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STATE OF CALIFORNIA

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

TRAFFIC DEPARTMENT

MAY 1965

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Materials & Research Dept.

Mr. J. E. Wilson
Traffic Engineer
Sacramento, California

Dear Sir: [redacted]

THE LOS ANGELES TEST

OF THE INDUCTIVE LOOP-DETECTOR-COUNTER SYSTEM

Study under general direction of.	E. A. Jenkins
Test coordination	A. F. Bailey
Field Supervision and Report.	J. J. Majestic
Equipment assembly and technical assistance .	M. Wilson, Materials & Research Dept.
Test site and field personnel	Dist. 7 Traffic Dept.

Sincerely,

J. T. Kassel

J. T. KASSEL
Asst. Traffic Engineer

65-49

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Submitted for your consideration is a report of:

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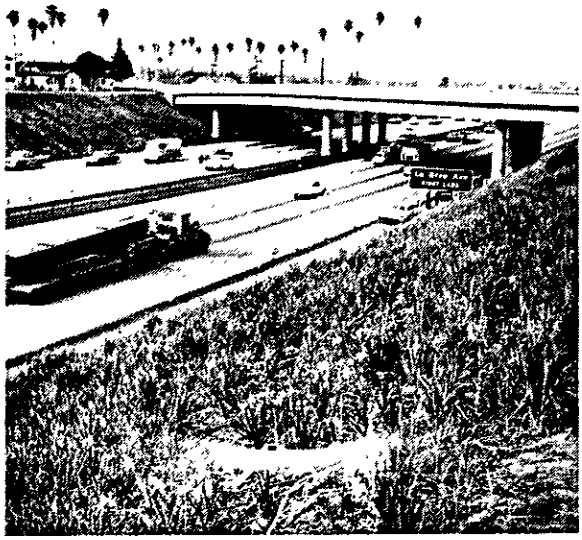
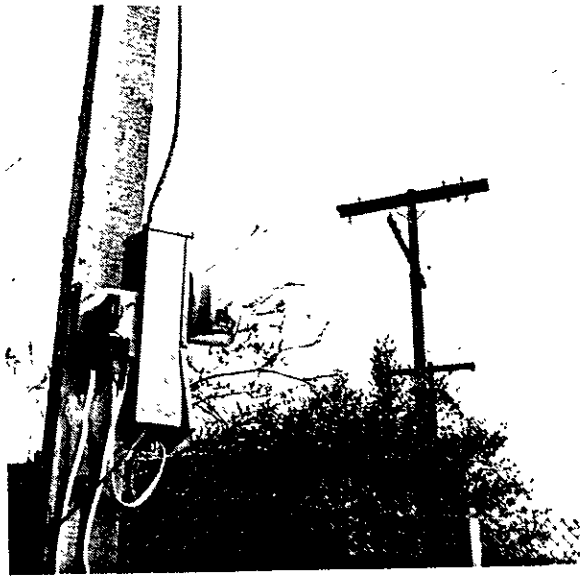


1. This is the test site at West Boulevard Overcrossing, LA 10, MP 11.03. Personnel conducting the test are on the shoulder in the right foreground.

2. At West Boulevard, inductive loops were buried on both sides of the freeway using the configuration recommended in Circular Letter 64-174.



3. Commercial power was led to a meter within the freeway right-of-way. To demonstrate its feasibility, power was stepped down to low voltage at the meter and led through 1,000 feet of wire.

4. Loop leads from the pull box and power from the 1,000 foot long wire (stepped up again to 110V AC) are connected with the 4 detector units and their power supply unit via a temporary board.

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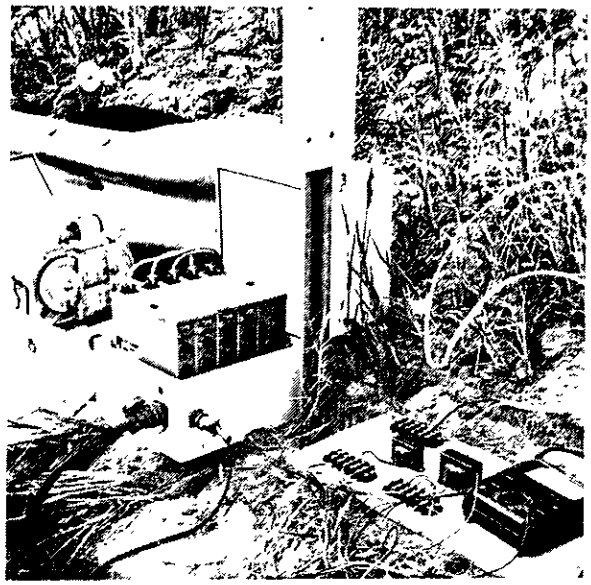
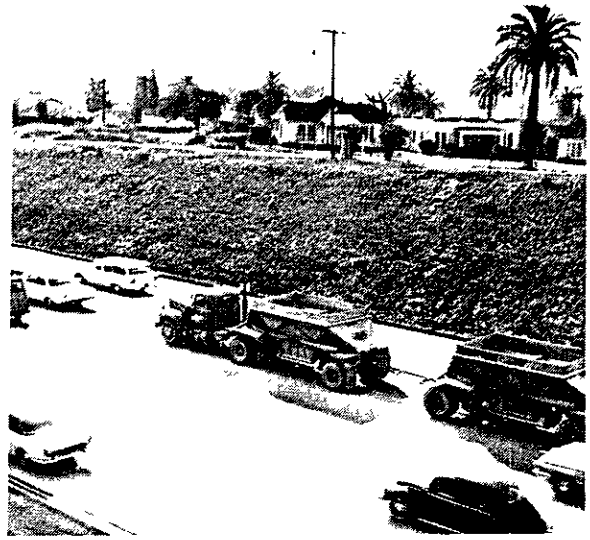


5. When a detector unit senses a vehicle passing through its loop's inductive field, an impulse is fed into a summator which in turn feeds impulses one-at-a-time into the counter unit.



6. Infrequently, a combination with a long tongue or uneven bottom configuration may doubl count. A truck changing lanes may activate two loops or a small car may slip by between loops.

7. Both a lane-by-lane manual count and a hose count using a Fischer & Porter counter were made simultaneous with the loop count. It is impossible to keep a counter hose from pulling loose in heavy traffic.

8. This is a high volume hour looking eastward. (150,000 ADT). Note the detector-counter hook-up working off the loops and fifteen feet beyond, the counter making a hose count.

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THE LOS ANGELES TEST
OF THE INDUCTIVE LOOP-DETECTOR-COUNTER SYSTEM

Problem to be Solved

The test of a loop type detector and counting system was planned in early October, 1964, to resolve questions raised by conflict in instructions issued by Fischer & Porter Company in their bulletin 90-36-02 dated January, 1964, and Division of Highways' Circular Letter No. 64-174 dated June 17, 1964. It was also desired to develop a packaging method for the detector and summator assembly, and to mate this package with a Fischer & Porter portable recording counter.

Site

The site selected for the test was a high volume location on Interstate 10 (the Santa Monica Freeway) just east of the West Boulevard O.C. (07-LA-10-M.P. 11.03). District 7 had installed loops here in accordance with Circular Letter 64-174 and had brought in 110V AC power to temporary power poles near the right of way line.

Equipment

Equipment chosen for the test consisted of the following:

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2 each - 4-Pak Vehicle Detector M 1441224 (RCA Ve-Det unit)

2 each - Fischer & Porter Count Summator Model 55CP 1010 with 4 input channels and 1 output channel

2 each - Fischer & Porter Waterproof Case assembly for Model 1546 TOP counter

2 each - Fischer & Porter TOP counter Model 1542

2 each - Filament transformers 26.82V and 24.02V

1,000 ft. #10 2-conductor UF cable

Miscellaneous cable, terminal blocks, amphenol connections and cable to join counter to detector package.

The Headquarters Laboratory obtained these components in February and assembled them into two packages each capable of counting 4 lanes of traffic. They tested each unit at District 3's Control Station 301 on Route 160 near the American River Bridge and "debugged" each unit.

Test Procedure and Observations

The assembled units were transported to District 7 on March 8, 1965. On March 9, 1965, they were connected to the loops in 8 of the 10 lanes at the selected site. The curb lane loops were not connected to any of the detectors at this time.

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The 110V AC power was brought in over 1,000 ft. of #10 2-conductor UF cable from temporary power poles near the right of way fence.

The detectors were each adjusted and their output fed into the summator. In turn, the summator output was fed into the portable F & P TOP counter where the impulses were recorded. Several short manual counts by personnel from Headquarters Laboratory, Headquarters Traffic and District 7 - Traffic, indicated that the combined package counted the freeway traffic without any noticeable error.

Low Voltage Operation

A test of low voltage transmission of current was performed. The current was stepped down from 110V AC at the power pole to 26.8V with a filament transformer (picture 3), transmitted through 1,000 ft. of #10 2-conductor UF cable and then stepped back up to 110V using a 24V filament transformer. The output from this last transformer was fed into the Ve-Det power supply to furnish the required 24V DC to operate the Ve-Det 4 pak.

It was decided to dispense with a test of transmittal of 24V DC through the 1,000 ft. of cable as it was impractical at this time. Since Ve-Det detectors require a very well regulated power supply,

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a special circuit board and enclosure would have been necessary for the Ve-Det power supply unit.

The line voltage at the pole was 119V AC. When this was put through the 26.8V transformer the yield was 31.0V AC with no load. This voltage was then transmitted through 1,000 ft. of #10 wire with a voltage drop of 2.0V. The 29 volts remaining was fed into the normally secondary windings of the 24.0V filament transformer and 117V AC was obtained from the normally primary windings while the transformer was under the load imposed by Ve-Det 4-Pak power supply.

During the test conducted under these conditions the detector-counter package performed well. Neither transformer heated appreciably during the 1 to 1-1/2 hours of the test.

At the end of the day the entire layout was disconnected from the loops and power source and the detectors, power supply and counter packages were picked up to preclude, to as great a degree as possible, any damage to the components by traffic or vandalism.

The following morning, March 10th, the loops were reactivated and further tests of the low voltage transmittal of current was made, this time with 750 ft. of cable. (The remainder was used to bring in 110V AC for the operation of a tape recorder used in the test later in the day.)

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The test of the entire counting unit was continued from 0900 to 1245 without any noticeable errors which could be traced to power supply. There was no overheating of transformers so it was decided to run the afternoon test of the counters using this source of power for the westbound lanes. The night operation of the system was continued with this power source since the system was still working well at 1700 hours. Periodic checks indicated no problems existed with the low voltage transmittal method. When the cable was wrapped in plastic and buried, the temperature rise in the transformers was not significant even after continuous operation for 24 hours.

Hose Installation

On the morning of March 10, 1965, District 7 personnel installed "flat" pneumatic hose with regular Fischer & Porter counters to count both directions of travel near the loops. These counts were made concurrent with the loop installation tests. The hose on the westbound lanes was reinstalled when it came up about noontime. Minor repairs to the hose operated Fischer & Porter counter on the westbound lanes was also made by the representative of Headquarters Traffic.

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Test of Loops In Series

During the late morning hours of March 10th, an attempt was made to put the loops of lanes 1 and 2 in series and readjust the detector. This resulted in a loss of sensitivity. 150 vehicles were recorded, 3 vehicles missed entirely and 12 spurious calls were recorded. These spurious calls resulted from counting of axles or axle groups of trucks with high beds (bottom-dump trucks). District 7 personnel estimate that the over-all number of occurrences of this type would have slight affect on the total 24 hour count, but would have more affect on any individual hour. Any data obtained with this type of hook-up would be unacceptable where lane analysis is to be done.

When the loops were restored to their original configuration and the detectors readjusted, there was a return to the original counting accuracy.

Manual Count

At 1300 hours on March 10, 1965, a manual count was started which lasted until 1700 hours. Traffic was recorded by lane in 15 minute increments, coordinated with the punch-out cycle of the Fischer & Porter counter. These manual counts and the pneumatic hose counts are compared with the counts obtained by the loop-detector-summator-counter system which was tested. (See Exhibit 2)

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The manual count was stopped at 1700 but the hose counts and loop counts continued until 1000 on March 11, 1965. (See Exhibit 1)

Test with Crystals of Similar Frequencies

Subsequent to the forementioned tests, a brief test was made using crystals one KC apart in adjacent lanes and using the same crystal frequency in loops on opposite sides of the road approximately 38-40 ft. apart. There did not appear to be any interference in either test at this location.

Packaging Problems

There were problems concerning the packaging of the detectors and summator. The container selected was the case from a Fischer & Porter portable counter. One inch of height was cut off the summator unit to permit a mounting plate to be placed on the chassis channel in the lower portion of the counter case. The Ve-Det 4-pack was carefully mounted on this plate. Two braces in the top section of the case were removed and the other two notched to permit closing of the case. Terminal blocks were placed at one side of the plate for ease of checking during the test period. Normally all the connections made here would be made through amphenol connectors or "Jones" plugs. The appropriate wire connections were made to the summator, detectors, electric

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power and sockets and plugs. Cables for connecting the detector-summator package to the loops, power and traffic counter were constructed. The combined unit was then tested and "debugged".

This packaging configuration works well but others will also work. The manufacturer may modify components to more easily fit in a portable case. District 7 may use surplus "G"-type controller cabinets which can easily be adapted to housing the components but would require two men for carrying.

The mercury relays in both the RCA Ve-Det detector and the Fischer and Porter summator increase the difficulty of packaging since they have to be kept in a relatively level position to operate, (no more than 30° off horizontal). The use of mechanical type relays, as in the newly developed Fischer & Porter Tacdet , would permit a more efficient arrangement of components. This is very important if the unit is to be portable. In permanent or semi-permanent installations, lack of this feature is of little consequence. A frequency shift register has been suggested as a substitute for the present summator. (This type of unit would be considerably cheaper than a Fischer & Porter Summator).

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Hookup and Tuning Problems

There was little difficulty encountered in tuning the loops and obtaining good counts from the Ve-Det 4-Pak. Connection between the loops and detectors were easily made. The use of standard type connector plugs and sockets will further increase the efficiency and ease of connecting all components.

Electrical Power Problems

Difficulty with long power leads failed to materialize. The step-down step-up system utilizing transformers of appropriate capacities and direct burial of #10-2 conductor UF cable to carry low voltage current rather than long lines at 110V AC appears to solve the power supply problem for distances up to 1000 feet or more. Most Traffic Census count stations can probably be moved within the same traffic profile section to be near enough to 110V AC power to allow use of commercial power. In remote areas, some type of generator (possibly thermo-electric) is indicated for use with loop installations since batteries appear to be impractical due to the power requirements and the sheer number of batteries which would be necessary for each count.

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Conclusions

The newly developed Tacdet detector by Fischer & Porter appears to have many advantages over the RCA Ve-Det. It is easier to adjust, uses mechanical relays and is much less expensive. District 11 has some of the Tacdet units on loan from the Fischer & Porter Company for trial and will make a report to Headquarters Traffic on their operation and on packaging considerations. If they perform as well as anticipated, they should be substituted for the Ve-Dets, particularly where packaging is a problem.

Low voltage transmission of power works well. Direct burial of #10 2-conductor UF cable is indicated since only a few inches of earth cover and no conduit is needed (the voltage is under 30 volts with low amperage.)

As a suggestion for placement and interconnection of the equipment, the lead-on wires from the loops should be carefully soldered into an appropriate standard connector socket. These sockets could be imbedded in a concrete slab in the vicinity of the counting location in a manner which would minimize the wire movement and reduce the time required to make connections. Tie down bolts, pins or angle irons should also be imbedded at the same time for purposes of securing the counting equipment.

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The counter man who tends this type of count equipment will need some mechanical and electrical ability and a desire to do a good job.

Recommendations:

It is recommended that loops and vehicle detection equipment be made available for use at major control stations throughout the State where AC power is readily available or which could easily be made available by moving the station a short distance. Further, it is recommended that this equipment be made available for surveillance sites on high volume freeways and for use at numerous selected profile count locations. Specific locations for operation are under study and information regarding them will soon be available.

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Exhibit 1

THE LOS ANGELES TEST OF THE INDUCTIVE LOOP-DETECTOR-COUNTER SYSTEM

Santa Monica Freeway - LA 10, MP 11.03

20-HOUR COMPARISON OF VE-DET AND HOSE (ROAD TUBE) COUNTS

Date	Hour Ending	Eastbound			Westbound			Total		
		Ve-Det Count	Hose Count	Ve-Det % Diff	Ve-Det Count	Hose Count	Ve-Det % Diff	Ve-Det	Hose Count	Ve-Det
3/10/65	1400	3720#	3080#	+20.8	3860#	failed	-	-	-	-
	1500	4000	3340	+19.8	4660	4500	+ 3.6	8660	7840	+10.5
	1600	4700	3470	+35.4	5460	4720	+15.7	10160	8190	+24.0
	1700	5080	3670	+38.4	6850	6270	+ 9.2	11930	9940	+20.0
	1800	4580	3230	+41.8	6640	6530	+ 1.7	11220	9760	+14.9
	1900	4160	2760	+50.7	5700	5400	+ 5.6	9860	8160	+20.8
	2000	3240	1790	+81.0	3080	2930	+ 5.1	6320	4720	+33.9
	2100	2020	1000	+102.0	2320	2070	+12.1	4340	3070	+41.4
	2200	1820	1210	+50.4	2800	2340	+19.6	4620	3550	+30.1
	2300	1660	960	+72.9	2700	2680	+ 0.7	4360	3640	+19.8
	2400	1300	850	+52.9	1540	1600	- 3.7	2840	2450	+15.9
10-HOUR TOTAL		32560	22280	+46.1	41750	39040	+ 6.9	74310	61320	+21.2
3/11/65	0100	1000	710	+40.9	1020	1040	- 1.9	2020	1750	+15.4
	0200	560	360	+55.6	480	470	+ 2.1	1040	830	+25.3
	0300	380	260	+46.2	360	390	- 7.7	740	650	+13.8
	0400	280	280	0.0	240	240	0.0	520	520	0.0
	0500	300	190	+57.9	320	310	+ 3.2	620	500	+24.0
	0600	840	440*	+90.9	780	700	+11.4	1620	1140	+42.1
	0700	3620	1480*	+144.6	3260	2930	+11.2	6880	4410	+56.0
	0800	6820	3270*	+108.6	4700	4260	+10.3	11520	7530	+53.0
	0900	6260	6200	+ 1.0	4140	3800	+ 8.9	10400	10000	+ 4.0
	1000	4820	2850*	+69.1	3440	3210	+ 7.2	8260	6060	+36.3
10-HOUR TOTAL		24880	16040	+55.1	18740	17350	+ 8.0	43620	33390	+30.6
20-HOUR TOTAL		57440	38320	+49.9	60490	56390	+ 7.3	117930	94710	+24.5

\# - This figure is excluded from the totals.

* - The District indicates for these hours, "Operation of counter is suspect". One would doubt figures for many of the other hours, also.

Both the Ve-Det and the hose counts were recorded by Fischer & Porter counters. It is much more difficult to adjust the counter to properly record the highly variable pneumatic impulses received from hoses than the constant electronic impulses from Ve-Det counts.

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Exhibit 2

The Los Angeles Test
of the Inductive Loop-Detector-Counter System

Westbound on Santa Monica Freeway-LA 10, MP 11.03

4-HOUR COMPARISON OF TRAFFIC COUNTS BY COUNTING SYSTEM

Date	Qtr Hr Ending	Ve-Det Count	MANUAL # Lane 2	Lane 3	Lane 4	Lane 5	Total	Ve-Det % Diff	Hose Count	Ve-Det % Diff
3/10/65	1315	880	214	193	216	177	800			
	1330	960	268	244	220	214	946			
	1345	980	234	242	242	207	925			
	1400	1040	281	256	248	245	1030			
		3860	997	935	926	843	3701	+4.3	failed	--
	1415	1040	275	269	257	231	1032			
	1430	1160	292	278	268	281	1119			
	1445	1180	280	289	325	278	1172			
	1500	1280	322	312	310	328	1272			
		4660	1169	1148	1160	1118	4595	+1.4	4500	+3.6
	1515	1240	296*	306	296	311	1209			
	1530	1320	273*	328	353	365	1319			
	1545	1400	277*	326	323	393	1319			
	1600	1500	211*	370	355	436	1372			
		5460	1057*	1330	1327	1505	5219	+4.6	4720	+15.7
	1615	1620	384	370	380	462	1596			
	1630	1720	389	402	415	508	1714			
	1645	1720	401	396	427	518	1742			
	1700	1740	410	405	463	500	1778			
		6810	1584	1573	1685	1988	6830	-0.3	6270	+8.6
4-HOUR TOTAL		20,790	4807	4986	5098	5454	20,345	+2.2	--	--

* - The manual count for Lane 2 during this hour appears about 250 or more low. Compare it with Lane 3 before and after and with the Ve-Det count. No unusual activity was observed in this lane during this hour to affect the traffic.

\# - Lane 1 was not counted by Ve-Det, and it was subtracted from the hose count.

Note - It was not possible to get all counts 100% coordinated at the end of each time period.

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Exhibit 3

EQUIPMENT COST ESTIMATES FOR INDUCTIVE LOOP-DETECTOR-COUNTER SYSTEMS

	ITEM	LANES OF TRAFFIC	COST	QUANTITY PURCHASE DISCOUNT COST
(1)	Loop installation cost	2	$150-$300	-
		3	$200-$450	-
		4	$250-$600	-
(2)	Detector Units			
	(A) Ve-Det	2	$640	-
		3	$890	-
		4	$1140	-
	(B) Tacdet	2	$270	$230
(3)	Power Supply	-	$ 85	$ 75
(4)	Summator	2	$185	$165
		3	$200	$180
		4	$215	$195
(5)	Protective Container (per unit):			
	(A) Fisher & Porter counter cabinet		$ 50	-
	(B) Signal controller cabinet, type G		$300 } Salvaged	-
	(C) " " " type M		$600 } units may be	-
	(D) " " " type R		$800 } available	-
	(E) Specially constructed Box		$ 50-$100	
(6)	Counter (per unit):			
	(A) Fisher & Porter battery-powered		$650(a)	-
	(B) " " " AC		$590(b)	-
	(C) Streeter-Amet recording counter		$410(c)	-
	(D) Streeter-Amet Junior (transistored)		$ 65(d)	-
(7)	Connecting Hardware (per unit)		$ 10-$ 50	-
(8)	Power, conduits, platform, tiedown, etc. (one side of road)		$ 50-$500	-

	ITEM	4-LANE ROAD SET-UP		8-LANE ROAD SET-UP	
		QUAN.	COST	QUAN.	COST
(1)	Install loops	4 Loops	$300-$600	8 Loops	$500-$1200
(2)	Tacdet Units	2 2-Pak	$460	4 2-Pak	$920
(3)	Power Supply	2 Units	$150	2 Units	$150
(4)	Summator	2 4-Lane	$390	2 4-Lane	$390
(5)	Container	2 F&P Boxes	$100	2 F&P Boxes	$100
(6)	Counter	2 F&P Batt.	$1300(a)	2 F&P Batt.	$1300(a)
(7)	Hardware	Misc.	$20-$100	Misc.	$20-$100
(8)	Power, etc.	Misc.	$100-$1000	Misc.	$100-$1000
	TOTAL		$2820-$4100		$3480-$5160

ON HAND: (a) 285 units, (b) 32 units, (c) 162 units, (d) 446 units

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