Test tech: Check off each line upon satisfactory completion. Mark X for problem & describe on reverse.

1. Physical inspection

a) External
- * No dents or scratches, paint smooth
- * Perfect silkscreen, no voids or smears; straight
- * All 4 knobs line up perfectly with silkscreen (TUNE = 100 @ Cmax, LOAD = 100 @ Cmin)
- * All cover screw holes line up with chassis PEM nuts
- * Correct serial number XXYYzzzzz where...
  XX = last 2 digits of year (e.g., 94)
  YY = number of the week (i.e. 1-52)
  zzzzz = serial number beginning 10001 + n
  Example: Ser. no. 9446100008 = 1994 week 46, 91B #8
  Example: Ser. no. 9512101105 = 1995 week 12, 91B #105

b) Internal
- * All components & PCBs straight, tightly fastened
- * All parts correct, wiring accurate and neat
- * Solder joints shiny & smooth - per ETO workmanship man.
- * All HV and RF parts & wiring properly spaced & position
- * No flux, dirt, or cigarette smell on parts or chassis
- * All connectors tight & all cables routed & fastened ok
- * Mains taps set for 240V input; blower on 106V
- * Install transformer using 1 bolt (to ground the core)

2. Preliminary Operational Checks & Calibration

a) Leave cover off; disable HV crowbar; set OPER/STBY to STBY
- * Disconnect the transformer HV plug from the HV PCB

b) Connect AC input to 240V mains 220 V

c) Press POWER ON - There must be no response.
- * Connect high-Z voltmeter from CONTROL gnd to U4 pin 12

d) Disable the AC mains interlock switch

e) Press POWER ON and start timing --
- * step-start relay closes in less than ~1 second
- * blower running normally; normal air exhaust from tubes
- * red WAIT & amber STBY LEDs lighted
- * at 150 ± 2 seconds record voltage @ CONTROL U4 pin 12
- * move voltmeter to U4 pin 13 & adjust R31 (2.5 MIN ADJ) so voltage is identical with V in previous step
- * with multimeter on Ip, all LEDs must be dark
- * all RF OUTPUT, GRID & REFL POWER LEDS must be dark
- * measured with VOM, DC screen voltage is 370 ± 10V 368V
- * actual DC plate current = zero (meter @ HV FILTER R1)
- * on DISPLAY board, adjust R1 for 5.00 V at U5 pin 6
- * remove the AC interlock disable; all amplifier power must go off with no delay; replace interlock disable

f) DO NOT TURN ON AC MAINS POWER YET
- * on control board set ALC GAIN R16 to center of rotation
- * connect a variable DC power supply (at least 10 volts @ 1 ampere) in series with an accurate DC ammeter, from HV- to chassis across 10 ohm R1 (HV Filter PCB)

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g) Press 91B POWER ON and switch the multimeter to Ip
- * After 150±10 sec, WAIT must go dark & green STBY light
- * Turn on the external DC supply and adjust its voltage so the external amp meter reads exactly 1.0 ampere
- * Adjust the Ip meter pot so 91B multimeter reads 1.0 amp

h) Press 91B POWER OFF & turn the external DC supply OFF
- * Remove the external power supply but keep the wires connected across R1 for the next test

i) Press 91B POWER ON
- * Charge a 5000 uf electrolytic capacitor to 40-60 VDC
- * Connect the cap (+) side to the ground wire from R1
- * Firmly connect the cap (-) side to R1 wire from HV(-); 91B mains power should trip OFF immediately, proving that the Ip severe-overcurrent protection works ok
- * Connect an accurate HV voltmeter (≥ 3 kV) to HV supply
- * Re-connect the xfmr HV plug to the HV PCB

j) Press 91B POWER ON and wait for the STBY LED to light
- * W/multimeter in HV position; adjust control PCB R92 HV MTR so bargraph = actual HV (approx. 2850 VDC)
- * Switch STBY/OPR to OPR
- * Use jumper cable to short 91B T/R relay line to chassis
- * Connect CONTROL U4 pins 4-5; set R62 for 400-450 mA Ip
- * Remove pin 4-5 short & adjust CONTROL R61 for 50 mA Ip
- * Remove short from 91B T/R relay line

k) Connect 91B as normal to TS-950SD or similar modern xcvr which has low harmonic output (at least -40 dB)
- * Tune up 91B on 14 MHz into a good 50 ohm dummy load
- * Adjust drive so a good external wattmeter reads 1500W carrier (A0) RF output
- * CAREFULLY adjust the Prefl detector variable cap for lowest possible indication (~0) on Prefl bargraph
- * Adjust DISPLAY R3 so the first red RF OUTPUT LED just flickers (but is not fully lighted)
- * Adjust TUNE and LOAD controls so the amplifier can just be driven to 1750-1800 W Pout before flattopping.
- * Adjust CONTROL R68 so the lighted TUNE LED is directly below or just slightly left of the TUNE V indfex
- * Set drive to 25 watts; measure V at CONTROL U2 pin 5
- * Adjust CONTROL R52 for exactly the same V at U2/pin 6
- * Set drive to 50 watts; mis-adjust LOAD setting and/or TUNE setting until Po drops to 500W
- * Carefully but quickly adjust CONTROL R8 to fault amp
- * Adjust drive until Ip = 1.0 amp; adjust CONTROL R49 so voltage at U2 pin 8 = 2.50 V.
- * Connect a voltmeter from ground to CONTROL U4 pin 2.
- * Set drive ~75W & use the external voltmeter across 10 ohm R1 in HV- lead to mistune amp until Ip = 1.6 A
- * Quickly adjust CONTROL R25 to set that same voltage at U4 pin 3 and immediately return exciter to standby

} EXT P.S

- * Connect a load of SWR 2:1 to 3:1 to the amplifier.
- * Apply excitation (≤ 50W) and TUNE/LOAD amp for Prefl = 300W on the external RF meter; Carefully adjust CONTROL R110 to fault amplifier at that level. SWR 3:1

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l) Disconnect all 91B connections to the transceiver
* VERY CAREFULLY connect the 91B chassis to HV (+) through a big (100W) 1200 ohm resistor
* Confirm that Ip ~2A, HV ≥ 2 KV, & amp -> STBY in ~4 sec
* VERY CAREFULLY connect chassis to HV (+) through a big 500-600 ohm resistor (Ip ~4A)
* Amp must hard-fault immediately to mains-power OFF

m) Confirm that DC output from screen filter cap is 420-450V 431
* Connect chassis to screen supply out output through a 5k/50W resistor; voltage should be ≥ 375VDC 173mA
* IF THE AMP HAS THE SCREEN CURRENT LIMITER INSTALLED...
* THEN connect chassis to current limiter output through a 2-2.5k/25W resistor and a DC milliammeter; current through R must be ≤ 120 mA 2,5K

3) RF Tests

a) Install 91B top cover with 4-5 screws
b) Connect 91B to TS950SD transceiver and via a NYE or Bird wattmeter to a good 50 ohm dummy load
c) With 91B in STBY mode, apply 100-150W @ 14 MHz and confirm that RF OUTPUT bargraph reads ~correctly and load SWR shown by transceiver is 1.1 : 1 or better.
d) Disconnect the load and feed ~100W to 91B input. Confirm that both RF OUTPUT and Prefl bargraphs read ~100W
e) Re-connect dummy load to 91B and press OFR
f) Set xcvr & 91B to 7 MHz; set xcvr to LSB; preset all 91B controls to "normal" positions for 7.1 MHz
g) Disconnect mike and set 91B multimeter to Ip
h) Switch xcvr to XMIT; 91B Ip meter should be dark or 1 LED
i) Set XCVR to RCV and CW mode, RF output controls to minimum
j) Go to XMIT; 91B should show Ip ≥ 400 mA @ drive ≤ 1W
k) Switch 91B multimeter to TUNE; increase drive to ~10W
l) Adjust TUNE to move TUNE LED as far left as possible
m) Adjust LOAD to move TUNE LED under the "V" or slightly left
n) Repeat l) and m) until LED remains under the "V" after TUNE
o) Increase drive until RF OUTPUT ~1.7 kW (mains still 240V?)
p) Record RF OUTPUT meter reading when NYE reads 1.50 kW AVG 1900W
q) Record Prefl meter reading, if any 0
r) Check Ip; should be ~1.0 ± 0.1 amp 1.0A
s) Check HV; should be 2300-2400 VDC 2400V
t) GRID green LED should be partly lighted; red must be dark
u) Apply USB voice excitation until NYE meter shows 1.5+ kW peak-and-hold; drive must be 50-65W peak-and-hold
v) If possible check with scope for no flat-topping @ 1.7 kW
w) Find TUNE meter setting for 2.2 kW Po; record As "LED #__"
x) Record all TUNE, LOAD & Ip in amplifier's permanent record
y) Reduce drive to minimum; change amplifier band but do not retune; increase drive on original band and record level at which low gain/arc fault occurs. 17W
z) "Touch up" the main pi coil, spacing right-hand 4 turns so the TUNE cap dial is at ~15% when tuned properly for ~1.6 kW Pout on 21.45 and 29.7 MHz

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aa) "Burn in" amp at least 8 hours at 1.6 kW peak output on 29 MHz CW, keyed ~50% duty cycle, mains voltage 250 V 50 Hz or 260V 60 Hz. Must pass all tests after burn-in.

bb) REPEAT steps c) - r) @ 1.8, 3.7, 7.1, 10.1, 14.2, 18.1**, 21.45, 24.9 & 29.7 MHz

** First confirm that 91B won't remain in OPR if driven on any 18-29.7 MHz band; then temporarily disable BAND LOCK to complete those tests. Restore BAND LOCK.

cc) Keep permanently a test record for each amplifier showing all TUNE & LOAD settings for each band and also describing any test result that was not normal

dd) Observe RF OUTPUT, Prefl, & Ip bargraph movements during SSB voice and keyed CW operation for normal dynamics

ee) Is TUNE meter adjustment consistent (stable) on all bands? Tune amp using TUNE meter per instructions; should result in same gain +~5% @ 1.7 kW output on all amateur bands

ff) Check T/R "hot switching" interlock functions on 1 band:

* go to key-down CW transmit @ ~500W RF Output
* unplug T/R line from amplifier (must remain in xmit)
* reduce CW drive slowly; 91B must go to RCV @ ≤1W Pin
* increase CW drive to ~50 W; plug the T/R line back in; amplifier must NOT go to XMIT

gg) Adjust RF input coil for SWRin ≤ 1.3 all bands (per Phil)

hh) Every amp must operate for ≥ 5 minutes at 1.5 kW carrier @ lower edge of each amateur band with no overheating

ii) Every amp should be tested for normal operation (one band ok) on 120V mains, if possible.

jj) Wires (A) and (B) to the mains tap-change strip should be clearly labeled (A) and (B) to avoid customer confusion

kk) Must be NO audible rattle or irregular noise from blower; only a very smooth "air" sound in quiet room acceptable

ll) No abnormal hum or buzz from xfmr at full or partial load.

4) Tests to be conducted at ETO for product acceptance of 3 pilot models, <u>at least</u> one production amp from each group of 10 for the first 50 units, and on a spot-test basis thereafter:

a) 2-tone lin. IM3 & IM5 at 3.8, 7.15, 14.2, 21.2 & 28.5 MHz
Must use exciter with 3rd & 5th order IM at least -35dB relative to either of 2 equal tones. Must meet -30dB

b) T/R timing during CW QSK
1) Close key @ t=0; Kout closure @ ____ ms, Kin @ ____ ms
2) Open key @ t=0: Kin opens @ ____ ms, Kout @ ____ ms
3) Both must have safety margin ≥ 200 us (or???)

IMPORTANT NOTE: ANY test result which does not meet specifications or in any way appears "unusual" or "abnormal" must be noted on the amplifier's permanent record by the tester. These records should be reviewed by another technician or manager before the amplifier is released for shipment to ETO or to a customer.

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DATA AND NOTES

1) RF OUTPUT BARGRAPH reading at 14 MHz & 1.50 kW = 1500 W

2) Pref1 BARGRAPH reading @ 14 MHZ, 1.5 kW -> 50 ohms = 0 W

3) INTERMODULATION TESTS

Exciter (60W PEP) IM3 @ 14 MHz = -_____ dB ref. either tone

IM5 = -_____ dB

Amplifier (1.5 kW) IM3 = -_____ dB ref. either tone

IM5 = -_____ dB

4) HARMONIC OUTPUT @ 1.7 KW AØ RF OUTPUT:

1.8 MHz	-____ dBc	3.95 MHz	-____ dBc
7.3 MHz	-____ dBc	10.12 MHz	-____ dBc
14.3 MHz	-____ dBc	18.12 MHz	-____ dBc
21.4 MHz	-____ dBc	24.95 MHz	-____ dBc
28.5 MHz	-____ dBc	29.7 MHz	-____ dBc

4) AMPLIFIER TUNING & GAIN DATA @ 1.7 KW (OPTIMUM) Pout

	FREQ, MHZ.	TUNE	LOAD	DRIVE, W	GAIN, dB
*	1.80	05 68	1132	60	1600
	3.50	84 84	2842	60	1700
	~~4.00~~	~~62~~	~~61~~	~~60~~	
	7.15	5558	2428	55	1800
	10.12	7778	5862	57	1800
	14.15	3940	5056	60	1800
	18.1	7074	5052	60	1700
	21.45	2323	7072	60	1600
	24.90	6470	6062	65	1600
	29.70	1520	7880	60	1400
	28.	36	74		1400

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* Add cap 150 pF across C1 on PADCAP PCB