The Engineering Society For Advancing Mobility Land Sea Air and Space®

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Storage Batteries for Off-Road Work Machines

SAE Recommended Practice
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An American National Standard

The Engineering Society For Advancing Mobility Land Sea Air and Space®
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OFF-HIGHWAY MACHINERY PRACTICE

an American National Standard

SAE J930

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Ø STORAGE BATTERIES FOR OFF-ROAD WORK MACHINES

1. PURPOSE:

The purpose of this recommended practice is to provide uniform definitions, requirements, and application recommendations for off-road work machine (ORM) storage batteries.

2. SCOPE:

This SAE Recommended Practice applies to all types of heavy-duty storage batteries intended for use on off-road work machines as described in SAE J1116. Included are definitions, test procedures, general requirements, application recommendations, standard sizes, overall dimensions, and electrical values.

3. DEFINITIONS:

3.1 Heavy-Duty Storage Battery: An engine-cranking battery specifically designed to withstand the shock, vibration, job grade requirement, and dusty environment normally encountered by earthmovers and other off-road work machines.

3.2 Batteries Not Requiring Periodic Water Additions: A large variety of batteries are designed to reduce or eliminate the need for periodic watering; the necessary intervals may also vary with the intended application. Standard procedures which may be used to define battery water-use characteristics include steady-state charging current and self-discharge tests.

4. STEADY-STATE CHARGING CURRENT TEST PROCEDURE:

The rate at which a battery uses water, that is, generates gas, is determined by such factors as charging voltage, operating temperature, grid alloys, and element design. Following is a standard procedure for determining steady-state charging current, which is a relative indication of the rate of battery water usage:

4.1 Pre-Test Conditioning: After completing the cold cranking and reserve capacity tests, charge the battery according to the method recited in SAE J537 under "Conditioning."

4.2 Soak Period: Place the fully-charged battery in an oven or circulating water bath maintained at a temperature of 52 ± 0.3°C (125 ± 0.5°F). Allow a 16 h soak. Charge at 14.1 ± 0.1 V during the soak period.

4.3 Test Measurements: Charge the battery at 14.100 ± 0.005 V measured at the battery terminals. Battery electrolyte temperature shall be 52 ± 0.5°C (125 ± 1°F). Measure charge current every 15 minutes. When current stabilizes (less than 2 mA change between successive readings), record current and test is completed.

4.4 Interpretation of Results: Water loss is proportional to steady-state charge current at a rate of approximately 1/3 mL/Ah per cell. The ORM manufacturer and the battery supplier should jointly establish an acceptable specification.

5. SELF-DISCHARGE TEST PROCEDURE:

The rate of battery self-discharge is dependent upon such factors as grid alloys, impurities in the electrolyte, and element design. Following is a standard test procedure for determining the rate of battery self-discharge.

5.1 Pre-Test Conditioning: According to procedures defined in SAE J537, run a reserve capacity test on a new (10 - 60 days age), fully charged, and conditioned battery. Record data. Recharge the battery according to SAE J537.

5.2 Soak Period: Place disconnected battery in an oven or circulating water bath maintained at a temperature of 41 ± 1°C (105 ± 2°F) for a period of 28 days.

5.3 Unboosted Reserve Capacity: At the end of the 28-day soak period, run an unboosted reserve capacity test according to procedures defined in SAE J537 at a temperature of 27 ± 3°C (80 ± 5°F). Record data.

5.4 Calculation of Self-Discharge Rate: Calculate the percent loss in reserve capacity as follows:

$$\text{Percent self discharge loss} = \frac{RC_I - RC_F}{RC_I} \cdot 100$$

where RC_I = Initial reserve capacity, min.
RC_F = Final reserve capacity, min.

5.5 Interpretation of Results: Batteries not requiring periodic water additions may lose approximately 10% of their capacity under the above-described test conditions, while other types of batteries may lose considerably more. Again, however, the ORM manufacturer and the battery supplier should jointly determine a satisfactory specification.

6. REQUIREMENTS - GENERAL:

All types of heavy-duty storage batteries intended for use on off-road work machines should conform to the following applicable requirements:

6.1 Tilt Angle: The battery construction and vent type and location shall be such that no electrolyte is lost when the battery, filled to its recommended level, is tilted to an angle of 45 deg in any direction from the normal horizontal at-rest position and remains in the tilted position for a period of 2 hours.

6.2 Performance Ratings: Cold cranking performance, reserve capacity, and charge rate acceptance tests shall be accomplished according to procedures defined in SAE J537. The minimum requirement for charge rate acceptance is 2% of the -17.8°C (0°F) cold cranking (30 s Test) rating.

6.3 Vibration: Batteries conforming to this recommended practice shall survive 18 h of vibration at an acceleration of 5 g (49 m/s^2) and a frequency of 30-35 Hz according to the procedure defined in SAE J537.

6.4 Remote Venting: If required, provisions for single outlet venting shall be from a recessed nipple to which a vent tube could be attached. The venting nipple shall not extend beyond the side of the battery such that it could be accidentally sealed off, as by a hold-down bracket.

6.5 Handles or Lifting Devices: Batteries may be equipped with lifting devices, such as handles or integral hand- or finger-grips. With the battery in its normal at-rest position and maintained at a stabilized temperature of 52 ± 0.5°C (125 ± 1°F), the lifting devices must be able to withstand a vertically-applied static load equal to twice the mass of the battery and a horizontally-applied static load equal to the mass of the battery, each for a period of 30 minutes.

6.6 Battery Sizes: Overall dimensions and terminal configurations shall be as defined in Table 1 and SAE J537.

TABLE 1 - Storage Batteries Recommended For Off-Road Work Machines

SAE No.	Assembly Figure Ref. J537	Ref.	Maximum Overall Dimensions						Typical Electrical Values			
			Length		Width		Height		Reserve Capacity min	ORM Cold Cranking Rating (30 s) A		Overcharge Life Units
			mm	in	mm	in	mm	in		-17.8°C (0°F)	-28.9°C (-20°F)	
4D ORM 750	8	21T1	527	20.75	222	8.75	276	10.88	285	750	600	9
8D ORM 850	8	21T2	527	20.75	279	11.00	276	10.88	430	850	680	13
2 ORM 550	2	1H2C	263	10.38	181	7.13	238	9.38	220	550	430	7
4 ORM 650	2	1H4B	333	13.13	181	7.13	238	9.38	280	650	520	9
30 ORM 500	10	9H9B	342	13.50	173	6.82	238	9.38	158	500	410	13
31 ORM 475	18	--	333	13.13	173	6.80	239	9.41	130	475	375	--
31 ORM 625	18	--	333	13.13	173	6.80	239	9.41	160	625	490	--
28 ORM 500	18	--	262	10.31	174	6.85	241	9.49	100	500	370	--
28 ORM 400	18	--	262	10.31	174	6.85	241	9.49	80	400	290	--

7. APPLICATION RECOMMENDATIONS:

Design and location of the battery tray or carrier may be as important as the selection of the battery itself. Following are application recommendations which can contribute to optimum battery life in off-road work machines.

7.1 Vibration Considerations: Battery trays or carriers should be located so as to minimize the damaging effects of vibration, especially at frequencies of from 3-50 Hz. Generally, vibration problems can be minimized by mounting the batteries near the main frame and as close to the center of the machine as possible.

7.2 Environmental Protection: Batteries should be located in a clean environment or protected from accumulation of mud, dirt, or other foreign materials which may block vents, drop into the batteries during watering, or contribute to terminal corrosion.

7.3 Ventilation: Batteries produce hydrogen and oxygen gases as natural by-products of normal operation; these gases may exist in inflammable and potentially-explosive concentrations in and around the batteries. Therefore, batteries shall be located so as to allow adequate ventilation of the gases and away from potential ignition sources such as sparks, flames, and tailpipe openings.

7.4 Temperature Limitation: Exposure to extreme heat will hasten deterioration of batteries. Therefore, battery carriers should be located away from exhaust systems, radiators, or other high-temperature devices. Battery temperatures should not exceed 52°C (125°F) during normal machine operation.

7.5 Hold-Down Devices: Batteries should be solidly mounted to the tray or carrier by means of suitable hold-down devices. Hold-down devices should be designed to uniformly distribute force over the case walls and/or solid partition areas of the battery case. Clearance shall be provided to avoid blockage of the vent(s) and around terminals to minimize the risk of accidental short circuits and/or battery discharge.

7.6 Terminal Connections: See SAE J537 for terminal detail and SAE J821 for mating cable connector requirements.