DATE [illegible]/62 SHEET 1 OF [illegible]	TMC SPECIFICATION NO. S - 713	D
N.P. COMPILED / N.P. CHECKED	TITLE: FFR TEST PROCEDURE (F.A.A.)	
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FFR TEST PROCEDURE

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M

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I. Purpose:

To provide the procedure for aligning and testing the Model FFR so as to obtain the best possible performance for a communication receiver.

II. Test Equipment Required:

A. Standard Signal Generator, Measurements Model 82 or 65-B.
B. Distortion Analyzer, Barker & Williamson.
C. VTVM (audio type), Ballantine 314.
D. VTVM, (dc type), RCA Voltohmyst or H.P. 410B.
E. Frequency Counter, Hewlett Packard Model 524A.
F. 455 Kc crystal.
G. 600 ohm 5 watt resistor.
H. Variable DC voltage source, 0 to $\pm 4\frac{1}{2}$ volts.
I. Headset.
J. 15,000 ohm resistor, 10 watt.
K. 2,500 ohm 75 watt resistor.
L. Line cord with insulated alligator clips at one end.
M. Oscilloscope Tektronix Mod. 515 or equivalent.
N. Crystal Calibrator Mod.111-B.

III. Procedure, FFR Main Chassis:

A. Pre-assembly Test (To be used for trouble shooting.)

1. Power Supply: DANGER HIGH VOLTAGE

Insert tubes, 5Y3 GT and OA2 into V-108 and V-109 sockets. Place power unit upside down on a non-conducting work bench. Short out the two white leads and insulate from chassis. (Locate these leads coming out of grommet hole behind power transformer.) Check that all exposed ends of cable leads are not shorting with each other.

2. Test A - Resistance Test

Using V.T. Ohmeter, check resistance at following points and compare with nominal values.

TEST POINT	NOMINAL VALUE
a. transformer primary, white & grey leads near rectifier tube V-108	2 ohms
b. R-149 between chassis & terminal 12 of transformer	540 to 660 ohms
c. junction of L-101 and C-149B to gnd.	70,000 ohms
d. pin no. 1 of V-109 to gnd.	70,000 ohms

3. Test B - DC Voltages

Connect the line cord clips to the white & grey transformer primary leads near Rectifier socket V-108, and pull rubber insulation over connection to prevent possible short. Next connect 15,000 ohm resistor between pin 1 of V-109 to gnd. and the 2,500 ohm 75 watt resistor from junction of L-101 and R-148 (5,000 ohms) to gnd. These two resistors will provide sufficient load to simulate receiver loading.

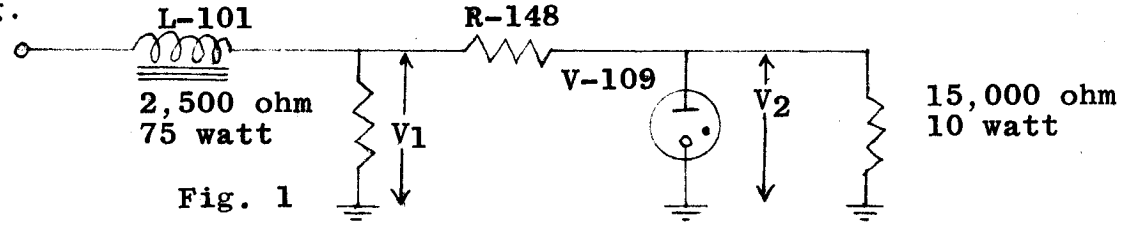

Fig. 1

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Plug line cord into power socket and measure DC & AC voltages at following test points.

Test B- DC Voltages

Test Point	Nominal Value
V_1	+ 225 to 240 Volts
V_2	+ 150 Volts
V_3- across R149 or terminal 12 of power transformer to ground.	-50 to -65 Volts
V_4- 4 brown leads in cable to gnd.	+6.3 to+6.8 V for each lead to gnd.

Test B- AC Voltages

V_5 filament voltage across short pair brn leads	6.1 to 6.5V RMS
V_6 " " " long " " "	6.1 to 6.5V RMS
V_7 pin no 4 of V-108 to gnd	360 to 380V RMS
V_8 pin no 6 of V-108 to gnd	360 to 380V RMS
Across transformer terminals 7 and 14	4.7 to 5.2V RMS

B. Post assembly test (Prior to alignment)

1. Set controls as follows;

Audio Gain----------fully clockwise
AVC Manual Switch----------AVC
Noise Limiter Switch----------On
BFO Switch----------On
BFO Slave Master Switch----------BFO
Line Cord Disconnected

2. AVC line check. On terminal board E-101 with terminals 7 & 8 shorted, measure resistance from 7 to ground. Compare with following approximate values (AVC switch to MANUAL):

RF Gain counterclockwise Resistance 120K ohms approx.
AVC Switch in AVC position, Resistance 1.4 meg.

3. Voltage check:

(a) Connect line cord
(b) Measure filament voltage:
AC 6.1 to 6.5 VRMS across filaments
DC +6.3 to +6.8 VDC from each filament to grnd.
(c) Measure B+ voltages. (±10%)

Tube Sockets	Socket Pin Numbers 1	2	5	6	9
V-100			215	70	
V-101			215	70	
V-102			215	70	
V-104					125
V-105		16	250	250	
V-106	50	50			
V-107			150		

Multiple Connection Socket (J-107)

Pin	Voltag
1	+250 VDC
4	+150 VDC
2	+6.3 VDC
5	+6.3 VDC
2-5	6.3 VAC

C. I.F. Alignment

1. Alignment of the I.F. channel requires an accurate 455 Kc signal source. Plug the 455 Kc. crystal in the BFO circuit (Y-100 on the schematic) and set the BFO Master-Slave switch to the Xtal position. Connect the equipment as follows:

(a) Connect 600 ohm load across Audio Output Terminals;

(b) Plug headset into phones jack;

(c) Connect the AC-VTVM across Detector Terminal and ground at rear of receiver;

(d) Connect the standard signal generator to pin A2 of Multiple Connection Socket.

2. Set Receiver Controls:

(a) R.F. Gain fully on; AVC to MANUAL.

(b) Noise limiter switch off;

(c) Audio Gain fully on;

(d) B.F.O. switch off.

3. Set signal generator to 455 Kc. modulated with 1000 cycles at 30% and inject enough voltage into receiver to produce audible signal.

4. Tune I.F. transformers T-101, T-102, T-103 for maximum output.

5. Turn B.F.O. switch to ON.

6. Remove modulation from 455 Kc. output of signal generator.

7. Tune signal generator until zero beat is obtained in FFR and leave generator frequency set.

8. Turn B.F.O. switch to OFF position.

9. Re-establish 1000 cycle 30% modulation of signal generator.

10. Retune I.F. transformers for maximum meter deflection. Keep generator input low so as to produce 1 volt A.C. on meter.

11. Adjust C-100 so a signal of 115 microvolts produces 1 volt A.C. on meter, with 47 ohm load on IF out J100.

D. Audio Amplifier:

1. With Audio Gain set to Maximum measure voltage across 600 ohm load with AC-VTVM.

2. It should be MIN. 34.6 volts or 2 watts.

3. Check operation of Audio Gain control observing change of output.

NOTE: Input of 115uv should produce 1.0v ±10% across detector load and 34.6v minimum across 600 ohm output. Readjust C100 to meet these requirements.

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4. Distortion check:
(a) Connect distortion meter across 600 ohm output resistor;
(b) With 2 watts output of FFR the distortion should be less than 10%.
5. Hum level with RF Gain counterclockwise and Audio Gain at maximum read AC - VTVM across 600 ohms. Voltage should be lower than .016V RMS or 34 db below zero dbm (0.775V.) and 66db below 2 watts. When taking hum measurements, disconnect signal generator.

E. B.F.O.
1. Turn B.F.O switch ON;
2. Zero beat generator against 455 Kc crystal in FFR;
3. Switch B.F.O. SLAVE-MASTER switch to BFO position;
4. Set BFO pitch control to zero position, capacitor C137 plates in mid-position; (Cover should be placed over oscillator section):
5. Tune BFO coil L103 to obtain zero beat;
6. Measure BFO pitch with audio frequency counter connected across 600 ohms output load.
7. Pitch should vary ±2 Kc. or greater.

F. B.F.O. Reactance
1. Connect an Audio Frequency meter across 600 ohms output resistor.
2. Connect to pins 7 and 8 of E102 a DC voltage source which is variable from zero to ±4.5 volts.
3. Leave BFO control voltage set to zero.
4. Tune signal generator to obtain zero beat.
5. Set DC control voltage to +4.5V and observe reading on frequency meter.
6. Set DC control voltage to -4.5V and observe reading on frequency meter.
7. Adjust reactance tube balance control R136 to obtain balanced frequency shifts, approximately ±3KC.
8. Recheck Part E, steps 1 to 7.

G. B.F.O. Output
1. Using RF - VTVM, measure RF voltage from BFO output jack J104 on rear of receiver.
2. Should be 1v ±10%.

H. Noise Limiter
1. Operation of Noise Limiter switch should produce a clipping of sine wave output as viewed on scope across 600 ohm output.

I. A.V.C.
1. Place DC - VTVM on AVC terminal of E101 pin no. 4.
2. Place AVC manual switch to AVC.
3. Increase signal generator output and look for a negative deflection of VTVM.

J. RF Gain
1. Operation of RF gain control should reduce the output of the receiver with the AVC switch on or off.

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K. I.F. Selectivity

1. Connect the standard signal generator thru a variable attenuator to pin A2 of Multiple Connection Socket. Connect counter to generator output.
2. Connect DC-VTVM to detector load of receiver.
3. Set variable attenuator to 66 db.
4. Set signal generator to 455KC and inject enough voltage into receiver to produce 3 volts on the DC VTVM.
5. Remove 6 db from the variable attenuator, increase the frequency of the signal generator above 455KC and note the frequency at which the detector voltage returns to 3 volts.
6. Decrease the frequency of the signal generator below 455 KC, note the frequency at which the detector voltage returns to 3 volts. Subtract the two frequencies to obtain the 6db bandwidth. Should be 5KC minimum.
7. Repeat steps 5 and 6 using 60db instead of 6db, to obtain the 60db bandwidth. Should be 25KC minimum.

IV. RF Tuning Drawers

A. Pre-alignment check.

1. Insert tuning drawer in FFR receiver chassis and turn power ON.
2. Measure voltage at following points:

(a) Using AC-VTVM measure all filament voltage at tube socket pins. Should be 6.1 - 6.5 VRMS.

(b) Using DC-VTVM measure voltage from filament to ground. Should be +6.3 to +6.8V DC.

(c) Measure DC plate and screen voltage to ground.

Drawers 5, 6, 7, 8.

TUBE	PIN NO.	APPROX. DC VOLTAGE
V(5)00	5	+150
	6	+ 60
V(5)01	5	+150
	6	+ 60
V(5)02	5	+112
	6	+112
V(5)03	5	+ 95
	6	+125
V(5)04	5	+ 60
	6	+ 90

Drawers 1, 2, 3.

TUBE	PIN NO.	APPROX. DC VOLTAGE
V(1)00	5	+130
	6	+ 50
V(1)01	5	+130
	6	+ 50
V(1)02	5	+240
	6	+240
V(1)03	5	+100
	6	+130
V(1)04	5	+ 85
	6	+ 75

B. Align IF Transformer:
1. Connect signal generator to J101 HFO IN jack on rear chassis.
2. Place HFO MASTER-SLAVE switch in EXT. position.
3. Tune signal generator to 455 Kcs. and align the IF transformer in tuning drawer according to section IIIC-IF alignment, neglecting Part 11.

C. Align Crystal Filter Tuning Drawer 1, 2, 3:
1. Equipment Required:
   (a) Sweep signal generator
   (b) Oscilloscope
2. Equipment Set-up:
   (a) Connect scope vertical plate input to FFR detector terminals.
   (b) Connect sweep generator sweep output to scope horizontal plates.
   (c) Connect sweep RF output to mixer grid, pin 1 of V(1)02.
3. Receiver Controls:
   (a) RF gain fully ON.
   (b) Noise limiter switch OFF.
   (c) Audio gain - as desired.
   (d) BFO switch OFF.
   (e) MASTER-SLAVE switch on tuning drawer to EXT.
   (f) Bandwidth control to normal.

4. Alignment:
   (a) Set scope horizontal gain fully clockwise with amplifier switch in 1st amplifier position.
   (b) Set sweep generator deviation control to give two or three inch scope trace width.
   (c) Center sweep generator frequency on 455 Kc.
   (d) Set sweep generator output voltage to give a vertical trace of approximately 4 inches with scope amplifier in its most sensitive position. Adjust sweep output to prevent receiver overload.
   (e) Tune primary and secondary of T(1)03, top and bottom slugs, for an increase of 455 Kc.peak display.
   (f) Set bandwidth control to 1.3 Kc. position.
   (g) Tune slug of L(1)01, filter output tank, for a maximum peak. Retune primary and s condary slugs of T(1)03.
   (h) Adjust C(1)23 for symmetrical wave from. Approximate setting is at mid-position. As this trimm r is vari d from maximum to minimum capacity using an insulat d scr w driver, a notch should app ar first on on side slope, disappear and appear on the other side. If the p ak incr as s or d cr ases with no apparent notch, the tun d circuits are not on the crystal fr qu ncy. Repeaking of T(1)03 and

L(1)01 is necessary.

(i) As the Bandwidth Control is reset to its other positions the peak should become narrow r with a decrease in amplitude.

(j) Check Bandwidths using standard signal generator method.

D. Equipment Set-Up:

1. Connect appropriate attenuator pad to FFR to match signal generator to receiver. (50/70 - 20 DB).
2. Receiver set-up
   (a) BFO switch to OFF.
   (b) AVC switch to manual.
   (c) RF gain fully ON.
   (d) Audio gain - as desired.
   (e) Noise limiter OFF.
   (f) HFO - MASTER-SLAVE switch to HFO.

E. H.F.O. Oscillator:

1. Tune signal generator and FFR tuning dial to high frequency end of band. Check RF and HFO Alignm nt Chart (Fig. 2) for correct alignment frequ ncy.
2. Adjust H. F. O. trimmer for correct signal. Check for proper placement of image which should be found by tuning signal generator 910 Kc. above receiv r frequency.
3. At low frequency end of band in use, adjust H. F. O. coil tuning slug.
4. Check for proper placement of image.
5. Again recheck oscillator at high end.
6. Connect crystal calibrator to ANT & repeat low & high end alignment & trackin

F. R.F. Alignment

1. With receiver dial tuned to high end of band adjust the three R.F. coil trimmer capacitors for maximum signal on output meter. As each tank is tuned reduce signal voltage to keep output below 1V.

NOTE: When tuning mixer, two peaks may be obtained. Correct peaks found at maximum trimmer capacity setting.

2. Tune receiver and generator to low end and tune the three R.F. coil tuning slugs for maximum output.
3. Retune both ends adjusting also the R.F. oscillator as the tuning of the mixer section may introduce some pulling on the oscillator frequency.
4. Recheck band for alignment and tracking.

G. I.F. Rejection

With receiv r tuned to high end of band check receiver for sensitivity at 455 Kc. Rej ction should be 60 db or b tter. Band 3 tuning draw r (200 - 400 Kc) must

be checked at 400 Kc. with the bottom cover in plac . If rejection is under 60 db., the antenna filter choke coils can be moved closer or further away from the chassis to tune filter.

H. Signal to Noise Ratio:
1. With no signal, measure the noise voltage developed across the 600 ohm load, (Use Ballantine Met r).
2. Multiply this voltage by 3.16.
3. Tune in a signal and adjust the signal level to obtain an output equal to 3.16 times the noise voltage. The strength of signal is the sensitivity to produce a 10 db signal to noise power ratio. Should be less than 1 uv.
4. Enter this figure on the tuning drawer test sh et.

I. Sensitivity:
1. The output of the signal generator in step H.3 is the sensitivity at 10 db signal to noise p w r ratio. Record data on Tuning Drawer Test Sheet. Should be less than 1 uv.

J. Image Ratio:
1. Tune the generator to the image frequency and note the sensitivity to produce the same voltag at the detector as in Step H.3.
2. Divide this image sensitivity by the sensitivity reading in Step I.1 to obtain the image ratio.
3. Convert this ratio to db and record on Tuning Drawer Test Sheet. Should be 60 db (50KC - 15MC) and 40db (16MC-32MC).

L. Reactance Tube Shift:

1. Connect a variable DC voltage source ±4.5 volts to pin 1 and 2 of E102 terminal board on rear of receiver.
2. Use the TMC VOX or other accurate signal generator as signal source where small changes in frequency can be read.
3. Turn BFO switch ON.
4. Set HFO reactance control voltage to zero.
5. Tune signal generator and FFR to midband test frequency.
6. Tune for zero beat.
7. Set HFO control voltage to +4.5V.
8. Retune signal generator to obtain zero beat and note frequency shift.
9. Set HFO control voltage to -4.5V.
10. Retune signal generator to obtain zero beat and note frequency shift.
11. Compare total shift obtained with Fig. 3. If inadequate, adjust HFO reactance tube balance located in tuning drawer. (C-( )23)
12. Check HFO shift at both ends of band and adjust as required.
13. Enter shift obtained in test sheet.
14. Retuen oscillator at both ends of band with reactance voltage zero.

M. HFO Output:
1. With a RF - VTVM measure the voltage available at the HFO output jack on the rear of the FFR chassis.
2. Enter this data on the test sheet.
3. Turn HFO MASTER-SLAVE switch to Xtal position.
4. Place appropriate crystal in socket on front of tuning drawer.
5. Note output voltage on HFO jack.

N. A.V.C. Check:
1. Turn AVC manual switch to AVC and RF GAIN control to full clockwise position.
2. Connect Ballantine meter across 600 ohm output and switch to 1 volt scale.
3. Adjust signal generator for 1 microvolt out and AUDIO GAIN control for 0 db on the Ballantine meter.
4. Check db output at [redacted] uv. Should remain within 12db. Record data on Tuning Drawer Test Sheet.

O. Overall Selectivity
1. Connect the Sig.Gen. thru variable Atten. to antenna input of the receiver. Connect counter to generator output.
2. Connect DC VTVM to detector load of the receiver.
3. Using any band 5, 6, 7 or 8 tuning drawer adjust signal generator until voltage at the detector is 3 volts.
4. Increase output of signal generator by 6db, increase frequency and note frequency at which the detector output returns to 3 volts.
5. Now decrease the frequency to the lower side of the receiver response curve and note the frequency at which the detector output returns to 3 volts.
6. Subtract the two frequencies noted in steps 4 and 5 to obtain the 6db bandwidth of the receiver. Should be 5KC (-10%) minimum. See Fig. 2A for BW of other FFRD's.

P. A test sheet is to be filled out for each tuning drawer and signed by the tester.

ALIGNMENT CHART

FIG. 2

BAND	OSC.	MIX.	R.F.	ANT.
1	50 Kc 100 Kc	50 Kc 100 Kc	50 Kc 100 Kc	50 Kc 100 Kc
2	100 Kc 200 Kc	100 Kc 200 Kc	100 Kc 200 Kc	100 Kc 200 Kc
3	200 Kc 400 Kc	200 Kc 400 Kc	200 Kc 400 Kc	200 Kc 400 Kc
3M	485 Kc 515 Kc	485 Kc 515 Kc	485 Kc 515 Kc	485 Kc 515 Kc
5	2.0 Mc 4.0 Mc	2.1 Mc 4.0 Mc	2.1 Mc 4.0 Mc	2.1 Mc 4.0 Mc
6	4.0 Mc 8.0 Mc	4.25 Mc 8.0 Mc	4.25 Mc 8.0 Mc	4.25 Mc 8.0 Mc
7	8.0 Mc 16.0 Mc	8.5 Mc 16.0 Mc	8.5 Mc 16.0 Mc	8.5 Mc 16.0 Mc
8	16.0 Mc 31.0 Mc	16.0 Mc 31.0 Mc	16.0 Mc 31.0 Mc	16.0 Mc 31.0 Mc

NORMAL SELECTIVITY

FIG. 2A

(Approximate Values)

BAND	FREQ.	6DB POINTS
1	50 KC 100	2 KC 4
2	100 200	2.5 4.3
3	200 400	4.1 4.8
3M	500	3.8
5,6, 7,8	2 to 32MC	5

NOTE:

On the low freq. heads (FFRD 1,2 & 3) the BW control provides 4 positions of selectivity, one normal as indicated and three narrow positions of 1.3KC, .5KC and .3KC.

FIG. 3

H.F.O. REACTANCE TUBE SHIFT

BAND	TOTAL FREQ. SHIFT / Mc	FREQ.	TOTAL SHIFT
1	Min shift of 4 Kc throughout the band	50 Kc 75 Kc 100 Kc	4.0 Kc 4.0 Kc 4.0 Kc
2	"	100 Kc 150 Kc 200 Kc	4.0 Kc 4.0 Kc 4.0 Kc
3	"	200 Kc 300 Kc 400 Kc	4.0 Kc 4.0 Kc 4.0 Kc
3M	Min shift of 6 Kc throughout the band	485 Kc 515 Kc	6.0 Kc 6.0 Kc
5A	4 Kc/Mc	2 Mc 3 Mc 4 Mc	8 Kc 12 Kc 16 Kc
6A	4 Kc/Mc	4 Mc 6 Mc 8 Mc	16 Kc 24 Kc 32 Kc
7A	3 Kc/Mc	8 Mc 12 Mc 16 Mc	24 Kc 36 Kc 48 Kc
8A	Min shift of 32 Kc throughout the band	16 Mc 24 Mc 31 Mc	32 Kc 32 Kc 32 Kc
7B	Min shift of 8 Kc throughout the band	8 Mc 12 Mc 16 Mc	11.2 Kc 16.7 Kc 22.4 Kc
8B	Min shift of 8 Kc through the band	16 Mc 24 Mc 31 Mc	16 Kc 24 Kc 32 Kc

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MODEL FFRD_____

SERIAL NO._____

MFG. NO._____

	LOW FREQ.____Mcs.	MID FREQ.____Mcs.	HIGH FREQ.____Mcs.
SIGNAL TO NOISE RATIO	uv	uv	uv
IMAGE RATIO	db	db	db
SENSITIVITY AT 10 db SIGNAL TO NOISE RATIO.	uv	uv	uv
REACTANCE TUBE SHIFT	Kc	Kc	Kc
OSC. OUTPUT (J-102)	V.	V.	V.

A.V.C.

INPUT	1 uv	10,000uv
OUTPUT	db	db

XTAL OSC. OUTPUT (J-102)_____VOLTS

HFO INPUT _____

SELECTIVITY_____KC.

I.F. REJECTION_____DB.

BY:_____

DATE:_____

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SERIAL NO._____ MFG. NO._____

I.F. SENSITIVITY: INPUT_____uv.

ADJUST FOR 115 uv._____OK.

I.F. OUTPUT (J-100)_____V.

AUDIO GAIN_____OK.

AUDIO OUTPUTS: 600 OHMS_____V.

8 OHMS_____V.

PHONES_____V.

HUM LEVEL_____V.

DISTORTION_____%

B.F.O.: XTAL_____OK.

VARIABLE_____OK.

B.F.O. REACTANCE TUBE SHIFT ±4.5 V_____Kcs.

B.F.O. OUTPUT (J104): XTAL_____V.

VARIABLE_____V.

B.F.O. INPUT_____OK.

NOISE LIMITER_____OK.

A.V.C._____OK.

R.F. GAIN_____OK.

I.F. SELECTIVITY 6DB_____KC.

60DB_____KC.

TESTED BY_____.

DATE_____.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 459M

REVISION SHEET

THE TECHNICAL MATERIEL CORP.
MAMARONECK NEW YORK

S-713
LIST NO.

DATE	REV.	SHEET	EMN #	DESCRIPTION	APP.
5/8/63	A	10, 11	8983	Revised per EMN #8983	
8/30/63	B	---→	9878	Revised Sheets 3,4,5, 6,9 per EMN	
6/6/66	C	all	16319	Revised per EMN	
12/16/66	D	10	17511	Revised per EMN	