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BOEING

SEATTLE, WASHINGTON

X-20 TERMINATION

MANUFACTURING

SUMMARY

Contract No. AF 33(657)-7132
December 15, 1963

35.39

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X-20 AIRBORNE TIS STATUS

This report is intended to provide a narrative description of the status on the major elements of the subject system at the time of work stoppage on December 13, 1963. This report, along with the latest X-20 production status reports issued by Production Control, should provide a fairly complete status of the program.

I. PCM SUBSYSTEM

A. PCM Deck Sub Assembly (81-[illegible]0X)

Assembly was not started. Assembly planning, drawings, and tooling were 95% complete. The deck wiring was broken down into 8 harnesses and the tooling aids to produce the harnesses were nearly complete. Termination of the harnesses utilized some 30 different crimp on contacts and this special tooling was in the house. All material lists were complete for the systematic withdrawal of material from the production stockroom.

The only major material item missing was the deck casting.

The PCM deck test equipment, TE-9552-310, consisted of a DIT-MCO automatic circuit tester and cabling. The DIT-MCO was on hand and the cables were 50% complete.

B. PCM Power Supply (81-[illegible]0X)

1. Top Assembly (502059)

This unit was not started in assembly. Because of a redesign effort manufacturing planning and tooling were delayed. The assembly replanning and tooling effort by Manufacturing Engineering was about 80% complete at the time of work stoppage. The wire wrap tooling had been procured and was on hand and the techniques for split pin wire wrap were perfected. Reference: Process Standard PS-901556. The crimp tools for the power cable were in the house and material draw sheets were complete.

The power supply test equipment, TE-9552-305, was complete. The module test procedure was not complete.

2. Modules

Except for module #9 (402086), none of the modules were assembled. Mylar films became obsoleted and were scrapped because of the engineering redesign of modules #1 through #8 and #11. Module #10 was deleted.

The first stycast potting for the fuseholder was complete and machined and the next potting operation was complete.

TE-9552-305 was the test set for these modules.

Of the 31 test procedures which were required, 6 were incomplete.

C. ADC/Programmer (81-[illegible])

1. Top Assembly (5020[illegible])

Assembly was not started. The Manufacturing Engineering drawings, tooling, and planning were complete and the molds and crimp tools were in the house. Material draw sheets were complete and available. Manufacturing drawings for the complex cable which was to be wire-wrapped into the programmer were complete. Mylar positioning films were photographed and in the process of being inspected.

The finished unit was to be tested by Engineering.

2. Modules

a. Switch Modules [illegible]-[illegible]30X-1 through -9.

The low level and high level switch module assembly work consisted of punching the submodule mylars and the wiring matrices. This phase of assembly was near completion. Transformer shortage was the gating item which prevented further assembly effort. PCM transformers which were being built at EMR, Sarasota, were in process. All transformer material was on hand, tooling was in the house, and about 10 assemblers were in the process of assembling and potting the units. Production problems relating to the stripping of insulation on the fine (#39) coil wire were solved for the 9 different types of transformers. Reference: EMR Project 411311**-411317** schedule published by Production Control on 11-13-63.

Manufacturing Engineering completed the assembly processing and tooling for the modules and submodules.

The TE-9552-140 and (2) TE-9552-168 test sets were complete. Out of 18 test procedures required, 6 were complete with the remainder in the process of being written.

TE-9552-100 was complete and in operation (Dymec Automatic Component Selection and Data Logging Test Set). All test procedures pertaining to this effort were complete.

b. Programmer Modules (501013 through 501019)

These programmer modules, commonly termed "Programmer Components #1 through #7," were in various stages of assembly. The assembly processing and tooling were 100% complete and assembly was under way on the 501012-1 and 501013-1 submodules, and 46 of the 401181 Dual [illegible] Gate submodules were being tested.

The remaining modules and submodules were not yet started in assembly.

The TE-9552-142 test set was 90% complete and 2 of the 14 test procedures required were finished. (Most of the programmer modules could be tested at the 90% level of test set completion.)

c. Calibrate and [illegible] Modules (501019)

Assembly planning and tooling were complete and assembly of submodules was in process. Of the 30 submodules, 6 were in the process of being tested and the remainder were in various stages of assembly. The module matrix was also being assembled and welded.

Two (2) test sets, TE-9552-167 and -170, were used for module and submodule testing. The -167 test set was complete and the -170 test set was 85% complete.

Of the 11 test procedures required for submodules, 9 were complete and the test procedures for the modules were incomplete.

d. Sample and Hold Module (501020)

Assembly, planning and tooling were complete. Of the 18 modules, 8 were in test and the remainder in various stages of welding assembly. Material shortages due to engineering changes halted production on 6 modules.

Test Sets, TE-9552-168, -166, -167 and -170 were required to test these components and their completion status has been previously discussed, except for -166 which was 90% complete.

e. Reference Component (501021)

The assembly welding and tooling were complete, and assembly was complete on the submodule and welding matrices.

Component shortages curtailed production on 4 of the 7 module types and all material was on the production floor ready for assembly of the other 3 types at the time of work stoppage.

TE-9552-171 and -169 were the test sets for module and submodule testing. The -169 test set was complete and the -171 test set was 85% complete. The 3 module test procedures were not started. Of the 13 submodule test procedures required, 7 had been completed.

f. Bit Logic Module (501022)

Assembly, processing and tooling were complete and all submodules were in the process of being manufactured. Sixteen (16) ladder switch flip-flop modules (401314) were in test, 32 "C" gates (401530) were complete in assembly, and for 16 storage flip-flops (401313), matrices were welded and ready for installation of components.

Test Sets TE-9552-170, -168 and -167 were required. All 4 submodule test procedures were complete and the module test procedure was not started.

g. 12-Stage Ring Counter (501023)

Assembly processing and tooling were complete and all 28 modules were in the process of being manufactured. About 33% of the assembly work was completed; none of the units were yet in Test.

The TE-9552-167 and-170 test sets were to be used and have previously been covered. All submodule test procedures were complete. The 2 module test procedures were not yet started.

h. High Level Output Switch (501031)

Assembly was not started, although all processing and tooling were completed. Lack of transformers precluded production of this item. These transformers, to be manufactured by EMR, Sarasota, were previously discussed.

The TE-9552-168 test set to be used for this item was previously covered. The 3 test procedures required for modules and submodules had not been started.

i. High Level Amplifier (501032)

This unit was delayed by an engineering hold order. Of the [illegible] different types of submodules, only 2 each of 2 types were being manufactured. Of these, 1 type had only the matrices completed and the other was completed in assembly (401401-1 H.L. Amp. S-1-1). No testing was performed.

Test sets TE-9552-168, -142, -167 and -170 were used to test the variety of modules and submodules. Out of [illegible] submodule test procedures required, 6 were complete. The module test procedure had not yet been started.

j. Low Level Amplifier Module (501033)

Processing and assembly tooling were complete but assembly was not yet started.

Test sets TE-9552-140 and -166 were involved. Of the 7 module and submodule test procedures required, 1 was complete.

k. Common Mode Module (501034)

Processing and assembly tooling were complete but no assembly work was started.

Test Sets TE-9552-166 and -167 were involved. None of the test procedures were complete, but all were in process.

l. High Level Amplifier and Reference Logic Module (501036)

Processing and assembly tooling were complete and the submodules were in various stages of assembly and test. There were 4 NOR gates (401395) in test; some of the submodules were on Engineering hold.

Test Sets TE-9552-167, -170, -166 and -171 were involved. Of the 6 submodule test procedures, 4 were complete and the 2 module test procedures were not yet started.

m. Output Filter (501037)

Processing and tooling were complete and no assembly was started. TE-9552-166 was previously discussed. The 2 test procedures for this module were in the process of being written.

n. 400 SPS High Level Input Module (81-7660X-10)

Processing and assembly tooling were complete but no assembly effort had begun.

The TE-9552-168, previously covered, was to be used; none of the test procedures for modules and submodules were started.

o. 400 SPS High Level Switch Module (81-7660X-11)

Status is the same as the 81-7660X-10 above.

p. 50-200 SPS High Level Filter (81-7660X-13)

Status is the same as 81-7660X-10. This unit was not required for prototypes 1 and 2.

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II. FM DECK SUBSYSTEM

A. FM Deck Sub Assembly (81-7660Z)

Manufacturing drawings, planning and tooling were complete for the FM deck. This included such items as material draw sheets, connector crimping tools and clamping bar for securing the modules.

No assembly was started since there were various material shortages which included the casting.

Cables for wire checking the deck were a part of TE-9552-310 and were complete. The -310 test set included the DIT-MCO automatic circuit tester.

B. Voltage Controlled Oscillator Module (81-7660E)

Assembly processing and tooling were 100% complete. Of the 38 oscillators required for the first prototype, 2 of the 3 submodules for all units were in test and the other submodule was in an incomplete stage of assembly due to transformer material shortages (vendor supplied). Manufacturing was estimated to be 10% complete.

Five (5) TE-9552-133 test sets were complete and all test procedures were written. All of the 3 types of submodules had to be completed before both the submodule and module testing could be completed.

C. Voltage Controlled Oscillator (81-7660F)

All processing and assembly tooling were complete. Four (4) of the 8 units were tested and potted. Of the remaining 4, the 501090-1 oscillator submodules were in test and the (8) 501089-1 amplifier assemblies were delayed due to a transformer shortage.

D. Voltage Controlled Oscillator (81-7660G)

This unit was completed, potted and tested. TE-9552-133A was used.

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E. Voltage Controlled Oscillator (81-7660B)

Three (3) units were potted and tested. TE-9552-133A was used.

F. Mixer Amplifier (81-7660K)

This module was potted and tested. The TE-9552-174 test set was used.

G. Dual Mixer Amplifier (81-7660R)

Same status as the 81-7660K.

H. Translator (81-7660 -1 through -5)

Processing and assembly tooling were complete and the assembly of the 11 units was about half complete. Transformers caused a material shortage which prevented further completion.

TE-9552-174 was complete and all 15 translator test procedures were finished.

I. FM/Mixer Power Supply (81-7660AA)

Assembly processing and tooling were complete but material shortages prevented assembly of the unit. Some mylar punching and submodule matrix welding was performed, amounting to about 10% completion of the entire unit.

TE-9552-304 was complete. Seven (7) of the 8 test procedures for the module and submodules were finished, and the final procedure was in writing.

J. Relay Module (81-7660E)

Manufacturing, processing and tooling were complete. The unit was tested on TE-9552-312 and in finished goods stock.

K. Time Code Generator (81-7660B8)

1. Wiring Module (502029)

Manufacturing, planning and tooling were complete. No assembly was started on this unit because of material shortages.

2. Modules (TCG-1 through -14)

One (1) module was tested, potted and machined; 3 modules were in preliminary test prior to potting, and the remainder were in various stages of welding assembly. Due to a late engineering release, material shortages existed for 2 of the module types. The matrices for these were complete.

Test sets TE-9552-307, -308 and -309 were complete. Out of 34 test procedures required, 31 were complete.

The wiring module was to be circuit tested with TE-9552-310. Cables for this accomplishment were 60% complete.

L. Pre-Emphasis Module (81-7660T-1)

Not required for prototypes 1 and 2.

M. Pre-Emphasis Module (81-7660T-2)

These units were completed in assembly, less potting. The potting molds were in the process of being modified for improved connector location.

Test Set TE-9552-311 and the test procedure was complete.

N. Insulation Amplifiers (81-7660[illegible]-1 and [illegible]-2)

All processing and assembly tooling were complete. The 10 submodules were assembled and connectors were installed. Units lacked test and potting.

TE-9552-306 was complete and all 6 test procedures were finished.

F. J. Janda

FJJ:gt

X-20 TIS Status SIL Station and AFMTC Van

A. SIL Station

This station which consisted of 15 racks was nearly complete. Subsystem and system testing was not the responsibility of Manufacturing. Indication of a "complete" status is related to Manufacturing's obligation.

Of the 15 racks, 5 were procured complete and contained tape transports which required some modifications and 10 were designed by EMR for the SIL station. Of these 10 major equipment items such as drawers were about 98% complete. All standard product items with the exception of two (2) 236A-02 units were complete.

(1) Integration Support Rack

Rack wiring complete. Rack test in progress.

(2) Input Rack

Complete

(3) Time Code Rack

Wiring and assembly complete. Minor hardware missing.

(4) F.M. Rack

Complete with the exception of two (2) 236A-02 units. These were in in-process testing at the time of work stoppage.

MANUFACTURING CONTROLS FOR WELDED ELECTRONIC PACKAGES

Manufacturing controls at EMR were developed to assure the highest degree of quality and product uniformity for high reliability welded electronic equipments. Those basic manufacturing elements over which controls are exercised are outlined as follows:

- I) Manufacturing Environment
- II) Operator Training
- III) Tooling
- IV) Weld Schedules
- V) Weld Control in Manufacturing
- VI) Raw Materials and Parts
- VII) Repair and Rework

The reasons for the above controls are not covered in this dissertation. The purpose of this paper is rather to provide a narrative description of the controls and their implementation.

I) Manufacturing Environment

The EMR welding manufacturing area is housed in a special room within which dirt and contamination, humidity and temperature, are specially controlled. The temperature is maintained at a level of 75 [illegible] °F and the relative humidity is not allowed to exceed 50 [illegible]. Automatic electronic devices make a continuous chart record of the temperature and humidity; thermostats provide the necessary continuous control. Two dehumidifiers are located inside the welding area.

To control the dust and foreign material, personnel are not allowed to eat, drink or smoke in the area. Upon entering the airlock, which is provided to help stabilize the area temperature, all personnel are required to don knee-length synthetic fibre smocks and hats. Finger cots are worn by assemblers to protect material and units of manufacture from hand contamination. In addition, the area is vacuum cleaned once every twenty-four hours.

In addition to separate work piece illumination by bench lamps, the general level of illumination in the area is 75 to 100 foot candles.

II) Operator Training

All candidates for employment are required to pass the Federal Employment Agency General Aptitude Test Battery, Parts 1 and 2, and Test Battery 212 (Counter) in order to be selected as a welding operator. Upon appointment, new employees attend a formal training program and are required to pass both written and workmanship performance type tests. Upon successful completion of these tests, operators are certified and are required to carry a dated certification card.

The training program covers a period of ten working days which includes instructions in the use of welding equipment, storage and handling of materials and welded modules, mylar film preparation, macro examination and use of the microscope, visual detection of welding defects, use and care of hand tools, cleaning and maintenance of electrodes, general cleanliness of their work station, reading of assembly drawings, and welding with the aid of a microscope. Additional factors included in the training program are matrix punching, lead wire clipping, and component loading into modules (matrices). Background information is furnished on potting and encapsulation, metallographic practices, and the general operation and purpose of welding and welders.

III) Tooling

A. The Welder

The basic welder is the capacitance discharge-energy storage type with independent control of the energy and electrode force. EMR welders have regulated power supplies and specially rated capacitors to provide precision control of the discharge. Welder power supplies are calibrated upon receipt from the manufacturer by the EMR Standards and Measurement Laboratory and are recalibrated no less than every seven days. Voltage regulation must be better than 1.0% for line voltage variation from 105 to 125 VAC at any point in the range of from 5 to 100% of the maximum energy setting. Ripple may not exceed 0.1% of the DC voltage, and the maximum charge time shall not exceed two seconds.

The discharge capacitors are measured to an accuracy of ±1% under the temperature conditions of the welding room to assure a capacitance tolerance of ±4% of the stated value.

The hysteresis and force of the welding head are measured to assure proper calibration to the dial setting. Force measurements must be within ±5% and are calibrated at the maximum, 50%, and minimum dial settings.

Upon meeting the above exacting requirements, additional tests are conducted for the welder to become qualified as a production tool. Qualification includes the production of welds to known weld schedules, examination by the use of microphotographic techniques, and tensile testing.

A sample of 37 welded connections are made. Thirty (30) are tensile tested and 7 are selected at random for micro examination. From the pull test data, three criteria must be met. First, the average weld strength must be 65% or greater than that of the weakest member. The second is that the variation in pull strength between the various connections shall be:

$$.35 < \frac{\text{Range}}{\text{Average}} = \frac{\text{Difference between high and low}}{\text{Average of individual weld strength}}$$

Additionally, the weakest weld in the group shall not be less than 50% of the weakest member.

Three weldments are examined visually for penetration, discoloration, expulsion, sticking, cracking, deformation and porosity at a magnification of 30X. One weldment is peeled to show the depth of the nugget and another is given repeated 90° bends to destruction. Four welments are mounted for photo micrographing and examination of the weld cross section. Two welds are cross sectioned to show the transverse area and two are sectioned in the longitudinal direction. Examination of the cross sections by a metallurgist is made for the type of bond, heat zone, notching, expulsion, cracks, deformation, base metal melting, voids, inclusions and lack of bonding.

The above welder testing is performed on a number of different materials to cover the entire range of the welder.

Should a welder require repair, upon completion, the above procedure in its entirety must be repeated for the unit to be re-qualified.

B. Microscopes

A 7X binocular microscope is used by manufacturing welding operators. All welding is performed under microscope to achieve a more precise and higher quality weld than would be possible using the naked eye.

C. Electrode Control

Welding electrodes of different materials and configurations are required when a variety of lead materials must be welded. EMR specification drawing 9910006 for electrodes specifies the material size, tip diameter, angle, dielectric coating and polarity. This information is included on the welding schedule which becomes a part of the manufacturing process drawing.

D. Hand Tools

Manufacturing process standards cover the type, use and care of hand tools used by welding assemblers. The condition of the tools is specified in sufficient detail to provide a means for the control of defective tooling by Quality Control.

The following list of standard tools which are issued to welding operators have been chosen from all known makes on the current market by experimentation and usage in manufacturing:

Peer Matrix Cutter	#33-619
Klein Diagonal-Flush Cutter	#D230-4C
Peer Tweezer-Open [illegible]	#00
Mirror Tech. Dental Mirror ½" Dia.	--
Clauss Scissor	#43-½
Clauss Scissors	#184-½SS
Hunter Scale, 6 inch	#53L
Hexacon Buss Wire Positioning Tool	#800P
X-Acto Knife W #11 Blade	--
Klein Pliers, Transverse end cutting	#224-41/2C
Klein Pliers, Long-nose, smooth	#322-4½C

IV) Weld Schedules

A scientific and systematic procedure is employed by the metallurgical laboratory to develop the proper welding energy, and electrode pressure for the production of an optimum welded connection. The results are entered on the weld schedule.

Development of the welding schedule is performed in four stages as follows:

A. First Approximation

The first approximation defines the entire range of energy and pressure over which bonding occurs.

B. Second Approximation

The second approximation is performed to determine the optimum area and limits of the range for good welds.

C. Search Sample

The search sample is performed to determine if metallurgical difficulty exists at the energy and pressure settings determined by the second approximation. Welds are made with energy settings slightly above and below the optimum condition found in (B) as well as at the optimum condition itself. The same procedure is conducted for welder electrode pressure settings. These samples are then mounted and the weld is cross-sectioned for microscopic examination by the trained eye of a metallurgist. Weldment cross section details are made visible by polishing and selective chemical etching.

D. Final Welding Schedule

The final welding schedule is prepared from a sample of 34 welds made at the optimum energy and pressure settings as determined from (B) and (C) above. Four (4) of the weldments are selected at random for macro and micro examination and cross sectioning. The remaining 30 welds are tensile tested on an automatic pull testing machine. Ten (10) samples of the weakest member are pull tested for control information. From the tensile test data, the following conditions must be met:

1. The average strength must be 6.5% greater than the average strength of the weakest material.

2. No single weld in the sample may be less than 50% of the average strength of the weakest material.

3. The variation in pull strength shall not exceed 0.35 as determined by the following formula:

$$V = \frac{\text{Difference between high and low}}{\text{Average of individual weld strength}}$$

If all of the above conditions are met, the pressure and energy settings are recorded on the weld schedule.

Additional information which is provided on the weld schedule includes the electrode data, materials, material finish, tensile strength, and material size (usually the lead diameter which is of circular cross section), tensile pull limits, and welder head type. Acceptable weldment characteristics as observed during the schedule development are provided. These characteristics contribute to the information used by inspection for the acceptance of production welds.

V) Weld Control in Manufacturing

After the initial approval of the welding station, control during the course of manufacture is maintained. Five samples of the production weld materials are made, inspected under a microscope at a magnification power of 30X and pull tested on the following basis:

1. At the start of each welding schedule or after a shut-down of two hours or more.

2. At intervals of every two hours.

3. After electrode replacement.

4. After a weld schedule change.

5. After a "no-weld" (failure to weld).

6. At the first indication of arcing or blow-out.

The weld shop supervision is responsible for the execution of this program and examination and tensile testing is done under the auspices of Quality Control.

If any sample is defective, another lot of five is taken for reexamination. Should two or more of the welds fall outside of the specified strength limit, the Metallurgical Laboratory is required to conduct an investigation and to correct the out-of-tolerance condition.

VI) Control of Raw Materials and Parts

Specification control drawings are required for all weldable lead materials which define and provide limits on its metallurgical make-up, and size.

Detailed physical and metallurgical tests are made of all material prior to issue to the manufacturing stockroom. Analyses of the chemical composition of the material are made along with welding and pull testing.

Materials are stocked on a first in, first out basis and are segregated by project. The identity of the vendor and lot number is maintained to the point of issue to the production floor. Prior to issue to the dust controlled welding production area, the materials are stored in clean containers and dust-free cabinets. Personnel who must handle the material are required to wear clean, unpowdered finger cots.

VII) Repair and Rework

Repair and rework, depending upon the program, is handled in two different ways. On certain programs, repair and rework is conducted through a material review board which is made up of representatives from Engineering, Quality Control and the Government. Repair action is decided upon by this group, and the Quality Control representative thereupon issues a standard repair document describing in detail the allowable repair. Once a repair decision is made, it is catalogued in the standard allowable repair procedures manual. Using this initial action as a precedent, future repairs of an identical nature, upon approval by EMR Quality Control, are permissible.

The other manner for repairing welded modules is controlled by EMR Production Process Standards. Certain repairs which do not degrade the quality of the end item are permissible. Consideration is given to the following general criteria:

1. Location of the parts in the assembly.
2. The extent of rework on the parts and its effect on other adjacent welded connections and parts.
3. The ultimate dimensional requirements.
4. The degree or stage to which the assembly has advanced when the rework becomes necessary.
5. The cost, labor and time factors.

The following general restrictions provide control over the end result:

1. Welds shall not be made over previously welded areas.
2. All leads to be welded must intersect at 90 ± 10°.
3. Blown or no-welds are not permitted for inclusion in the circuit.

For a greater detail on this facet of welding, the reader is referred to the EMR PS 901557 Production Process Standard.

MANUFACTURING CONTROLS AND STATUS OF AIRBORNE TIS PRODUCTION PROTOTYPE

CONFORMAL COATING AND POTTING

Conformal coating and hard potting was performed on the following X-20 TIS airborne modules:

Model Number	Description	Quantity
81-7660K	[illegible]	1
81-7660G	VCO	1
81-7660H	VCO	3
81-7660F	VCO	8
81-7660R	VCO	1
400496 (TCO-9)	81-7660GB	1
402086 (PC-9)	81-7660A	1

I) Conformal Coating

Conformal coating consists of immersion of the modules in a pot of silicone varnish, Dow Corning Type DC 997. The procedure for coating welded modules is covered in Process Standard #901562 and is summarized as follows:

That portion of the module or submodule not to be coated is first masked off (such as the connectors). The module is then immersed in the dip pot, drained and placed in a vacuum chamber. A vacuum is drawn down to a level of 5 mm Hg until all air entrapped in the module and dissolved in the conformal coating material is removed. The vacuum is released and the module withdrawn from the chamber after bubbles stop coming to the surface.

The module is allowed to drain until the coating no longer drips. It is then placed in an oven to cure at 160 F.

The finished module contains a conformal coating five to ten mils thick.

II) Potting

Stycast 1090, manufactured by Emerson & Cummings, was selected for the hand potting of airborne modules. A summary of the procedure which was developed follows:

After conformal coating, the completed module is prepared for hard potting in its appropriate mold. The mold is first cleaned by vapor degreasing for not less than two minutes. All inside surfaces of the mold are then given a thin, but thorough, coat of Emerson & Cummings EC122S, DC-20 mold release. The excess is wiped off by stroking with a linen cloth.

The module to be potted is first cleaned by immersion in trichlorethylene for a period of about two minutes and then allowed to dry.

The pre-proportioned package of catalyst and resin are heated to 140 F for two minutes, then mixed together. The module and mold are placed in a pre-heated vacuum oven at 140 F for 7.5 minutes for each 1/8" of mold wall thickness. The pre-heated resin is then placed in the oven and a vacuum of about 2mm of Hg is drawn for two minutes and slowly released over a period of one minute.

Resin is now poured in the mold to a level of ½ the mold height and a vacuum of 2mm Hg for two minutes is drawn. Upon release of vacuum the mold is completely filled with resin and another vacuum is drawn.

The potted module is next placed in a dust-free cabinet and left to cure at room temperature for 48 hours. This cure period is followed by a second curing in an oven for 75 minutes at 100 F and a third cure period of 90 minutes at 140 F.

The potted module is then removed from the mold and left to cool and final cure for 5 hours at room temperature.

The purpose of drawing vacuums in the aforementioned sequence is to assure complete removal of voids and dissolved air from the potting material and also avoid excessive bubbling and overflow of potting material from the mold.

After potting, it is necessary to precision grind the potting material to meet the precise external dimensional tolerances required for modules in the X-20 TIS.

The success of potting on critical electrical circuits is attested to by the fact that the 81-7660F VCO module, considered to be sensitive to potting, met all of its electrical specifications in production module testing. Although not covered in the above summary, a pre-potting procedure is used

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wherein the basic module was potted with leads to certain portions of the circuit exposed. Passive components are selected by the tester to final trim adjust certain critical electrical parameters through the performance of electrical tests and measurements with the module in operation. Upon completion of these final test adjustments, the components are welded in place, flush with the pre-potted module and a final potting is made to encapsulate the exposed components.

[illegible signature]

[illegible] Janda

(5) and (6) Recording Oscillograph Rack A & B

Wiring and assembly complete. Some trim hardware was missing.

(7) Digital Printer

Wiring and assembly complete. Some trim hardware was missing.

(8) I.G. Decommutator (56-7660L)

Rack and drawer wiring and assembly complete. Cards were 95% complete. Drawer testing and I.G. Decom testing as a subsystem was to be done by Manufacturing since it was a Model [illegible] type unit with which Manufacturing has had prior experience. This effort was not yet started. See I G Decom estimate to completion, F. Janda to J. Lyden dated 1-27-64 for further detail.

(9) and (10) PCM and IG Format Converters (56-7660J and K)

Printed circuit cards were 90% complete. Only about [illegible] of the rack assembly and wiring work was completed at the time of work stoppage.

(11) and (12) Tape Transports

These two purchased racks of equipment were in the process of being modified at the time of work stoppage. The racks were partially modified and painted but none of the rack wiring was started.

(13) MISC

The inter-rack cable assemblies were about 95% complete.

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B. AFMTC Van

The van had 8 racks, 3 of which were purchased complete. The status of the remaining 5 racks is as follows:

(1) Time Code Rack

This rack was complete less some trim hardware. The FM calibrator (56-7660?-1) was in trouble because of a crystal problem: assembly was complete, but some re-test was required because of the crystals.

(2) FM Rack

Standard product items were complete. Wiring and assembly were complete but some rack wiring changes were in process at the time of the work stoppage.

(3) Recording Oscillograph Rack

Assembly and wiring were complete less some minor hardware items.

(4) PCM Decommutator (56-7660?)

Rack and drawer assembly was 50% complete. The cards were about 85% complete. The rack was being assembled and wired at the time of the work stoppage.

(5) Digital Printer Rack

This rack was complete less some hardware trim. The 56-7660? signal simulator was completed but Engineering changes were reported to be in process at the time of the work stoppage.

(6) MISC

Inter-rack wiring was completed in January 1962. Engineering changes to this cabling was reportedly in process at the time of work stoppage.

F. J. Janda

FJJ:jt
cc: V. Mella

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