

RIP (1012)

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SANTA CRUZ TEST BASE
Briefing by Agena Division
17 January 1961

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Presented by
Lt Colonel *[Signature]*

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SANTA CRUZ TEST BASE OPERATIONS
SUMMARY OF SIGNIFICANT FINDINGS

SUBSYSTEM A - AIRFRAME

Improved Seals Resulted From Test Findings
Turbine Exhaust Stack Mounting Marginal
Separation Monitor Noise
Tank Seal Deterioration Problem Solved
Structural Problem Revealed in Forward Equipment Rack

SUBSYSTEM B - PROPULSION

Engine Performance Verification
Defective Pressure Regulator
Thrust Chamber Transducer Failure
Relay Box Vibration
Unreliable Engine Liquid Regulator
Improved Thrust Chamber Welding
Ox Pump Housing Leak
Ox Manifold Pressure Switch Boss Leak (Agens D)
Magnesium Chips in Turbines (Agens D)
Secondary Propulsion System Performance Verification
Orifices Pressurization System Performance Verified
Agens D Propulsion and Orifices Pressurization Verified
Isolation Valve Failures
Flushing or Fill and Drain Requirements

SANTA CRUZ TEST BASE OPERATIONS

SUMMARY OF SIGNIFICANT FINDINGS (cont'd)

SUB SYSTEM C POWER

Inadequacy of Aluminum Wiring
Microphonics in Power Supplies Revealed
Guidance Amplifier Power Supply Instability
Pyrotechnic Fusistor Mounting Failed under Engine Vibration

SUB SYSTEM D GUIDANCE

Sticking Pitch Gyro, Intermittant Horizon Scanner, D-Timer Switch Failures, Noisy Integrator Circuit
Deficiencies in N₂ Gas Valve Transducers
Gas Jet Assembly Susceptibility to Vibration
Hydraulic Package Failure
Horizon Sensor Mounting Bolt Problem

SUB SYSTEM C & C COMMUNICATIONS AND CONTROL

Typical; Ruptured Oxidiser Pressure Transducer

SIGNIFICANT FINDINGS

SUBSYSTEM A

STEEL SEALS SUBSTITUTED FOR ALUMINUM SEALS - Oxidiser leakage traced to aluminum tank seals which were found to be nicked and scratched thereby not providing good seal. Steel seals more durable and less susceptible to such minor but critical damage were substituted.

TURBINE EXHAUST STACK MOUNTING BRACKET - Shown to be of marginal design in that it lacked the necessary rigidity. During test at SCTB it became loosened. This situation could have resulted in a possible problem during actual flight conditions. To positively preclude such a possibility the bracket was re-designed.

SEPARATION MONITOR NOISE - During engine firing the separation monitor produced high noise level blameting telemetry transmission.

TANK SEAL DEGRADATION - Tank seal leakage noted under actual operating conditions at Santa Cruz showed that seals for propellant tanks, fuel and oxidiser seals were reversed in installation causing eventual and sometimes rapid deterioration. Such a situation could only be uncovered under actual operating conditions.

IMPROVED SEALS RESULTED FROM TEST FINDINGS - As a result of continuing testing and operating experience, steel seals were found to have significant difficulty in obtaining proper compression and seal. A composition seal which is compatible with the propellants utilized was discovered and is now in service.

STRUCTURAL PROBLEM REVEALED IN FORWARD EQUIPMENT RACK - In investigating horizon-sensor vibration problems encountered in Santa Cruz Captive Test, vibration tests at Sunnyvale on the forward equipment rack revealed a structural problem. The structure was strengthened, correcting the problem.

SIGNIFICANT FINDINGS

SUBSYSTEM B

ENGINE PERFORMANCE VERIFICATION - One of the most important products of the complete vehicle systems at the Santa Cruz Test Base is that of Engine Performance Verification. Each vehicle tested is instrumented to measure the necessary parameters. A case in point is Discoverer XII (1101 - RM - 1). The engine, a low performance, SCFB test results showed that the specific impulse (Isp) was seven (7) seconds of very small residuals.

DEFECTIVE PRESSURE REGULATOR - Found faulty operation under actual hot firing conditions. Inspection revealed disrupted casting and oversize spring. Entire lot re-inspected eliminating probability of recurrence on an actual flight.

THRUST CHAMBER TRANSDUCER FAILURE - Pressure transducer measuring thrust chamber pressure failed during early test. Found improper location, welding and support. Failure during flight could have resulted in thrust chamber failure and resultant destruction.

RELAY BOX VIBRATION - Tolerance limits proven low during hot firing test causing a premature shutdown. Incident proved that safety margin had to be added. Demonstrated that environment produced at SCFB useful and better source than machine. Production units changed.

UNRELIABLE ENGINE LIQUID REGULATOR - Original Agena A engine Model 8001 showed unreliable operation of engine liquid regulator. The regulator, a mechanical device, delivered 70% of normal flow to the gas generator, the remaining 30% being controlled by a bellows tap for constant RPM. Santa Cruz testing showed possible clogging due to saltling with special handling and flushing required. This was a major factor in the gas generator re-design incorporated in subsequent engines.

IMPROVED THRUST CHAMBER WELDING - Testing at Santa Cruz revealed faulty welds in the thrust chamber and oxidizer manifold assembly. Called to the immediate attention of Bell Aerosystems Co., improved welding and assembly techniques resulted.

SIGNIFICANT FINDINGS

SUBSYSTEM B (Continued)

OK PUMP HOUSING LEAK - Post-test inspection indicated oxidizer leakage during test in engine area. Post-test leak checks pinpointed leak to ox pump housing seal. Normal pre-fire checks gave no indication of leakage in this area.

OK MANIFOLD PRESSURE SWITCH BOSS LEAK (AGEMA D) - An AN bulkhead union with recess for backup gasket was installed in the OMP thrust chamber boss by Bell Aerosystems. This fitting had been modified by cutting the mating flange end off. Tight fitting recess caused an improper seal of the boss O-ring which in turn leaked at high pressure. None of the normal leak checks indicated leakage. The leak was pinpointed by motion picture coverage during the hot fire test.

MAGNESIUM CHIPS IN TURBINE (AGEMA D) - The engine on Agena D PIVA had a magnesium oil dam installed in the turbine drive assembly. During the course of testing, this dam worked loose causing magnesium from the dam to be ground off entering the pump gearbox. All bearings and seals in the pump were replaced and the magnesium dam was retrofitted by a substitute stainless steel dam of later design.

SECONDARY PROPULSION SYSTEM PERFORMANCE VERIFICATION - The secondary propulsion system was tested utilizing multiple starts and various hold periods. Various hardware problems with salting were encountered. However, generally the propulsion system was very successful. The salting problems initiated an improved technique of flushing to eliminate salt formation. During the course of the testing, GSE and launch base techniques were established and GSE design verified.

ORIFICE PRESSURIZATION SYSTEM PERFORMANCE VERIFIED - The orifice pressurization system was tested on engines to determine optimum orifice sizing and general design concepts for final design criteria. All objectives successfully met.

AGEMA D PROPULSION AND ORIFICE PRESSURIZATION VERIFICATION - The orifice pressurization system was tested in conjunction with engine firings to determine system compatibilities and also to determine the validity of using the electronic computer to establish design characteristics and blowdown curves. All objectives were met.

ISOLATION VALVE FAILURES - Various isolation valve failures occurred with the general controls propellant isolation valve. One of these failures occurred during the course of the hot firing causing a malfunction of the engine. The reliability of the general controls valve was tested with special tests as a direct result of this firing failure. Design improvements and/or substitution of valve with Parker designed valve were indicated as desirable from accomplished tests.

SIGNIFICANT FINDINGS

SUBSYSTEM B (Continued)

FLUSHING OR FILL AND DRAIN REQUIREMENTS - A continuous effort has been established to improve the fill and drain (flush) technique and to establish confidence levels in vehicle cleanliness. An outgrowth of this effort was the establishment of legitimate contamination levels. The tri-flush technique was eliminated in vehicles which had not been exposed to propellants thus decreasing the time required to meet cleanliness requirements.

SIGNIFICANT FINDINGS

SUBSYSTEM C

INADEQUACY OF ALUMINUM WIRING - After hot firing at Santa Cruz a number of broken leads were discovered. The crimp connectors were cutting the aluminum wire under vibration during engine firing. The aluminum was found to work-harden under crimping action. This was compounded by a personnel error in using an improperly sized crimping tool. The latter was a quality assurance inspection problem which was corrected and the aluminum wire was replaced by a copper wire. The difficulty might never have been discovered without a hot firing.

INSTABILITY OF GUIDANCE AMPLIFIER POWER SUPPLY - Instability in the IRF amplifier had been noticed in Sanyvale systems runs but could not be corrected because it was intermittent. The long lead lines and checkout system at Santa Cruz introduced more electronic noise and more frequent stimulation of these amplifier oscillations. Since the condition was more prevalent at Santa Cruz it was isolated, identified, and corrected there. The trouble involved coupling with the minus 28 volt power supply. The remedy involved increasing the power supply capacity from 30 watts to 100 watts, reducing its output impedance, and redesigning the amplifier to inhibit oscillation.

MICROPHONICS IN POWER SUPPLY REVALUED - After 10 seconds of engine firing during the Santa Cruz static test of HMM's vehicle 1006, extensive noise appeared on the minus 28 volt power supply and plus 28 volt regulator, with an amplitude of 4volts. The noise continued for the duration of the engine firing. Although the source of this trouble was never identified, the vehicle was externally reworked and suspected components were replaced. The condition was absent during a subsequent rework and thought to indicate loose wiring which might have existed during flight if undiscovered during the hot firing.

PYROFUSIONIC FUSISTOR MOUNTING FAILED UNDER ENGINE VIBRATION - Encapsulated fusistor circuits were subject to breakage by vibration when installed in the vehicle. One ullage rocket circuit failed during engine firing. The circuit to actuate the mechanical release on a payload failed during engine vibration. The method of mounting fusistors was re-designed.

SIGNIFICANT FINDINGS

SUBSYSTEM D

STICKING PITCH GYRO - INTERMITTENT HORIZON SCANNER - D TMR SWITCH FAILURES and NOISY INTEGRATOR CIRCUIT - The foregoing four items were malfunctions occurring during hot firing at Santa Cruz. Components affected were investigated thoroughly. Problems of design and quality control were uncovered and corrected.

DEFICIENCIES IN M2 GAS VALVE TRANSDUCERS - Malfunctions in gas valve transducers impeded ability to determine cold gas usage rate and reserve. Better potting techniques were developed improving accuracy of data furnished.

GAS JET ASSEMBLY SUSCEPTIBILITY TO VIBRATION - High amplitude - 800CPS vibration was evidenced on both telemetry and landing data. Shake table tests verified the susceptibility of the assembly to vibrations at this frequency. The fix consisted of electrically decoupling the gas valve so that the mechanical vibration could not be reflected through the circuitry and cause excessive gas loss.

HYDRAULIC PACKAGE FAILURE - During engine firing the hydraulic oil pressure oscillated peak-to-peak through a 1200 PSIG range. Several tests including both the flight vehicle and PTV A S/N 0006 hydraulic package were made using derated high pressure relief valves and the deliberate introduction of gas into the hydraulic oil.

HORIZON SENSOR MOUNTING BOLT PROBLEM - During the firing test one mounting nut on each horizon sensor head vibrated loose. Q.A.-verified procedural records assured that these bolts were properly torqued prior to the test. Improved securing methods were incorporated and verified on subsequent captive firings.

SIGNIFICANT FINDINGS

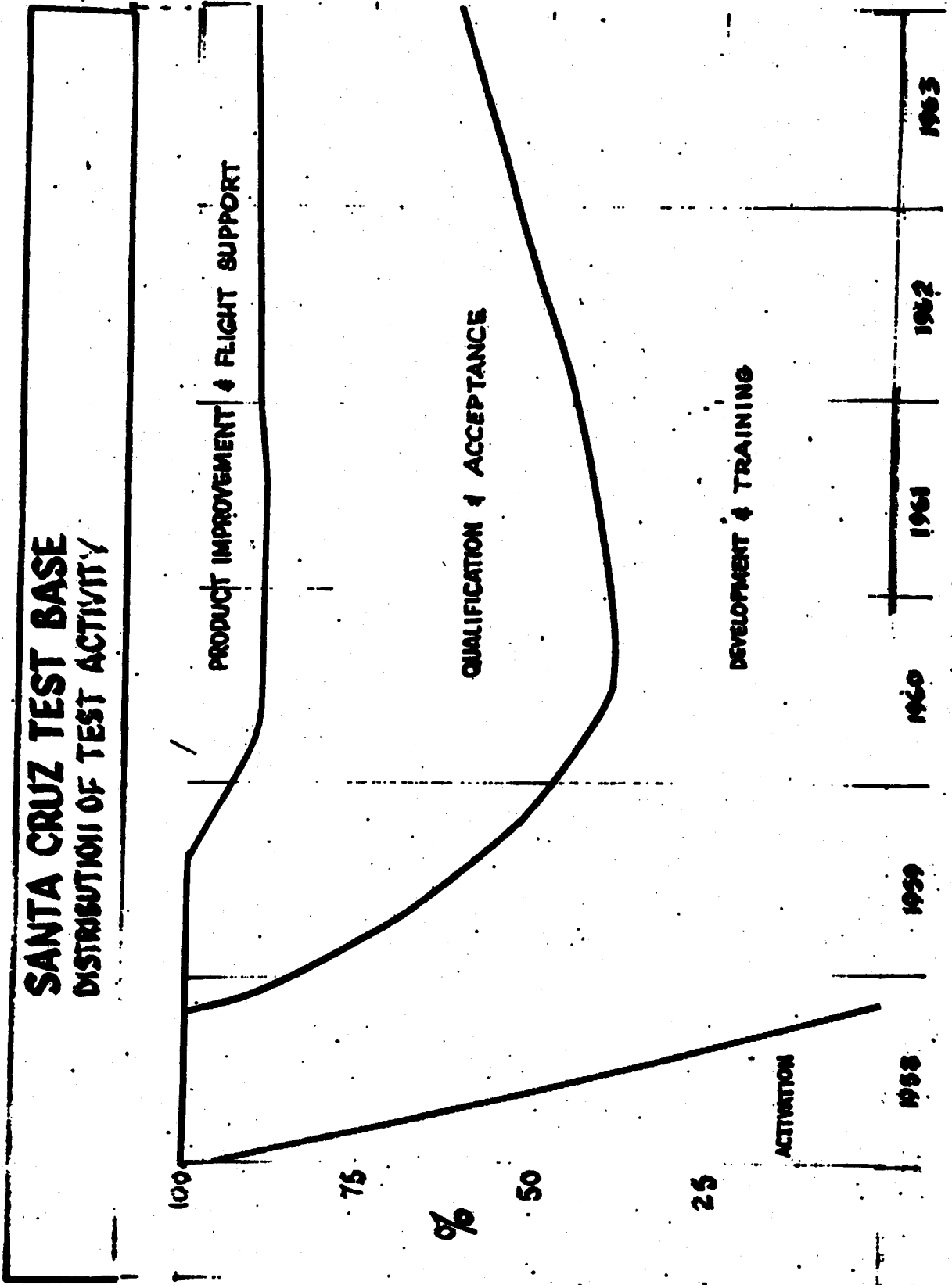
SUBSYSTEM C & C

A number of trouble and discrepant items of equipment have been found in the C & C area. A typical example was an oxidizer venturi inlet pressure transducer that ruptured during an engine firing. Oxidizer vapor was sprayed over the aft equipment area requiring replacement of several cables, switches, and transducers. As a result of this failure and detailed examination of the failed part, the qualification and test procedures for transducers have been strengthened to prevent a recurrence.

**SANTA CRUZ TEST BASE
MISSION**

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- I. DEVELOPMENT TESTING**
- II. QUALIFICATION AND ACCEPTANCE TESTING**
- III. PRODUCT IMPROVEMENT SUPPORT**
- IV. FLIGHT FAILURE ANALYSIS SUPPORT**
- V. TRAINING**
- VI. SYSTEM TEST BACK-UP**



**SANTA CRUZ TEST BASE
RESOURCES FOR SPACE SYSTEMS PROGRAMS**

SPACE SYSTEMS TEST STAND COMPLEX — 2 TEST STANDS

— 1 CONTROL BLOCKHOUSE

MISSILE SYSTEMS TEST STAND COMPLEX — 1 TEST STAND

— 1 CONTROL BLOCKHOUSE

GENC ORDNANCE —

— HIGH ENERGY TEST PAD & BLOCKHOUSE

— ORDNANCE DEVELOPMENT LAB (3 TEST
CELLS & ENVIRONMENTAL GENERATORS)

— EXPLOSIVE STORAGE FACILITIES

SPACE SYSTEMS COMPONENT TEST LAB — 3 TEST CELLS

— CONTROL BLOCKHOUSE

SUPPORT FACILITIES —

— MACHINE & FABRICATION SHOP

— PHOTO LAB

— CHEMICAL LAB

— VALVE SHOP

— INSTRUMENTATION & STANDARDS LABS

**SANTA CRUZ TEST BASE
PAST & PRESENT ACTIVITIES**

DEVELOPMENT TESTING

1. COMPATIBILITY TESTS OF ENGINE & OTHER PROPELLANT FEED SYSTEM FOR AGENA A/IRFNA/JP-4, AGENA A/IRFNA/JUDMH, AGENA B, & AGENA D CONFIGURATIONS. 53 FIRINGS OF PTVA & DTV VEHICLES.
2. TEST OF VEHICLE SUBSYSTEMS IN ENGINE FIRING ENVIRONMENT.
3. COMPATIBILITY TEST OF SECONDARY/PRIMARY PROPULSION SYSTEM COMBINATION - 6 FIRINGS OF PTVA.
4. DEVELOPMENT TESTING OF PROPELLANT HANDLING, SERVICING & CONDITIONING EQUIPMENT FOR AGENA A & B.
5. DEVELOPMENT TESTING OF ALL AGENA PYROTECHNIC & DESTRUCT SYSTEM DEVICES - 6230 ORDNANCE TESTS.
6. DEVELOPMENT OF PROPULSION COMPONENTS & ACCESSORIES - 200 CTL FIRINGS.

SAITA CRUZ TEST BASE

PAST 3 PRESENT ACTIVITIES (CONTINUED - PAGE 2)

QUALIFICATION TESTING

- 1. PERFORM SIMULATED FLIGHT TESTS INCLUDING HOT-FIRING FOR 34 FLIGHT VEHICLES OF THE AGENA A AND AGENA B CONFIGURATION.**
- 2. PERFORMED QUALIFICATION TESTING OF THE AGENA A AND AGENA B LAUNCH BASE PROPELLANT HANDLING, SERVICING AND CONDITIONING EQUIPMENT.**
- 3. PERFORMED QUALIFICATION TESTING OF THE MAJORITY OF THE PYRO-TECHNIC AND EXPLOSIVE COMPONENTS. (8000 TESTS)**
- 4. PERFORMED QUALIFICATION TESTING OF THE ORIFICE CONTROLLED PRESSURIZATION SYSTEM.**
- 5. PERFORMED QUALIFICATION TESTING OF RECOVERY PACKAGE STRUCTURE.**
- 6. PERFORMED 52 FILL AND DRAIN OPERATIONS**

SANTA CRUZ TEST BASE

PAST AND PRESENT ACTIVITIES (CONTINUED PAGE 3)

PRODUCT IMPROVEMENT AND FLIGHT SUPPORT:

- 1. DIAGNOSTIC TESTING TO IDENTIFY THE RECOVERY ATTITUDE CONTROL SYSTEM PROBLEM.**
- 2. DEVELOPED AN IMPROVED ATTITUDE CONTROL SYSTEM EMPLOYING A COLD GAS SYSTEM.**
- 3. DIAGNOSTIC TESTING OF THE HYDRAULIC PACKAGE.**
- 4. DETERMINED INABILITY OF ALUMINUM WIRING TO WITHSTAND ENGINE FIRING VIBRATION.**
- 5. PRODUCT IMPROVEMENT BY IDENTIFICATION OF PROBLEMS INVOLVING PROPELLANT ISOLATION VALVE, ENCAPSULATED FUSISTORS, GUIDANCE AMPLIFIER INSTABILITY.**
- 6. TRAINED LAUNCH BASE CREWS IN SERVICING AND OPERATING, PRIMARY AND SECONDARY SYSTEMS, PAYLOADS AND PROPELLANT SERVICING EQUIPMENT.**

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SANTA CRUZ TEST BASE FUTURE

DEVELOPMENT TESTING

1. GEMINI PTVA - DEVELOP A MULTIPLE START PROPULSION SYSTEM & IMPROVED SECONDARY PROPULSION SYSTEM
2. GEMINI DTV - DEVELOP IN-SPACE REFUELING TECHNIQUES
3. ORDNANCE DEVICES - CONTINUED DEVELOPMENT AS REQUIRED BY PROGRAMS.
4. MIST - SPECTRAL TEST FOR 239A.
5. PROPOSED 239A PTVA
 - A. EVALUATE THE LONG TERM EFFECT OF RESIDUAL PROPELLANTS EXPOSURE TO THE PROPULSION SYSTEM.
 - B. DETERMINE RESULTING SYSTEM PERFORMANCE.
 - C. DEVELOP SERVING TECHNIQUES REQUIRED TO MAINTAIN SYSTEM PERFORMANCE.

QUALIFICATION TESTING

1. FLIGHT VEHICLES - SIMULATED FLIGHT INCLUDING HOT-FIRING OF 6 MSA FLIGHT VEHICLES INCLUDING ONE GEMINI VEHICLE.
2. COMPONENTS & EQUIPMENT - QUALIFICATION OF ORBITAL DOCKING.
3. ORDNANCE DEVICES - QUALIFICATION OF PYROTECHNIC & EXPLOSIVE DEVICES.

PRODUCT IMPROVEMENT & FLIGHT SUPPORT

PAST EXPERIENCE INDICATES THAT SUPPORT WILL BE REQUIRED FOR AGEN D CONFIGURATIONS.

SYSTEM TEST BACKUP

ALTERNATE FACILITIES FOR SYSTEMS TEST OF 698AL & 698AM.

**SANTA CRUZ TEST BASE
COST SOURCES**

**PROGRAM SUPPORT EFFORT
SPECIFIC TEST PREPARATION,
PROCEDURES, TEST OPERATIONS,
AGE DESIGN, DATA PROCESSING,
ANALYSIS AND REPORTING.**

**ACCOUNTING METHOD
REQUESTING PROGRAM**

SUSTAINING EFFORT

**EQUIPMENT PREVENTIVE MAINTENANCE,
FACILITY AND EQUIPMENT UPDATING,
MAINTENANCE OF PERSONNEL TECHNICAL
COMPETENCE IN OPERATION OF FACILITY**

**ALL PROGRAMS INVOLVING
LAUNCH VEHICLES**

MANAGEMENT, SUPERVISORY, CLERICAL

**ALL PROGRAMS INVOLVING
LAUNCH VEHICLES**

SANTA CRUZ TEST BASE FUTURE



SUSTAINING COSTS

IT IS ESTIMATED THAT 84 PEOPLE ARE REQUIRED TO MAINTAIN THE RECOMMENDED RESOURCES, AND IT IS ASSUMED THAT NO MORE THAN AN AVERAGE OF 55 WILL BE CHARGING THE SUSTAINING ACCOUNT, EXTENDED OVER THE NEXT YEAR IT IS ESTIMATED THAT THE PROGRAMS LISTED BELOW WILL BE CHARGED AS SHOWN.

CHARGES WILL BE APPORTIONED TO THE PROGRAMS UTILIZING THE FOLLOWING FORMULA:

$$\frac{\text{TOTAL INDIVIDUAL PROGRAM HOURS}}{\text{TOTAL 550 AND 54 HOURS}} \times \text{TOTAL SCTB SUSTAINING CHARGES} = \text{SCTB SUSTAINING CHARGE}$$

PROGRAM	%	DOLLAR CHARGES
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**SANTA CRUZ TEST BASE
CONCLUSIONS AND RECOMMENDATIONS**

1. TEST BASE STILL REQUIRED IN R+D PROGRAMS-
ALL PROGRAMS WILL BENEFIT

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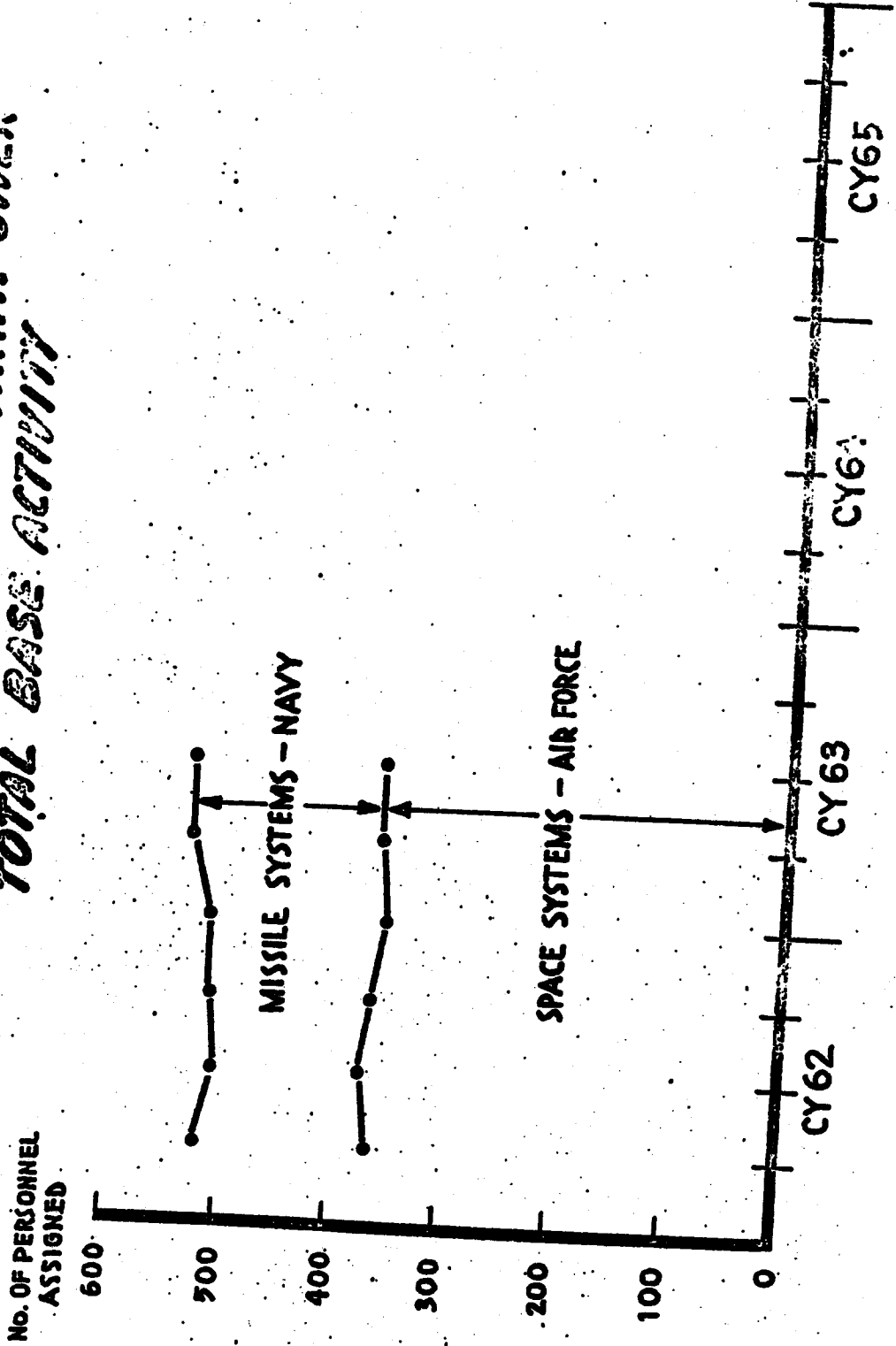
2. RETAIN ALL EXISTING FACILITIES IN AN OPERATIONAL
STATUS THROUGH CY 1963. (WITH LIMITATIONS)

2. CONTINUE TO UTILIZE EXISTING ACCOUNTING METHOD TO
A) ACCUMULATE OPERATING COSTS TO REQUESTING PROGRAMS.

B) ACCUMULATE SUSTAINING COSTS AND DISTRIBUTE
TO ALL BENEFITING PROGRAMS.

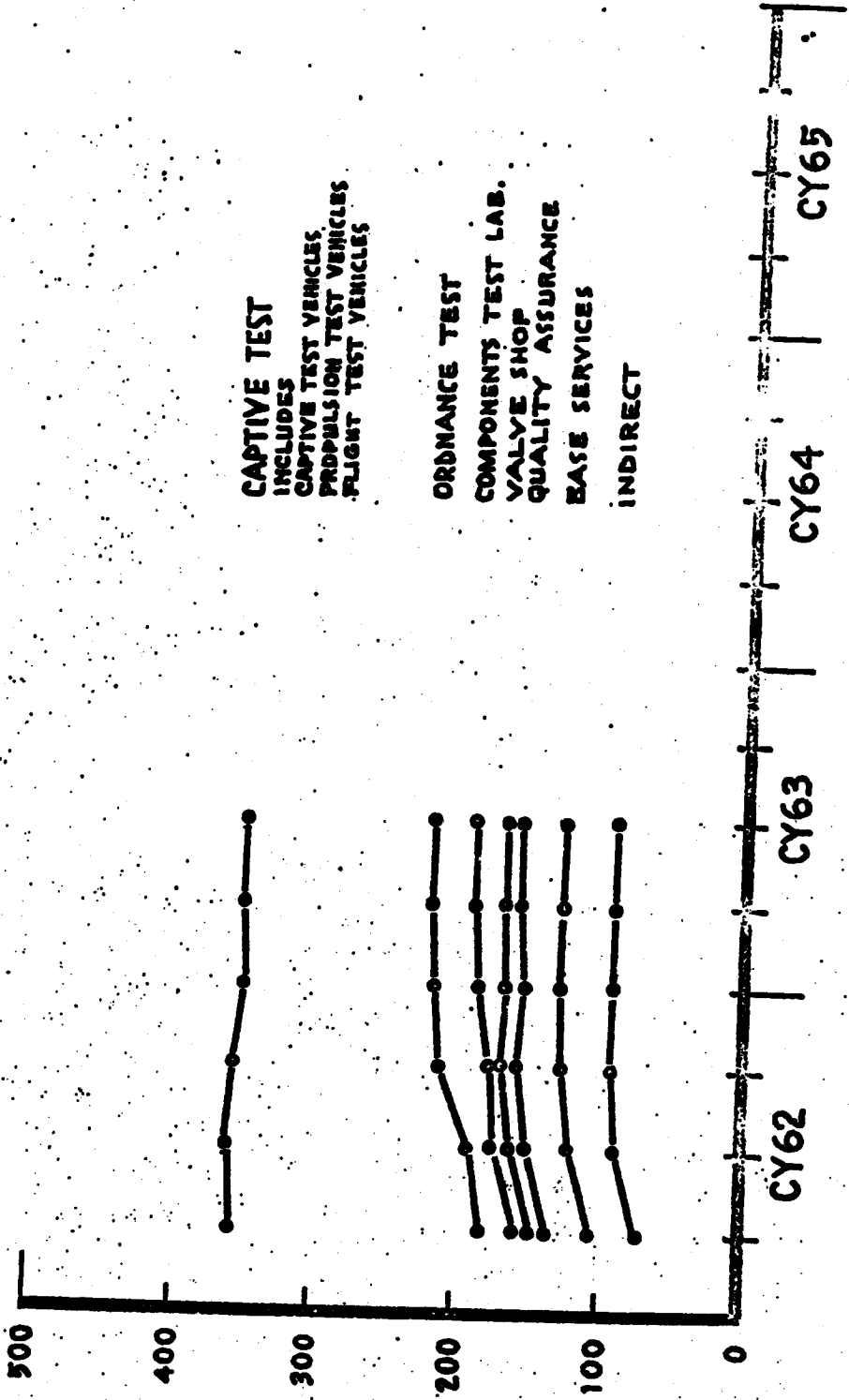
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SANTA CRUZ TEST BASE MANPOWER TOTAL BASE ACTIVITY



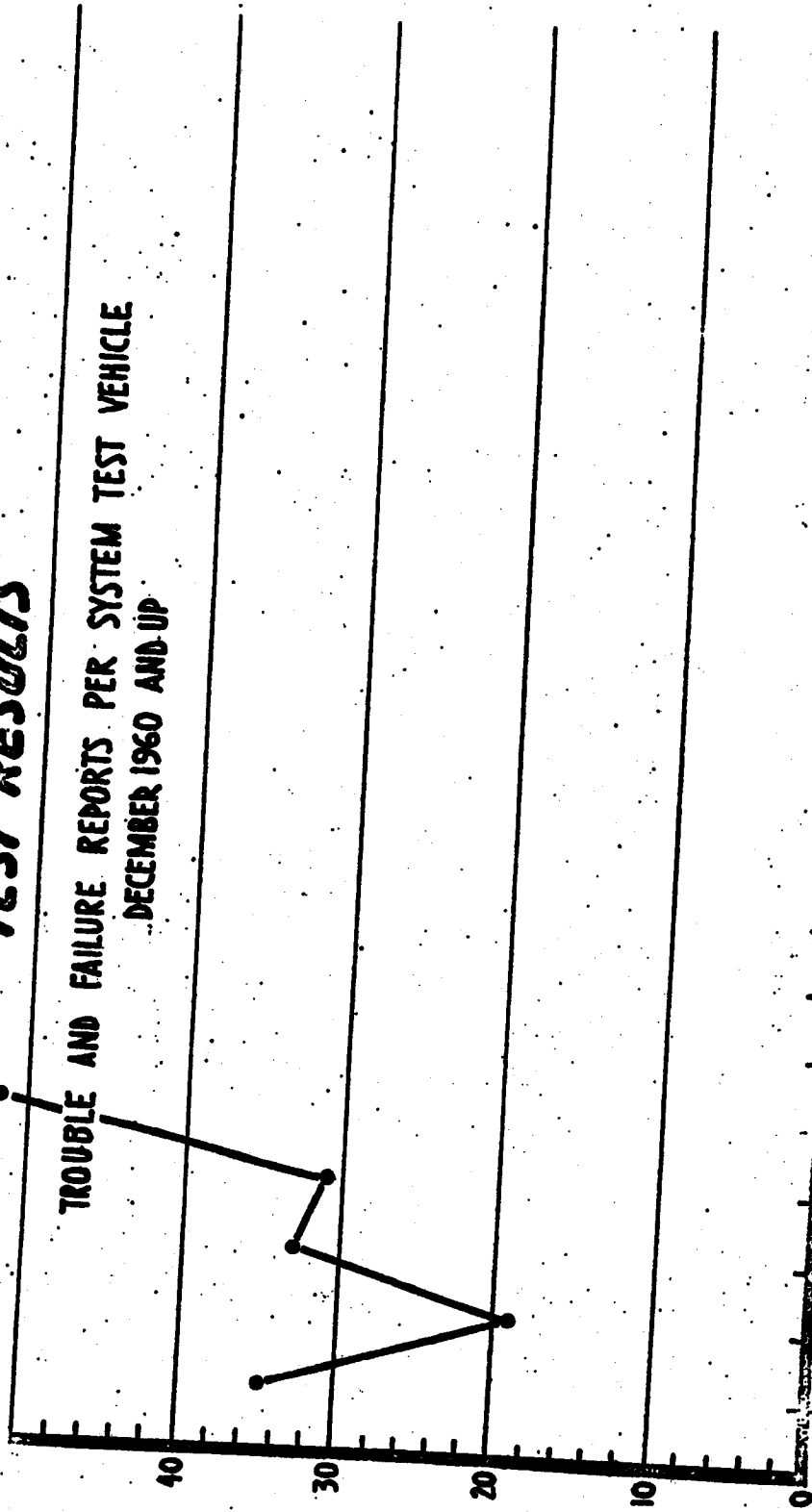
SANTA CRUZ TEST BASE MANPOWER SPACE SYSTEMS

No. OF PERSONNEL
ASSIGNED

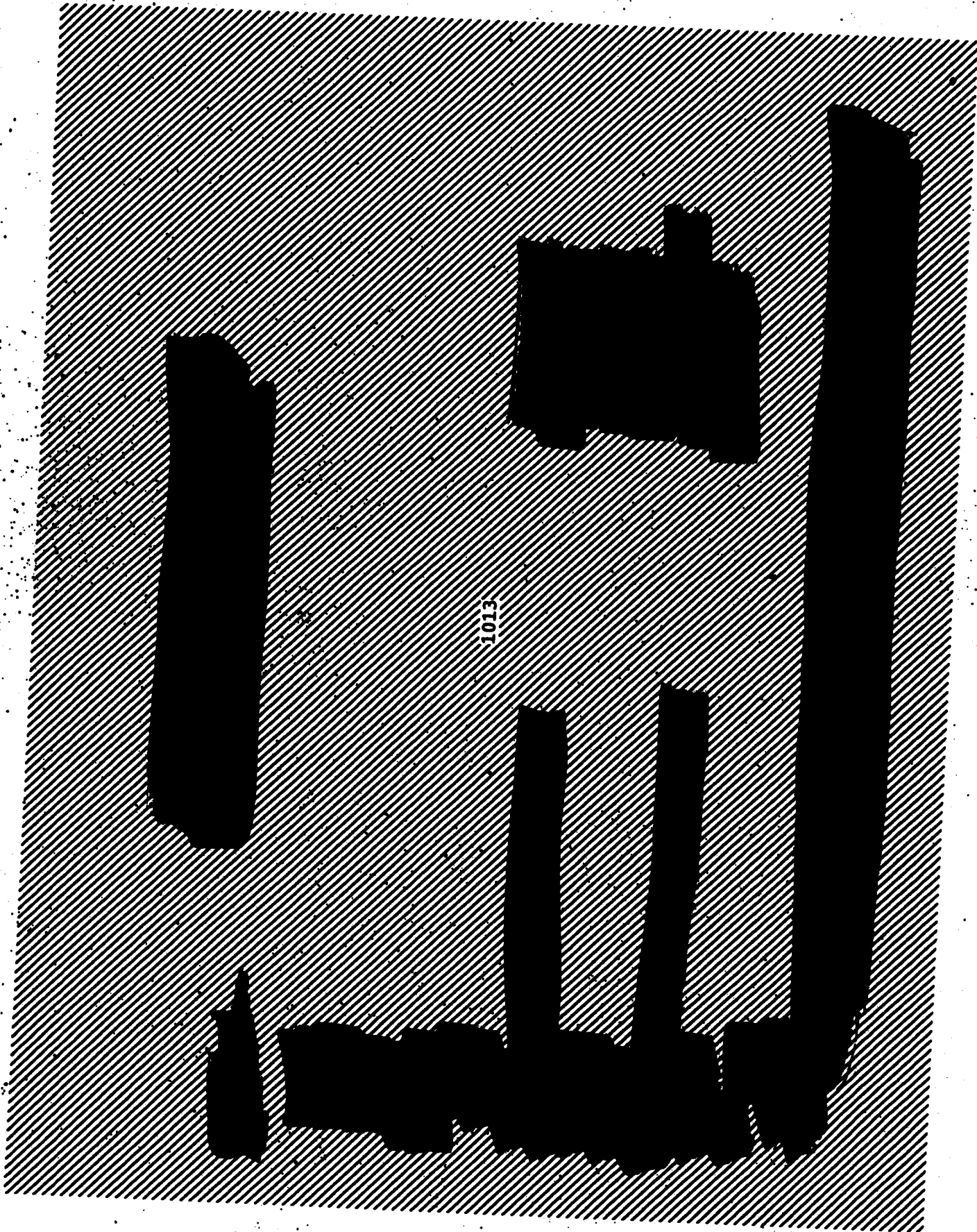


SANTA CRUZ TEST BASE TEST RESULTS

TRUBLE AND FAILURE REPORTS PER SYSTEM TEST VEHICLE
DECEMBER 1960 AND UP

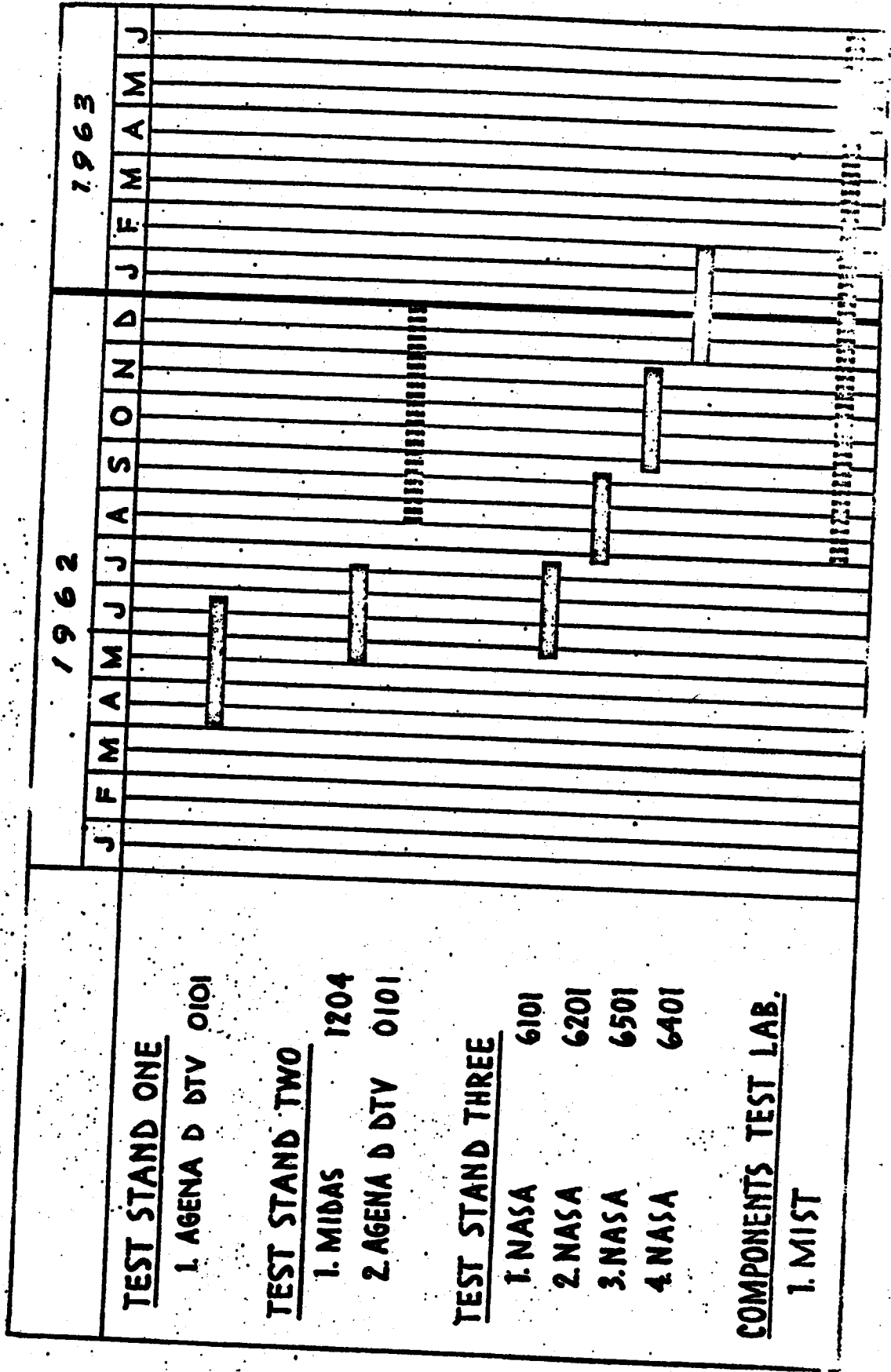


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SPACE SYSTEMS SANTA CRUZ TEST TEST STAND LOADING



FIRM BUSINESS [] PROPOSED BUSINESS []

**SANTA CRUZ TEST BASE
MANPOWER DISTRIBUTION**

FUNCTION	1062	2062	3062	4062	1063	2063
Captive Test	173	161	141	131	131	131
Ord. Test	31	32	34	35	35	35
Comp. Test	5	5	10	20	20	20
Valve Shop	9	9	9	9	9	9
CSE Lab	-	-	-	-	-	-
Q.A.	31	26	31	27	28	28
Base Services	32	35	37	38	38	38
Indirect	72	90	91	91	91	91
TOTAL SSD	353	358	353	351	352	352
% TOTAL	67	70	69	68	67	67
TOTAL NAVY	170	152	160	168	174	174
% TOTAL	33	30	31	32	33	33
GRAND TOTAL	523	510	513	519	526	526