ENGINE START AND CONTROL BATTERIES

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1. GENERAL

1.1 Scope

1.11 This section contains installing information and charging and floating instructions for storage batteries used for engine starting and control. Supplemental information may be found in the 17 and 18 series of sections where they apply.

1.12 Only batteries presently being installed are covered herein. If an Installer is required to replace batteries other than those listed, he should refer to the appropriate BSP listed below:

157-631-101 Nickel-Cadmium Batteries
157-633-101 Lead-Acid Batteries

1.13 These batteries are generally either KS-15577 low-gravity lead-acid batteries or KS-15578 nickel-cadmium batteries. However, other KS- types are sometimes installed as well as non-KS types, and these are also covered in the section.

1.14 Requirements on voltage variation and on specific gravity variation, which apply to regular power plant batteries, do not apply to the batteries in this section.

1.2 Description

1.21 Tables in Paragraph 4 show pertinent information on the various batteries, such as size, weight and ampere-hour capacities. List numbers for KS- batteries include cells, complete with end lugs, jumpers, straps, connectors and associated nuts and bolts. A polystyrene tube is also furnished with nickel-cadmium batteries for use in measuring electrolyte level.

1.22 KS-15577 batteries are lead-sulphuric type with grids made of lead-antimony. They are of the low gravity type and have a specific gravity between 1.195-1.225, as compared to 1.280 for regular automotive type. They resemble the automotive type in appearance. The cells are shipped filled with electrolyte and charged (Terminal posts are electrically alive).

1.23 KS-15578 batteries are nickel-cadmium alkaline type. Positive plates contain nickel hydroxide and negative plates contain finely-divided metallic cadmium. The elements, with suitable separators, are placed in either a plastic or stainless steel container and a number of containers are connected in series in wooden cases called trays. These batteries are shipped filled with electrolyte and charged (Terminal posts are electrically alive).

1.3 Charging Facilities

1.31 Charging equipment for use with engine start and control batteries is usually of small capacity and the charging ability amounts to a "trickle-charge" at best. After an engine start the charger goes to full output, usually five to six amperes. Charging current then tapers down to a small value when battery is restored to float voltage value.

1.4 Job Information

1.41 Follow the job plans to connect cells or groups of cells.

1.42 Carefully read the supplier's instructions with each shipment of batteries. Turn the instructions over to the customer for their use.

1.5 DS Inspection

1.51 Inspect each battery promptly after receipt, if possible. Check for acid or caustic stains or other evidence of spillage. Check electrolyte height if spillage is evident, and look for cracks or breakage as soon as possible so that replacements can be ordered.

1.52 Check that nameplate data agrees with rating and list number specified.

1.53 Check shipping papers and actual markings on batteries and cases to determine that markings agree with the job papers.

2. PRECAUTIONS

2.1 Lead-Acid Batteries

2.11 Terminal posts are electrically alive except for dry-charge cells. Serious burns or fires can result if terminals are accidentally short-circuited.

2.12 Vent plugs must be in place when making cell connections and interconnections.

2.13 Explosive gases are present during a charge and these may remain near the cells after completing the charge. Take extreme care when working around the batteries as the gases may be ignited by flashes resulting from opening or closing a circuit connection to the cells, by an open flame or by a spark resulting from discharge of static electricity.

2.14 Explosion control devices, or vents, must be in place at all times when charging (voltage higher than float value). When the batteries are on float a vent may be removed from one cell at a time in order to add water to the cell.

2.15 Discharge static electricity from the body before touching a cell or cell posts by touching a grounded surface such as the metal battery stand, if this is grounded. Otherwise, touch grounded iron work to discharge static electricity.

2.16 For personal protection and protection of clothing use R-3055 Safety Goggles, rubber gloves, aprons, overshoes and protective clothing, as required.

2.17 Use plain water as a wash for any electrolyte entering the eyes and secure medical attention.

2.18 Use soda solution to neutralize any electrolyte coming in contact with parts of the body other than the eyes.

2.19 To neutralize electrolyte on clothing use approximately one part ammonia to two parts water to avoid white spots left by soda. Use caution when opening an ammonia bottle because considerable pressure sometimes builds up in the bottle.

2.2 Nickel-Cadmium Batteries

2.21 Containers of KS-15578 cells may be metal cans in contact with the electrolyte. Containers are, therefore, electrically alive. Use only taped tools around the cells and make certain that terminals are never shorted to the containers.

2.22 Soda or sulphuric acid, even in small quantities, will ruin these cells.

2.23 The gas given off during charge is explosive. All anti-explosion precautions recommended for lead-acid cells apply also to these cells.

2.24 The electrolyte is corrosive and can cause burns and damage to clothing. Have a 3% or stronger boric acid solution handy at all times to neutralize electrolyte accidentally spilled on the person or on clothing.

2.25 Do not allow boric acid solution to get into a cell as this will damage the cell. Be sure to wash level indicators in water after each use.

3. INSTALLING EQUIPMENT

3.1 Tools and Meters

Code	Description
R-1370	Level, Bench, 12"
R-2628	Brush, Wire
—	Insulated Wrenches, Various Sizes
ITE-4474	DC Voltmeter

3.2 Supplies

Code	Description
R-3266	Compound NO-OX-ID "A" (for lead-acid cells)
RM-647651	Petrolatum (for nickel-cadmium cells - see Par. 7.3)
KS-14666	Cloth, Cleaning
612.173	Pencil, China Marking, Black

3.3 Electrolyte Neutralizing Solutions

3.31 Weak Soda Solution: Dissolve 4 ounces baking soda (bicarbonate of soda) in 1 gallon of water. This is used on lead-acid cells to neutralize and clean traces of electrolyte on battery surfaces.

3.32 Strong Soda Solution: Dissolve 2 pounds of baking soda (bicarbonate of soda) or one pound of washing soda (carbonate of soda) in one gallon of water. This is used to neutralize a strong concentration of electrolyte as in the case of spillage or dripping.

3.33 Boric Acid Solution: Dissolve one pound of boric acid crystals in two gallons (one bucket) of water. This is used to neutralize and clean traces of electrolyte on nickel-cadmium cells.

3.4 Personnel and Clothing Protection

Code	Description
R-3034	Gloves, Acid-Resistant
R-3043	Apron, Acid-Proof
R-3055	Goggles, Safety
Obtain Locally	Overshoes, Rubber

4. WEIGHTS, DIMENSIONS AND CAPACITIES

4.1 Tables A,B and C list weights, dimensions and ampere-hour capacities of the various engine start and control batteries

TABLE A: KS-15577 LEAD-ACID BATTERIES

LIST	SUPPLIER	NOMINAL VOLTS	POUNDS	DIMENSIONS (INCHES) Length	Width	Height	AMP-HOURS (8 HOUR Rate)	USE
1	EXIDE GOULD	32	85	15-5/16	7-1/2	11	72 68	10KW Diesel (J86625A)
8	EXIDE GOULD	32	365	28-3/8	11-3/16	18-7/8	306 310	225KW Diesel
11	EXIDE GOULD	24	171	21-1/4	11-3/32	10-1/32	110 108	5 KW KS-5667-01 L6 Gasoline Set
12	EXIDE GOULD	32	160	27-1/2	7-1/2	11	145 137	10KW Diesel (J86625C)
13	EXIDE GOULD	48	365	28-3/8	11-3/16	18-7/8	306 310	350KW, 500KW, 550KW Diesels
14 X	EXIDE GOULD	24	252	28-1/4	11-11/16	12-1/2	236 243	750KW Turbine
15	EXIDE GOULD	24	252	28-1/4	11-11/16	12-1/2	236 228	New Detroit Diesel Engine Sets (Start)
16	EXIDE GOULD	24	365	28-3/8	11-3/16	18-7/8	306 310	115KW KS-19587 (Start)
17	EXIDE GOULD	24	160	27-1/2	7-1/2	11	137 145	200KW Turbine Start.

TABLE B: KS-15578 NICKEL-CADMIUM BATTERIES

LIST	SUPPLIER	NOMINAL VOLTS	No. of Trays	Cells/ Tray	Pounds/ Tray	TRAY DIMENSIONS (INCHES) Length	Width	Height	AMP-HRS (5 HR Rate)	USE
4W	NIFE	32	3 1	7 4	144 86	30-3/4	8-1/4	14-7/16	80	10KW Diesel
8W	NIFE	32	12 1	2 1	81 40	12-5/8	8-1/4	18	180	225 KW Diesel
11W	NIFE	48	19	2	88	13-5/8	8-1/4	18	200	500 KW Diesel
12W	NIFE	24	4	5	202	36	8-1/4	18	250	750KW Turbine
13W	NIFE	24	4	5	132	25-1/8	8-1/4	18-1/2	95	30-115KW GM Sets
14W	NIFE	24	4	5	150	25-1/8	8-1/4	18-1/2	142	115 KW KS-19587 Diesel
15W	NIFE	24	4	5	132	19-5/16	6-15/16	14-7/16	100	200 KW Turbine (Start)
16W	NIFE	24	1	20	50	19-3/4	8-3/8	9-1/8	10 (10 Hour Rate)	200 KW (Control)

TABLE C: OTHER START AND CONTROL BATTERIES

TYPE	SUPPLIER	NOMINAL VOLTS	POUNDS	DIMENSIONS (INCHES)			AMP-HOURS and RATE	USE
				Length	Width	Height		
Nickel Cadmium MA-5	Sonotone	24	80	12	13-1/4	10-1/4	34 AH at 2 hour rate	200 KW Turbine (Note)
Lead-Acid AN-3150-2	EXIDE	24	80 (filled)	12	13-1/4	10-1/4	36 AH at 5 hour rate	200 KW Turbine
Nickel-Cadmium MDP-2	NIFE	24	2.8 (per cell)	3-1/4 (per cell)	1-3/4 (per cell)	8-1/2	18 AH at 5 hour rate	Control on Auto diesel
Lead-Acid KS-5361 L116C		24	14 (per cell)	7-5/8 per. batt.	4-1/4 per. batt.	8-1/2	10 AH at 8 hour rate	Control on 200 KW turbine

NOTE: Sonotone Type MA-5 Batteries are being replaced on a Class A basis.

5. RECORDS

5.1 Originate an ID-1285 Battery Report on each battery string installed.

5.2 Complete the Preliminary Information at the top of the ID-1285 Form. Refer to Section 17A in this Handbook for instructions on how to fill out the top of the form. Other information shall be added as called for in this section.

5.3 No copies of the battery report are required by the manufacturer.

6. UNPACKING CELLS

NOTE: Inform the truckman that any discoloration on the shipping containers may be due to spilled electrolyte. Yellow stains on the packing material usually is an indication that some electrolyte has spilled out during transit.

6.1 Place the crated battery in close proximity to its final location to avoid excessive handling after unpacking. Carefully unpack the batteries.

6.2 Exercise care when opening shipping containers as misuse of tools can damage the cells. Tear open paper-board cartons rather than attempting to remove the top with a knife.

6.3 Examine the cells carefully for damage after unpacking.

6.4 Temporarily number the cells with a China Marking Pencil in the order in which they will be permanently connected. The No. 1 Cell will be the cell that has one terminal at ground potential.

6.5 On KS-1557S nickel-cadmium batteries, wooden plugs are driven in vent openings of steel-encased cells and plastic membranes are provided under vent caps of plastic-encased cells for shipment. Remove the shipping plugs or membranes and then immediately close or replace the vent caps.

NOTE: Wooden shipping plugs can be removed by using a pair of pliers with a combined rocking and turning motion. Save several wooden plugs because they will be needed if a cell is returned for replacement. The plastic membrane is Saran-Wrap and a piece of this should be placed under the vent cap of a plastic-encased cell if it is returned for replacement.

7. CLEANING CELLS

CAUTION: Do not get any neutralizing solution in or near the cell vents.

7.1 Wipe the exterior of each cell to remove dust, dirt and electrolyte accumulations. Use a clean cloth, wet in neutralizing solution and then wrung dry, to wipe the cell exteriors. Then wipe each cell with a clean cloth wrung out in plain water. Finally, wipe the cells dry with clean dry cloths.

CAUTION: Soda solution is the neutralizing solution for lead-acid cells; boric acid solution is the neutralizing solution for nickel-cadmium cells.

7.2 Clean around all openings in the cells and wipe around the interior of the openings with clean dry cloths.

7.3 Some steel-cased KS-15578 nickel-cadmium cells may be coated originally with petrolatum by the factory. After these cells have been wiped clean and dry, clean petrolatum should be applied to cell tops, posts and connectors, but not on the electrical contact area.

7.4 A white, crystalline deposit may form on nickel-cadmium battery tops. This does no harm except spoiling the appearance. If this occurs around the posts the seals around the posts should be tightened. The white deposit may be dissolved with plain water.

8. PLACING CELLS

8.1 Follow job location plans and drawing notes that apply to the battery installation.

8.2 Clean the cells (per Paragraph 7) before placing them in their final location.

8.3 Nickel-cadmium batteries may be lifted by means of sash cord or manila rope passed under the inter-cell connecting straps. Leave cord long enough to form loops for handling purposes. Do not use wire rope or chain slings on these cells.

8.4 Lead-acid cells may be lifted by rope straps passed around the container. Use two straps for lifting purposes. To place heavy cells in position use the R-2667 Battery Hoist as covered in Section 17C of this Handbook.

8.5 Verify that metal cases of nickel-cadmium cells do not touch anything but the trays. Do not place anything on top of or between the cans as they must not be shorted to each other or grounded in any way.

8.6 After placing the cells in position, verify that the following requirements are met:

8.61 All trays or cases shall stand level and be in alignment with other cells or groups of cells.

8.62 Cells or trays shall be stable and not free to rock.

9. CONNECTING CELLS

9.1 Follow job plans when connecting cells or trays.

9.2 All connections shall be clean and tightened securely.

9.3 Clean and prepare connectors and battery terminals as follows:

9.31 Lead-Acid Batteries: Prepare connector contact surfaces by scraping them clean with a Wire Brush (R-2628). Then immediately coat the cleaned surfaces with a film of NO-OX-ID "A". Prepare contact surfaces of the battery terminals in the same way.

9.32 Nickel-Cadmium Batteries: Wipe connector surfaces and terminal contact surfaces dry with a clean cloth. No petrolatum or other material is required nor permitted on connectors or terminals.

10. ELECTROLYTE LEVEL

10.1 Preliminary

10.11 Observe original electrolyte level in each cell and record on ID-1285 Form. in the appropriate column.

10.12 Record all additions of water or electrolyte to each cell on the ID-1285 Form.

10.13 Unless there is evidence of electrolyte spillage, a cell with electrolyte level down to the top of the plates should be considered normal. This is assumed to result from degassing and evaporation.

10.2 KS-15577 Lead-Acid Batteries

10.21 The minimum electrolyte level for these cells is the top of the separators; the maximum level is the bottom of the cover.

10.22 If electrolyte level is below the tops of the plates, add sufficient electrolyte, when available, to just cover the plates. If electrolyte is not available, then add distilled water.

10.23 If loss of electrolyte is due to spillage, and 8 ounces or more water bas to be added to cover the plates, order replacing electrolyte for the cell. Be sure to give KS- number, List number and battery manufacturer on the order.

10.24 If electrolyte level is above the top of the separators do not add water at this time.

10.25 If electrolyte level cannot be seen through the filling funnel or container, determine that the plates are covered by using a hydrometer. The hydrometer will not indicate level other than the fact that the plates are covered.

10.3 KS-15578 Nickel-Cadmium Batteries

10.31 The minimum electrolyte level for the cells listed in TABLE B (Paragraph 4) is the top of the plates; maximum level is 3/4 inch above the top of the plates.

10.32 If the cells are in plastic jars that are marked with maximum and minimum level lines, gauge the level by eye.

10.33 If the cells are steel-cased, or, if lines are not marked on the container, use the polystyrene tube furnished with the cells to gauge electrolyte level. Push the tube through a vent hole into the cell until it contacts the top of the plates. Place a finger over the open end of the tube, withdraw the tube and measure electrolyte height in the tube with a scale. Then return the electrolyte in the tube to the cell.

10.34 If spillage has reduced electrolyte level below the top of the plates, add distilled water until the plates are covered. In this case order replacing electrolyte for the cell. Be sure to give KS- number, List number and battery manufacturer in the order.

10.35 Observe that there is mineral oil on top of the electrolyte. Pure mineral oil is added to these KS- batteries at the factory, and this forms a layer approximately 1/8 inch thick.

NOTE: The same mineral oil used for wet counter-cells may be used in these cells, if no oil was originally provided.

11. CHARGING

11.1 KS-15577 Lead-Acid Batteries

11.11 These lead-acid start and control batteries shall be given an initial charge equal to 100% of the ampere-hour capacity within three (3) months after shipment from the factory. (Refer to TABLE A for ampere-hour rating).

EXAMPLE: If ampere-hour capacity is 110 (for KS-15577 List 11) the charge would be 18.3 hours at a 6 ampere rate or any combination of current and hours totalling 110 ampere-hours.

11.12 If the cells have been on open-circuit from three (3) to six (6) months, the initial charge shall be 200% of the ampere-hour capacity of the battery.

11.13 If the cells have been on open-circuit longer than six (6) months they may have deteriorated enough to reduce the anticipated life. In this case ask the telephone company whether the cells should be returned to the factory for credit or charged on the job.

NOTE: If the cells will be charged on the job either the telephone company or the supplier should recommend the charging procedure.

11.14 Record voltage and charging current each hour on Form ID-1285. Use ITE-4474 DC Voltmeter to indicate voltage. Use whatever ammeter is furnished on the charging equipment to indicate current. In the case of the J87249 Rectifier, current is measured by using an ITE-4442 VOM across 4A/VOLT jacks.

11.15 During the charge do not exceed the following charging current:

GOULD Batteries: 5% of ampere-hour rating.
EXIDE Batteries: 7% of ampere-hour rating.

EXAMPLE: Consider List 8 batteries rated 306 AH for Gould and 310 AH for Exide. Do not exceed .05 x 306-15.3 amperes for Gould battery, or, .07 x 310=21.7 amperes for Exide battery.

11.2 KS-15578 Nickel-Cadmium Batteries

11.21 These start and control batteries shall be given an initial charge equal to 100% of the rated ampere-hour capacity. The cells do not deteriorate on open-circuit and there is no time limit before the charge must be applied.

11.22 During the charge there is normally no limit to the charging current that may be applied. However, the voltage should not be allowed to exceed 1.5 volts/cell and the temperature of the electrolyte shall not be allowed to exceed 120° F.

CAUTION: Reduce charging current if electrolyte temperature reaches 110° F. because the temperature will overshoot.

11.23 Record voltage and charging current each hour on Form ID-1285. Use ITE-4474 DC Voltmeter to indicate voltage. Use the ammeter furnished on the charging equipment to indicate current. Measure current on J87249 Rectifier by using ITE-4442 VOM connected across 4A/VOLT jacks.

11.24 If these cells are taken to a service station for charging warn the station attendant that the cells have an alkaline electrolyte and that cell voltages are lower than lead-acid type. He must also be warned that under no circumstances shall a hydrometer be used in the cells.

11.3 Other Batteries

11.31 The KS-5361 lead-acid batteries shown in Table C (Paragraph 4) are treated the same as the KS-15577 lead-acid batteries.

11.32 Batteries other than the KS-5361 cells listed in Table C shall be charged in accordance with supplier's instructions furnished with the batteries.

12. FLOAT VOLTAGE

12.1 After the initial charge adjust the charging equipment to float KS- lead-acid cells at 2.17 volts per cell and KS-nickel-cadmium cells at 1.40 volts per cell.

12.2 For certain batteries the float voltage may vary from the values given in Paragraph 12.1. This will generally be explained in the associated engine test section.

NOTE: An example of this is the 12 cell lead-acid battery (Exide AN-3150-2) furnished at one time with the KS-19896 turbine. Float voltage for this battery should be 2.22 volts/cell, or, about 27.0 volts total.

12.3 Various types of battery charging equipment are furnished with the different engine-alternators. Refer either to the section in Handbook 19 on the engine-alternator for information or to the supplier's manual with the charger.

13. SPECIFIC GRAVITY

13.1 Specific gravity of the electrolyte in fully charged KS-5361 and KS-15577 lead-acid cells shall be between 1.190-1.225. If readings fall in this range it will not be necessary to correct them to 77° F. If they do not fall in this range then correct the readings in accordance with Section 18E in this Handbook to 77° F. (Readings may be low due to high temperature)

13.2 As a matter information, specific gravity of the electrolyte in nickel-cadmium cells may range between 1.160-1.300, at the discretion of the battery supplier. This value does not change during charge or discharge. Therefore, specific gravity measurements on these cells do not give any indication of the state of charge.

14. DRY-CHARGE BATTERIES

NOTE: The following routine shows the general method for handling dry-charge lead-acid batteries. It applies specifically to Exide high-gravity AN-3150-2 batteries, which were furnished with some 200 KW turbines.

14.1 Bring the batteries out of a cold area into the room where they will be used.

14.2 After the batteries have warmed up for a short time remove the vent plugs. Then add electrolyte to each cell until the level is slightly above the bottom of the well (slightly above minimum level). Then replace the vent plugs.

NOTE: If electrolyte was not shipped with the AN-3150-2 batteries (and this cannot be air-shipped) purchase 5-1/2 quarts of 1265 electrolyte per battery at a local garage or gasoline station.

14.3 Allow the battery to sit overnight. In the morning recheck electrolyte level. Add electrolyte, as necessary, to bring the level just above the bottom of the well. Restore vent plugs.

14.4 Turn on the charging equipment and adjust charger output voltage (where possible) to 30 volts (2.5 volts/cell). Otherwise, turn on the charger and observe voltage and current.

14.5 Record voltage and current each hour. When 100% ampere-hour charge has been applied, turn off the charger.

14.6 Check electrolyte level in each cell and add electrolyte, as necessary, to bring the level just above the bottom of the well (minimum level).

14.7 Turn on the charging equipment. Measure the voltage and observe that the charger is set approximately at the correct float voltage for the cells (27 volts for AN-3150-2).

15. REPLACING BATTERIES OR ELECTROLYTE

15.1 When a replacing battery is entered in the string check electrolyte level and enter it on Form ID-1285. Then give the string, including the new cell(s), a 100% ampere-hour charge.

15.2 When replacing electrolyte is received for a lead-acid cell, dump the electrolyte from the cell and fill the cell with the new electrolyte up to the minimum level line. The higher the state of charge before dumping the electrolyte, the less the increase in specific gravity when the electrolyte is added.

15.3 When new electrolyte is received for a nickel-cadmium cell, discharge the cell completely before attempting to replace the electrolyte.

15.31 Disconnect the cell after it has been discharged. Remove or open the vent cap, turn the cell upside down and drain out the electrolyte into a suitable container.

15.32 Use pyrex, enameled iron, stoneware or hard rubber containers to handle the electrolyte. Fill the cell to a point just above the minimum level.

15.33 After the electrolyte has been placed in the cell add a layer of mineral oil to the cell.

15.34 Replace vent plugs in the cell.

15.35 No special charge is required after refill electrolyte is placed in the cell.

Arrows not shown due to extensive changes.

Vertical lines at side of paragraph indicate requirements.

Manager, Product Engineering

Reason for Reissue:
(1) To bring the section up-to-date.
(2) To include batteries presently being installed.