gr. |
| 1.207 sp. gr. | 86°F (30°C) | +.003 points = | 1.210 sp. gr. |
| 1.204 sp. gr. | 95°F (35°C) | +.006 points = | 1.210 sp. gr. |

## 11.3 CORRECTION FOR ELECTROLYTE LEVEL

The loss of water from the electrolyte due to evaporation as well as conversion of the water to hydrogen and oxygen by charging current; also affects the specific gravity value. For example: A fully charged cell with correct high level at 77°F (25°C) will have a nominal specific gravity of 1.215. When the electrolyte level has been reduced from evaporation and charging by 1/4", the specific gravity will be approximately 6 points (.006) higher or 1.221 @ 77°F (25°C). Therefore, when taking hydrometer readings, the electrolyte level referenced to the high level line should be recorded for proper evaluation of the specific gravity value. This applies when taking a pilot cell reading or for 10% of the cells when taking a quarterly set of readings.

## 11.4 SPECIFIC GRAVITY RANGE

The nominal specific gravity of Gould stationary batteries is 1.215 @ 77°F (25°C). The specific gravity may range from 1.205 up to 1.225 @ 77°F (25°C) with the electrolyte level at the high level line and still be considered satisfactory.

## SECTION XII

### 12.0 CELL VOLTAGE VARIATION

The tabulation below indicates the normal cell voltage variation that may exist with the battery on float and no greater than a 5°F (2.78°C) variation in cell temperature of a series string at any given time.

NORMAL VOLTAGE VARIATION

| Type | Float Voltage | Variation |
|---|---|---|
| Lead-Antimony | 2.15 to 2.17 V.P.C. | ±.02 V.P.C. |
| Planté | 2.17 to 2.19 V.P.C. | ±.03 V.P.C. |
| Lead-Calcium | 2.17 to 2.25 V.P.C. | ±.04 V.P.C. |

## SECTION XIII

### 13.0 PILOT CELL

A pilot cell is selected in the series string to reflect the general condition of all cells in the battery regarding specific gravities, float voltage and temperature. It serves as an indicator of battery condition between scheduled overall individual cell readings.

A slight amount of electrolyte may be lost each time a specific gravity reading is taken, even though it is recommended that all electrolyte in the hydrometer be returned to the cell after reading. Therefore, it is suggested that the pilot cell be changed to another cell annually to provide a representative specific gravity indicator for the battery.

## SECTION XIV

### 14.0 RECORDS

A complete recorded history of the battery operation is most desirable and helpful in obtaining satisfactory performance. Good records will also show when corrective action may be required to eliminate possible charging, maintenance or environmental problems.

The following data should be read and permanently recorded for review by supervisory personnel:

A. Upon completion of the initial charge and with the battery floating at the desired float voltage for one week, read and record individual cell voltages, specific gravities (corrected to 77°F(25°C), ambient temperature plus cell temperatures and electrolyte levels for 10% of the cells. The cell temperature readings should be from each step or tier of the rack to reflect temperature range of the battery.

This first set of readings will be the basis for comparison with subsequent readings to reflect possible operating problems and the need for corrective action.

B. Weekly - Pilot cell voltage and also total battery float voltage at battery terminals.

C. Monthly - Pilot cell voltage, specific gravity, temperature and electrolyte level.

D. Quarterly - A complete set of individual cell readings as recommended in "A" above.

E. Any time the battery is given an equalizing charge *(see Section 10.1)*, an additional set of individual cell readings should be taken after battery has been returned to normal float for one week. These will serve as an updated basis for comparison with future readings.

F. Record dates of any equalizing charges as well as total quantity of water when added. Also record any maintenance and/or testing performed.

The foregoing suggested frequency of record taking may have to be modified somewhat to suit local requirements.

## SECTION XV

### 15.0 WATER ADDITIONS

There are two conditions in the operation of batteries which cause a reduction in the amount of water in the electrolyte, resulting in a lowering of the electrolyte level. These are normal evaporation and the conversion of water into hydrogen and oxygen gases by the charging current. These gases are liberated through the cell vents. Periodically, this water loss must

be replaced with approved or distilled water to maintain the electrolyte level between the high and low level lines.

If suitability of the local water supply for use in storage batteries is questionable, contact your nearest Gould representative for instructions regarding procedure for submitting a sample for analysis. A report will be rendered as to whether or not the water is suitable.

If water is to be stored in containers, they should be clean and of non-metallic material; such as: glass, hard rubber, porcelain or plastic.

Infrequently used water lines should be purged to remove accumulated impurities; thus preventing their introduction into the battery.

Water additions should be scheduled prior to an equalizing charge so that mixing with the electrolyte occurs. Also at unheated installations, arrange water additions when battery temperature is above 50°F (10°C).

Never introduce "battery additives" into a Gould battery.

## SECTION XVI

### 16.0 TAP CONNECTIONS

It is not recommended that tap connections be used on a battery, as possible unbalance between the groups of cells may result. This can cause overcharging of the untapped group of cells and undercharging of the tapped cells supplying the load. This condition can cause unsatisfactory operation and reduced battery life.

## SECTION XVII

### 17.0 TEMPORARY NONUSE

An installed battery that is permitted to stand idle for a period of time should be treated in the following manner. With the battery on normal float, add approved water to cells to bring electrolyte level to the high level line. Give the battery an equalizing charge per Section 10.2. Following completion of the equalizing charge, open connections at the battery terminals to separate charger and load circuit from battery.

Every three months, temporarily connect battery to charger and give it an equalizing charge.

To return to normal service, re-connect all open connections, give equalizing charge and then return battery to normal float voltage.

## SECTION XVIII

### 18.0 BATTERY CLEANING

Periodically, clean cell jars and covers with a water dampened cloth to remove accumulated dust. Cell parts damp with electrolyte should be neutralized with a baking soda - water solution (1 lb. of soda per gallon of water). Apply with cloth dampened with the solution, making sure none is allowed to enter the cell. Continue to neutralize until fizzing action ceases, then wipe area with a water dampened cloth to remove soda solution. Wipe dry with a clean cloth.

Do not clean plastic cell jars or covers with solvents, detergents, oils or spray type cleaners, as these materials may cause crazing and cracking of the plastic materials.

## SECTION XIX

### 19.0 CONNECTIONS

Battery terminal and intercell connections should be corrosion free and tight to provide satisfactory operation while on float charging or when supplying emergency power. Periodically, these connections should be inspected. For proper removal of corrosion, disconnect the connections involved. Where circuit continuity must be maintained, use temporary flexible cables, of adequate current carrying capability, as parallel connections. Remove corrosion by neutralizing with a baking soda - water solution. Gently clean the affected area using a suede brush or #00 grade sandpaper. Apply a thin coating of No-Ox-Id "A" grease to the cleaned contact surfaces and re-establish connection. Reinstalled terminal hardware should be torqued to values in Section 7.7 (Connecting Cells). Annually, all terminal and intercell connections should be re-torqued per Section 7.7.

# BATTERY TYPES

| LEAD-ANTIMONY CELL TYPE | 8 HR. A.H. | FINISH RATE AMPS | 1.215 SP. GR. ELECTROLYTE GALS. PER CELL | SPECIFIC GRAVITY RANGE | LEAD-CALCIUM CELL TYPE |
|---|---|---|---|---|---|
| AS-5 | 10 | 0.5 | 0.09 | 55 | – |
| 2 AS-5 | 10 | 0.5 | 0.09 | 55 | – |
| 3 AT-5 | 10 | 0.5 | 0.08 | 67 | – |
| 2, or 3 BS-5 | 15 | 1.0 | 0.115 | 80 | – |
| 2 BS-9 | 30 | 1.5 | 0.25 | 80 | – |
| 3 BT-7 | 30 | 1.5 | 0.16 | 90 | – |
| 2, or 3 CS-7 | 50 | 3.0 | 0.32 | 85 | – |
| 2, or 3 CSO-7 | 50 | 3.0 | 0.32 | 85 | – |
| 2, or 3 CS-13 | 100 | 6.0 | 0.54 | 95 | – |
| 2, or 3 CSO-13 | 100 | 6.0 | 0.54 | 95 | – |
| 2, or 3 DS-5 | 50 | 3.0 | 0.29 | 100 | 2, or 3 DSC-5 |
| 2, or 3 DSO-5 | 50 | 3.0 | 0.29 | 100 | 2, or 3 DSCO-5 |
| 2, or 3 DS-7 | 75 | 4.0 | 0.40 | 100 | 2, or 3 DSC-7 |
| 2, or 3 DSO-7 | 75 | 4.0 | 0.40 | 100 | 2, or 3 DSCO-7 |
| 2, or 3 DS-9 | 100 | 6.0 | 0.50 | 100 | 2, or 3 DSC-9 |
| 2, or 3 DSO-9 | 100 | 6.0 | 0.50 | 100 | 2, or 3 DSCO-9 |
| DD-5 | 40 | 2.0 | 0.43 | 60 | – |
| DD-7 | 60 | 3.0 | 0.80 | 55 | – |
| DD-9 | 80 | 4.0 | 0.74 | 75 | – |
| DD-11 | 100 | 5.0 | 1.13 | 65 | – |
| DD-13 | 120 | 6.0 | 1.08 | 85 | – |
| DD-15 | 140 | 7.0 | 1.25 | 85 | – |
| DD-17 | 160 | 8.0 | 1.49 | 80 | – |
| DKR-5 | 50 | 2.0 | 0.34 | 85 | DC-5 |
| DKR-7 | 75 | 4.0 | 0.64 | 75 | DC-7 |
| DKR-9 | 100 | 5.0 | 0.59 | 95 | DC-9 |
| DKR-11 | 125 | 6.0 | 0.90 | 80 | DC-11 |
| DKR-13 | 150 | 7.0 | 0.86 | 105 | DC-13 |
| DKR-15 | 175 | 9.0 | 1.00 | 95 | DC-15 |
| EKR-11 | 200 | 10.0 | 1.7 | 55 | EC-11 |
| EKR-13 | 240 | 12.0 | 1.6 | 80 | EC-13 |
| EKR-15 | 280 | 14.0 | 1.5 | 100 | EC-15 |
| EKR-17 | 320 | 16.0 | 1.8 | 100 | EC-17 |
| EKR-19 | 360 | 18.0 | 2.3 | 85 | EC-19 |
| EKR-21 | 400 | 20.0 | 2.2 | 95 | EC-21 |
| EKR-23 | 440 | 22.0 | 2.7 | 90 | EC-23 |
| EKR-25 | 480 | 24.0 | 2.6 | 100 | EC-25 |
| EKR-27 | 520 | 26.0 | 3.1 | 90 | EC-27 |
| EKR-29 | 560 | 28.0 | 3.0 | 100 | EC-29 |
| FKS-17 | 626 | 31.0 | 3.6 | 90 | FCS-17 |
| FKS-19 | 704 | 35.0 | 3.4 | 105 | FCS-19 |
| FKS-21 | 782 | 39.0 | 4.9 | 90 | FCS-21 |
| FKS-23 | 860 | 43.0 | 4.8 | 105 | FCS-23 |
| FKS-25 | 938 | 47.0 | 6.7 | 90 | FCS-25 |
| FKS-27 | 1017 | 51.0 | 6.5 | 100 | FCS-27 |
| FKS-29 | 1095 | 55.0 | 6.3 | 105 | FCS-29 |
| FKS-31 | 1173 | 59.0 | 6.1 | 110 | FCS-31 |
| 2, or 3 ETA-5 | 120 | 6.0 | 1.3 | 45 | 2, or 3 ETC-5 |
| 2, or 3 ETA-7 | 180 | 9.0 | 1.2 | 60 | 2, or 3 ETC-7 |
| ETA-9 | 240 | 12.0 | 1.7 | 75 | ETC-9 |
| ETA-11 | 300 | 15.0 | 2.0 | 75 | ETC-11 |
| ETA-13 | 360 | 18.0 | 2.9 | 60 | ETC-13 |
| ETA-15 | 420 | 21.0 | 2.7 | 75 | ETC-15 |
| ETA-17 | 480 | 24.0 | 3.5 | 65 | ETC-17 |
| ETA-19 | 540 | 27.0 | 3.4 | 75 | ETC-19 |
| ETA-21 | 600 | 30.0 | 4.2 | 75 | ETC-21 |
| ETA-23 | 660 | 33.0 | 4.1 | 75 | ETC-23 |
| FTA-13 | 720 | 36.0 | 4.6 | 75 | – |
| FTA-15 | 840 | 42.0 | 4.2 | 85 | – |
| FTA-17 | 960 | 48.0 | 5.6 | 80 | – |
| FTA-19 | 1080 | 54.0 | 5.3 | 90 | – |
| FTA-21 | 1200 | 60.0 | 6.8 | 80 | – |
| FTA-23 | 1320 | 66.0 | 6.5 | 90 | – |
| FTA-27 | 1560 | 78.0 | 8.3 | 85 | – |
| FTA-29 | 1680 | 84.0 | 8.2 | 90 | – |
| FTAS 29 | 1800 | 90.0 | 8.2 | 95 | – |

# BATTERY TYPES

| LEAD-ANTIMONY CELL TYPE | 8 HR. A.H. | FINISH RATE AMPS | 1.215 SP. GR. ELECTROLYTE GALS. PER CELL | SPECIFIC GRAVITY RANGE | LEAD-CALCIUM CELL TYPE |
|---|---|---|---|---|---|
| – | 720 | 36.0 | 4.0 | 75 | FTC-13 |
| – | 840 | 42.0 | 3.9 | 85 | FTC-15 |
| – | 960 | 48.0 | 5.5 | 80 | FTC-17 |
| – | 1080 | 54.0 | 5.4 | 90 | FTC-19 |
| – | 1200 | 60.0 | 6.6 | 80 | FTC-21 |
| – | 1320 | 66.0 | 6.5 | 90 | FTC-23 |
| – | 1440 | 72.0 | 6.4 | 95 | FTC-25 |
| – | 1560 | 78.0 | 8.3 | 85 | FTC-27 |
| – | 1680 | 84.0 | 8.2 | 90 | FTC-29 |
| – | 1800 | 90.0 | 8.2 | 95 | FTCS-29 |
| 2 MAX-170 | 170 | 9.0 | 1.3 | 75 | 2 MCX-170 |
| 2 MAX-190 | 190 | 10.0 | 1.3 | 85 | 2 MCX-190 |
| 2 MAX-255 | 255 | 13.0 | 1.2 | 100 | 2 MCX-255 |
| MAX-285 | 285 | 14.0 | 1.7 | 80 | MCX-285 |
| MAX-340 | 340 | 17.0 | 1.6 | 100 | MCX-340 |
| MAX-380 | 380 | 19.0 | 2.1 | 90 | MCX-380 |
| MAX-425 | 425 | 21.0 | 1.9 | 105 | MCX-425 |
| MAX-475 | 475 | 24.0 | 2.8 | 110 | MCX-475 |
| MAX-510 | 510 | 26.0 | 2.7 | 105 | MCX-510 |
| MAX-595 | 595 | 30.0 | 2.7 | 120 | MCX-595 |
| NAX- 600 | 600 | 30.0 | 4.5 | 65 | NCX- 600 |
| NAX- 672 | 672 | 34.0 | 4.2 | 60 | NCX- 672 |
| NAX- 750 | 750 | 38 | 4.4 | 85 | NCX- 750 |
| NAX- 840 | 840 | 42 | 4.2 | 80 | NCX- 840 |
| NAX- 900 | 900 | 45 | 4.2 | 105 | NCX- 900 |
| NAX-1008 | 1008 | 50 | 4.1 | 100 | NCX-1008 |
| NAX-1050 | 1050 | 53 | 4.1 | 125 | NCX-1050 |
| NAX-1200 | 1200 | 60 | 3.9 | 150 | NCX-1200 |
| NAX-1344 | 1344 | 67 | 7.3 | 100 | NCX-1344 |
| NAX-1350 | 1350 | 68 | 8.1 | 100 | NCX-1350 |
| NAX-1500 | 1500 | 75 | 7.3 | 120 | NCX-1500 |
| NAX-1650 | 1650 | 83 | 8.1 | 90 | NCX-1650 |
| NAX-1680 | 1680 | 84 | 8.3 | 100 | NCX-1680 |
| NAX-1800 | 1800 | 90 | 7.8 | 115 | NCX-1800 |
| NAX-1848 | 1848 | 92 | 12.3 | 80 | NCX-1848 |
| NAX-1950 | 1950 | 98 | 7.6 | 150 | NCX-1950 |
| NAX-2016 | 2016 | 101 | 12.1 | 90 | NCX-2016 |
| NAX-2100 | 2100 | 105 | 12.1 | 105 | NCX-2100 |
| NAX-2184 | 2184 | 109 | 11.7 | 100 | NCX-2184 |
| NAX-2250 | 2250 | 113 | 11.8 | 115 | NCX-2250 |
| NAX-2400 | 2400 | 120 | 11.4 | 130 | NCX-2400 |
| NAX-2550 | 2550 | 128 | 10.7 | 150 | NCX-2550 |
| | | PLANTÉ TYPE CELLS | | | |
| 2 or 3 CPE-3 | 8 | 0.4 | 0.12 | 50 | – |
| 2 or 3 CPE-5 | 16 | 0.8 | 0.115 | 90 | – |
| 2 or 3 CPE-7 | 24 | 1.2 | 0.171 | 85 | – |
| DPR- 5 | 40 | 2.0 | 0.35 | 85 | – |
| DPR- 7 | 60 | 3.0 | 0.65 | 65 | – |
| DPR- 9 | 80 | 4.0 | 0.64 | 100 | – |
| DPR-11 | 100 | 5.0 | 0.90 | 90 | – |
| DPR-13 | 120 | 6.0 | 1.01 | 90 | – |
| DPR-15 | 140 | 7.0 | 1.27 | 85 | – |
| EPR- 9 | 160 | 8.0 | 1.8 | 45 | – |
| EPR-11 | 200 | 10.0 | 1.7 | 75 | – |
| EPR-13 | 240 | 12.0 | 1.6 | 110 | – |
| EPR-15 | 280 | 14.0 | 1.8 | 115 | – |
| EPR-17 | 320 | 16.0 | 2.5 | 95 | – |
| EPR-19 | 360 | 18.0 | 2.4 | 115 | – |
| FPS-11 | 415 | 21.0 | 5.2 | 75 | – |
| FPS-13 | 498 | 25.0 | 4.6 | 90 | – |
| FPS-15 | 581 | 29.0 | 4.0 | 105 | – |
| FPS-17 | 664 | 33.0 | 3.7 | 120 | – |
| FPS-19 | 747 | 37.0 | 5.5 | 90 | – |
| FPS-21 | 830 | 42.0 | 4.9 | 100 | – |
| FPS-23 | 913 | 46.50 | 6.4 | 100 | – |
| FPS-25 | 996 | 50.0 | 6.1 | 110 | – |