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Fuse Testing in Oil for
ALVIN Batteries

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for ALVIN Batteries

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This report includes the test results on a series of tests made by the DSRVG to find a more suitable fuse for the ALVIN batteries. Figure 1 gives the test setup.

The data on page 1 of 5 is of a 100 amp, 250 volt standard commercial buss fuse. This fuse was used in ALVIN for the first shallow water dives. Due to the higher I.R. drop and the high current required to blow this fuse, it was desirable to find and test better fuses.

The amp trap form 101, type #4, 250 volt fuse was selected for test because of its size and construction. Test data is found on sheets 2, 3, 4 and 5. Disassembly of the amp trap fuse shows that an insulating material is strapped on both sides of the blowing link. This construction minimizes heat loss to the oil and results in a more consistent blowing value when operated in oil.

Sheets #3 and 4 have the last test data run on a 150 and 200 amp fuse, pressurized to 3300 PSIG in Tellus #15 oil manufactured by the Shell Oil Company. This test was run to see if pressurizing had any effect on oil penetration.

Data collected and run by M.J. McCamis, W.M. Marquet, Geo. Broderson and D. Mason.

Figure No. 1
Fuse Test Circuit

Fig. 2 150 ampere AMP TRAP fuse showing internal construction.

Fig. 3 150 ampere AMP TRAP blown.

Make: 100 Amp. 250 Volt Commercial Buss Fuse

Modifications: Left in Tellus #15 oil for 72 hours.

<u>No.</u>	<u>Current Amps.</u>	<u>Volts</u>	<u>I.R. Drop Volts</u>	<u>Fuse Condition</u>	<u>Oil Temp.</u>	<u>Watts Loss</u>	<u>Time</u>
1	200	20	.5	Normal	58°F	100 watts	3 min
2	300	20	.9	Failed	60°F	270 "	23 sec
3	310	20	.9	"	60°F	279 "	25 sec
4	310	20	.9	"	61°F	279 "	35 sec
5	375	6	-	"	60°F	-	2 sec
6	180	24	.4	Normal	54°F	72 "	2 min

All fuses started heating and bubbling.

Fuse Test Oil Submerged

Type: 250 Volt Form 101 Amp-trap Type 4

Rating in Amperage: 70

Modifications: Saturated in oil with vacuum and pressure chamber.
Type oil -- Kerosene

<u>Applied Current Time</u>	<u>Current</u>	<u>Voltage</u>	<u>I.R. Drop</u>	<u>Watts Loss</u>	<u>Fuse Condition</u>	<u>Temp.</u>
3 min.	95 A	60	73 MV	6.935	Normal	34°F
3 "	100 A	59	79 "	7.9	"	34°F
3 sec.	160 A	56	----	----	Failed	34°F
30 min.	105 A	59	86 MV	13.76	Normal	36°F
3 "	115 A	57	102 "	11.73	"	35°F
3 "	125 A	56	123 "	15.375	"	37°F
20 sec.	135 A	56	----	----	Failed	37°F
10 "	145 A	55	----	----	"	37°F
3 "	160 A	55	----	----	"	70°F
5 min.	125 A	55	124 MV	15.6	Normal	70°F

Fuse Test of the 250 Volt 70 Amp Type 4
Fuse in Oil.

(Mfg. Chase Shawmut Co., Newbury Port, Mass.)

Make: Amp-trap 250 Volt Form 101 Type #4 150 Amp.

Modifications: Saturated in oil with vacuum and pressure chamber.
Oil used in test -- Kerosene.

<u>Time</u>	<u>Current Amps</u>	<u>Volts</u>	<u>M. Volt I.R. Drop</u>	<u>Fuse Condition</u>	<u>Oil Temp.</u>	<u>Power Drop just before failing</u>
3 min	150	29.2	.051	Normal	29°F	7.65 watts loss
3 "	210	28.0	.080	"	29°F	16.8 watts
3 "	250	28.0	.102	"	29°F	25.5 "
3 "	275	28.0	.127	"	29°F	35.925 "
3 "	275	28.0	.125	"	29°F	34.375 "
3 "	275	27.5	.126	"	29°F	34.65 "
3 "	284	27.2	.160	"	29°F	45.44 "
3 "	285	27.0	.165	"	29°F	47.025 "
3 "	285	27.0	.164	"	29°F	46.84 "
3 "	286	27.0	.168	"	29°F	47.648 "
min. 12 sec.	295	26.5	.125 start	Failed	30°F	* 1.50 volts
45 sec	300	27.0	.130 "	"	70°F	* .250 "
35 "	300	27.0	.136 "	"	30°F	* .250 "
30 "	300	27.0	.149 "	"	70°F	* .250 "
48 "	300	27.0	.132 "	"	30°F	* .250 "
30 "	305	27.0	.130 "	"	30°F	* .250 "
25 "	315	26.5	---	"	30°F	---
8 "	320	26.5	.196 "	"	30°F	* 1.45 volts
9 "	320	26.5	.195 "	"	30°F	* 1.2 "
3 "	330	26.5	----	"	29°F	----
2 "	335	26.0	----	"	29°F	----
1 "	345	26.0	----	"	71°F	----
7 "	330	26.5	.198	"	65°F	(This fuse was pressurized to 3300 PSIG before test; oil used in pressurizing and test was Tellus #15, Shell Oil Co.)

* IR Drop across fuse just before blowing

Fuse Test Oil Submerged
(Mfg. Chase Shawmut Co.,
Newbury Port, Mass.)

Make: Amp trap

Type: No. 4

Amperes: 200

Modifications: Saturated in oil vacuum and pressure chamber
Oil type -- Kerosene

<u>Time</u>	<u>Current</u>	<u>Volts</u>	<u>I.R. Volts</u> <u>Drop</u>	<u>Watts</u> <u>Loss</u>	<u>Fuse</u> <u>Condition</u>	<u>Temp.</u>
58 sec.	400	24.8	---	--	Failed	30°F
10 "	450	24.5	---	--	"	30°F
3 min.	370	24.5	.154	56.98	Normal	30°F
5 sec.	460	24.5	---	--	Failed	30°F
6 sec.	460	25.5	---	--	Failed	65°F This fuse was pressu- rized to 3300 PSIG before it was tested. The oil used to pressurize and test this fuse was Tellus #15, Shell Oil Co.

Fuse Test Oil Submerged
(Mfg. Chase Shawmut Co.,
Newbury Port, Mass.)

Make: Amp trap mfg. by Chase Shawmut Co.

Type: No. 4

Amperes: 40

Modifications: Saturated in oil vacuum and pressure chamber
Oil type -- Kerosene

<u>Time</u>	<u>Amps. Current</u>	<u>Volts</u>	<u>I.R.Volts Drop</u>	<u>Watts Loss</u>	<u>Fuse Condition</u>	<u>Temp.</u>
instant	80	30	--	--	Failed	30°F
5 min.	55	32	.165	8.855	Normal	30°F
3 min.	60	31	.187	11.22	"	30°F
5 "	65	31	.211	13.715	"	30°F
3 "	70	31	.229	16.03	"	30°F
3 "	72	31	.244	17.568	"	30°F
3 "	75	31	.257	19.275	"	30°F
3 "	77	31	.266	20.482	"	30°F
3 "	78	30.5	.269	20.982	"	30°F
3 "	80	30.5	.287	22.96	"	30°F
3 "	81	30.5	.298	24.138	"	30°F
3 "	83	30.5	.350	29.05	"	30°F
40 sec.	85	30.5	---	---	Failed	30°F
12 sec.	80	30.5	---	---	Failed	30°F
5 min.	75	31.5	.185	13.875	Normal	30°F
22 sec.	90	30.5	---	---	Failed	30°F