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DAAA21-89-C-0140/A004

AUTOMATION STUDY FOR LONGHORN ARMY AMMUNITION PLANT

HAND HELD SIGNAL FLIGHT ASSEMBLY, ROCKET BARREL ASSEMBLY, 40 MM SIGNAL, FINAL PACKAGING / PACK-OUT, AND STAR FINISHING

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PREPARED FOR
UNITED STATES ARMY
U. S. ARMY AMCCOM
PICATINNY ARSENAL, N. J.

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ABSTRACT

This report deals with the type of automation necessary to manufacture the various Hand Held Signals, 40MM Signals, and the Finishing of the Star Components at Longhorn AAP. It details the major objectives and necessary assumptions that evolved during the research and design phases of this report. The specific automation approaches to be taken are detailed for each assembly procedure. The report provides overall system integration requirements. The layouts of the two manufacturing buildings are detailed. Several component changes to the Hand Held Signals are proposed. None of these will affect the operation of the final product. They are suggested to improve automation and increase product reliability. The entire system will be monitored at a Remote Terminal which will be located in the Administrative area. This will provide quality and production information for reports, historical records, component ordering and maintenance scheduling. Implementation efforts required are scheduled and detailed by building. All costs including material, fabrication drawings, fabrication, checkout, and installation are given for each part of the automation system. The risks of implementing the proposed system are reviewed. Final conclusions and recommendations are presented.

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LIST OF SYMBOLS, ABBREVIATIONS, AND ACRONYMS

AAP	Army Ammunition Plant
AGA	American Gas Association
AMCCOM	Army Material Command
AMCR	Army Materials Command Regulation
Amp	Ampere
ANSI	American National Standards Institute
API	American Petroleum Institute
App.	Applicator
Assy	Assembly
C.	Celsius
CD ROM	Compact Disk Read Only Memory
CPU	Central Processing Unit
Dwg. No.	Drawing Number
EPA	Environmental Protection Agency
Fig.	Figure
FM	Factory Mutual System
Hdw.	Hardware
HHS	Hand Held Signal
IEEE	The Institute of Electrical and Electronic Engineers, Inc.
I/O Rack	Input/Output Rack
ISA	Instrument Society of America
LL	Low Level
LLL	Low Low Level
Max	Maximum
MIL Spec.	Military Specification
Min.	Minimum
Miss.	Missing
MM	Millimeter
N/A	Not Applicable
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
O&M Manuals	Operation and Maintenance Manuals
OSHA	Occupational Safety and Health Administration
P/N	Part Number
Psi	Pounds per square inch
RAM	Random Access Memory
SOP	Standing Operating Procedure
SPC	Statistical Process Control
Spkr	Speaker
UL	Underwriters Laboratory, Inc.
UPS	Uninterruptible Power System
UV	Ultraviolet
VGA	Video Graphics Adapter
WORM	Write Once Read Many

1.0 Introduction

The manufacture of the various Hand Held Signals, 40MM Signals, and the Finishing of the Star Components at Longhorn AAP has remained virtually the same since those products were introduced in the late 1950's. At that time, the most effective manufacturing needed to be very labor intensive. This subjects the operators to hazardous materials (in the form of pyrotechnics and solvents) and potential manufacturing accidents.

The operation of these lines at Longhorn AAP have never been either a safety or a quality problem. But now that new technology exists, it is possible to improve the present manufacturing procedures. Safety can be greatly increased by automating the assembly lines. It would keep the operator's exposure to hazardous materials to a minimum especially when undergoing manufacturing procedures. This is when the most risk occurs. Also any potential pinch points can be eliminated.

Because a piece of automation can be programmed to always perform certain operations before proceeding, it is capable of assuring that all correct steps are taken. If any problems are sensed during the operation, the part can be immediately rejected. Such rejection can be automatically recorded. Thus every part that is manufactured can be of the same high quality. The expense of some testing (e.g. visual and real time x-ray) makes it mandatory that manual inspection be employed at certain stages of the manufacture. Again, results from such examinations must be entered into the quality monitoring system.

By tracking the type and frequency of quality problems, adjustments can be made to guarantee product quality and production rates. These can include mechanical adjustments as well as changes in component supply.

Any good automation system requires precise location of the parts on which operations are being performed. For this reason it became necessary to integrate several large material transfer systems between the islands of automation. This led to the development of what can be referred to as large machines. Each of these is, in reality, only a conveying system between manufacturing processes. Such processes are described in detail.

Several of the product components should be modified or manufactured from bulk materials prior to assembly. The present design was developed for the manual assembly operations. They require needless complexity or potential quality problems. Changes proposed in this report will not change either mechanical or product firing process. It is often as simple as changing the bolt head for better torquing and not maring the fire hole. Such changes should be easily approved by AMCCOM without long testing.

The automation system proposed herein accomplishes the above while also maintaining the approved budget for this project.

2.0 Methods, Assumptions, and Procedures.

2.1 Overview and Objectives. This report was contracted to determine the feasibility and level of automation that is practical for the assembly of the Hand Held Signals and Star Finishing Operations at Longhorn AAP. Those operations are presently manual and subject the operating personnel to exposure to hazardous materials during the manufacturing.

The major objectives of this report were modified as the study progressed. Those changes included using the new target cost of $3,130,000 (1989) that have been approved rather than the $2,500,000 listed in the proposal. Also, it became apparent that to effectively automate the Hand Held Signal operations in Building 16Y; the 40MM Signals, that are also produced there, should be automated. One change in the current Hand Held Signal packout was discovered to be scheduled for implementation by AMCCOM in 1991. Thus, the new plastic shipping container was substituted for the present metal can. Several components that currently are being manufactured by outside sources could be more easily fabricated just prior insertion. This greatly simplified material handling problems. Five components were changed to facilitate easier automation. Those changes were also incorporated into this report.

The objectives for this report became as follows:

1) Determine the feasibility of automating the following assembly areas.

   a) Hand Held Signal Flight Assembly Operations
   b) Hand Held Signal Rocket Barrel Assembly Operations
   c) Hand Held Signal Containerization Operations
   d) 40MM Signal Assembly Operations
   e) Leak Testing and Final Packout Operations
   f) Payload Subassembly Operations
   g) Star Finishing Operations

2) Determine the level of automation for the above operations.

3) Use of readily available equipment and technology.

4) Automation shall be capable of meeting or exceeding current production line rates.

5) Automation shall guarantee high quality and reliability of products.

6) Assessment of risk associated with each automation approach suggested.

7) Automation concepts shall require only the deletion or modification of existing equipment only. Reconfiguration of existing facilities, i.e. "brick and mortar," shall not be considered.

8) The cost of the installed automation equipment is to be less than $3,130,000 (1989) or $3,440,000 (1992).

9) All inspections and tests currently required on the products and their components would be continued under the proposed system. Some inspection would require changes in method and would be so noted.

10) Use of the new Hand Held Signal plastic container that is scheduled to be implemented in 1991.

11) Component changes dictated by proceeding from a manual operation to automatic include:

a) On-line manufacture of washer and spacers to facilitate material handling.

b) Use of different bolt and lubricant to minimize critical defects in the Hand Held Signal Flight Assembly Operation.

c) Insertion of separate rubber and wood protectors in the HHS Rocket Barrel Assembly Operations.

d) Use of hot melt sealant rather than lacquer on the end of the assembled Hand Held Signal.

e) Use of a different parachute clip on the illuminates during the Payload Subassembly Operation.

f) Consistent orientation of the grooves in the two sides of the star and applying an orientation mark to the exterior of the star's cardboard tube.

12) Design to use products manufactured in the United States.

13) Royalty-free license for the use of all proposed automation.

14) Provide multiple source on equipment proposed.

15) Compliance with all safety rules and standards for final project.

16) Use of all applicable codes and standards.

17) Use of good engineering practice to assure proper and reliable operation as well as ease of maintenance.

18) Removal of operating personnel from potentially hazardous work and minimizing exposure to energetic materials.

All of these objectives were cleared through the Contracting Officer's Representatives prior to the preparation of this report.

2.2 **Component and Product Specifications.** The component and product specifications used during the preparation of this report are as follows:

Hand Held Signals Assembled Products		Numbers
Green Star Illuminant	M195	9255113
Red Star Illuminant	M126A1	9328576
White Star Illuminant	M127A1	9295010
Green Star Cluster	M125	8797956
Red Star Cluster	M158	8839489-X
White Star Cluster	M159	8839489-Y
Green Smoke	M128A1	8797998-1
Red Smoke	M129A1	8797998-2

40MM Signals Assembled Products		Numbers
Green Star, Parachute	M661	9317510
Red Star, Parachute	M662	9255145
White Star, Parachute	M583A1	9243881
White Star, Cluster	M585A1	9212688

Hand Held Signal Components

Component	MIL Spec. or Dwg. No.	Notes
Motor Tube Casing	8797921	
Delay Assembly	9251412	
Signal Body	8797963	

Spacer	8797936	New part proposed to be manufactured on line.
Propellant	8887530	
Spacer	8797936	New part proposed to be manufactured on line.
Tail Assembly	8797947	
Exhauster Plate	9235026	
Bolt	8797928	New part proposed to be used - redesign of bolt
Black Powder	Class V MIL-P-223	
Washer	New Part	Proposed to be manufactured on line to partially replace washer disc assembly.
Paper Seal	New Part	Proposed to be manufactured on line to partially replace washer disc assembly.
Cork	8797923	
Tape	N/A	
Rocket Barrel	8797929	
Primer	8797926	
Phenol Varnish	MIL-V-13750	
Black Powder	Class V MIL-P-223	
Rocket Barrel Washer	8797937	New part proposed to be manufactured on line.
Washer	New Part	Proposed to be manufactured on line to partially replace washer disc assembly.
Paper Seal	New Part	Proposed to be manufactured on line to partially replace washer disc assembly.
Retaining Washer	8797927	
Signal Motor Assembly		No number presently for this part.
Rubber Seal	New Part	Proposed to be manufactured on line to partially replace protector assembly.
Wooden Protector	New Part	Proposed to partially replace protector assembly.
Cork Seal	8797922	
Label	8797931-1 8797931-2 8797931-3 8797931-4 8797931-5 8797931-6	

	8797931-7	
	8797931-10	
Thermo Set Plastic	New Part	New part - replaces lacquer seal.
Barrel Cap	8797953	
Plastic Container	12900003	
O-Ring	12900007	
Lubricant	12900008	
Cap	12900013	
Label	12900005	
Containerized Hand Held Signals		No number for this item
Fillers, Separator	12900009-1	
	12900011	
Wooden Case	12900010	
Filler	12900009-2	
Banding Material	12900009-3	
Metal Security Seal	8794342	
Pallets		No number for this item
Cardboard Separator	MIL-F-50449	
Parachute Assembly	8797991	In new longer parachute holding tube.
Payload Assembly	9328576	
	9255113	
	9295010	
	879798-1	
	879798-2	
Washer	8797925	New part proposed to be manufactured on line.
Star Assembly	8797956	Manufactured with index mark for orientation.
	8839489-X	
	8839489-Y	
First Fire	MIL-P-48240 Type 1	
	MIL-P-48240 Type 2	
	MIL-P-48240 Type 3	
Quick Match	MIL-Q-378	
Cardboard Tubes	New Part	Proposed for containerization of stars (not assembled into final product - reuseable).
Bar Code Label	(Undefined)	

<u>40MM Signal Components</u>

Component	MIL Spec, or Dwg. No.	Notes
Body	9243900	
Delay	9243885	
Sealant	9243893	
Rubber Spacer	9243892	New part proposed to be manufactured on line.

Ogive	9243882 9317511 9255145	
O-Ring	9243894	
Lubricant	MIL-S-8660	
Cartridge	9207988	
O-Ring	MS-28900	
Assembled 40MM Signals		
Cardboard Packing Tube	929204	
Fillers, Separator, Desiccants	PPP-F-320 MIL-D-3464 9378429	
Metal Ammunition Box	9209204	
Separator and Fillers	MIL-F-50449	
Wirebound Box	9209205	
Banding Material	8799715	
Metal Security Seal	8794342	
Pallets		No number for this item.
Cardboard Separator	MIL-F-50449	
Parachute Assembly	8797991	In new longer parachute holding tube.
Payload Assembly	9317510 9255145 9243881	
Washer	8797925	New part proposed to be manufactured on line.
Star Assembly	9212688	Manufactured with index mark for orientation.
First Fire	MIL-P-48240 Type 1 MIL-P-48240 Type 2 MIL-P-48240 Type 3	
Quick Match	MIL-Q-378	
Cardboard Tubes	New Part	Proposed for Containerization of stars (not assembled into final product - reuseable)
Bar Code Labels	MIL-STD-129	

2.3 **Production Rates.** The contract documents detail specific production rates of:

Hand Held Signal Flight Assembly	12 Units/Minute
Hand Held Signal Rocket Barrel Assembly	12 Units/Minute
Hand Held Signal Containerization	12 Units/Minute
Leak Testing and Final Packout	12 Units/Minute
Star Finishing Operations	25 Units/Minute

To allow for downtime and assure necessary shift production rates, the minimum design rates were changed to:

Hand Held Signal Flight Assembly	15 Units/Minute
Hand Held Signal Rocket Barrel Assembly	15 Units/Minute

Hand Held Signal Containerization	15 Units/Minute
40MM Signal Assembly	15 Units/Minute
Leak Testing and Final Packout	15 Units/Minute
Payload Subassembly	15 Units/Minute
Star Finishing Operations	30 Units/Minute

As the technology was studied, it became evident that the production rates could be increased substantially above those rates without additional cost for automation. The only limiting factor to increasing those rates sixty percent is the ability to perform the manual inspections with one inspector per inspection station. Thus increased output would only result in added inspection personnel. The report is based upon the 15 Units/Minute and 30 Units/Minute rates for Star Finishing Operations.

2.4 **Equipment Restrictions.** The nature of the energetic materials and the required operations resulted in several equipment restrictions. Other contract requirements introduced further limitations.

1. All equipment shall meet the safety requirements as listed in section 2.6.
2. All equipment will be designed and built to industry standard practices and procedures. This shall include conforming to local regulations and ordinances and the latest applicable standards and recommendations of:

    ANSI - American National Standards Institute
    NEMA - National Electrical Manufactures Association
    IEEE - The Institute of Electrical and Electronic Engineers, Inc.
    NEC - National Electrical Code
    NESC - National Electrical Safety Code
    NFPA - National Fire Protection Association
    ISA - Instrument Society of America
    API - American Petroleum Institute
    AGA - American Gas Association
    UL - Underwriters Laboratory, Inc.
    FM - Factory Mutual System
    OSHA - Occupational Safety and Health Administration
    EPA - Environmental Protection Agency

3. Sanitary construction will be used throughout the equipment. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials.
4. System component selection will be made considering the energetic materials that will be handled on the system and the solvent cleaning solutions used to clean the equipment.
5. All equipment must be readily available and of proven technology.
6. Necessary checking shall be performed throughout the assembly to assure high quality and reliability of the product. Automatic rejection of questionable parts or operations shall result in virtual zero-defects at final packout.
7. Rejection records shall be automatically recorded (except in the

final packout area) to provide maintenance information.

8. Only products supplied by United States companies shall be considered. Major components shall be manufactured within the United States.

9. No payment of royalty will be permitted for any of the proposed automation.

10. Only equipment which has multiple sources shall be used.

2.5 Building and Utilities Limitations.

2.5.1 Building Limitations. The existing buildings 16Y, 18Y and 34Y shall have building restrictions in the construction of the scope of this project. The buildings shall not have any construction or demolition changes, therefore, existing walls shall remain with no modifications to their construction. The metal plates in Building 16Y separating the bays will have to be modified for the new conveyors and material handling systems. Any venting shall be routed to an outside wall so roof modifications will be prevented. Routing of conduit and piping shall be the exception for wall modifications. Holes for conduits will have to be made between the bays and the corridor where the control panels will be located in Building 16Y, and also between the utility room and the control panel in Building 34Y. Manufacturing equipment in Building 18Y may be removed and the building may be used for storage of materials used in the manufacturing process in Building 16Y. Ambient temperature for these buildings is +40 degrees Fahrenheit minimum and +85 degrees Fahrenheit maximum.

2.5.2 Utilities Limitations. The existing buildings 16Y, 18Y and 34Y shall utilize the existing utilities available currently. These utilities are listed in the following sections.

2.5.2.1 Electrical Utilities. Buildings 16Y and 18Y have 200 Amp, 440 volt 3 phase supply power and 100 Amp, 120 volt 1 phase supply power at each building. Building 34Y has 400 Amp, 440 volt 3 phase supply power and 100 Amp, 120 volt 1 phase supply power. The existing electrical utilities have ample expansion available at each building for the new equipment utilized in the scope of this project.

2.5.2.2 Compressed Air Supply. Each building is supplied from a central compressor system supplying 100 psi compressed air for the manufacturing processes.

2.5.2.3 Steam Supply. Each building is supplied with a steam supply from a centralized steam boiler system. During the summer 85 pounds of steam pressure is available, and 125 pounds of steam pressure is available during the winter.

2.5.2.5 Water Supply. The potable water supply has 75 pound pressure available at each building.

2.5.2.6 Fire Sprinkler Water Supply. The sprinkler system has 85 pound pressure available at each building and is a separate water supply system.

2.6 Safety Requirements. Safety is a primary concern of all manufacturing equipment, but is even more important when the materials used are hazardous and/or energetic. The safety requirements shall include:

1. The codes and standards listed in Section 2.4 and the following specific documents:

AMCR 385-100, Safety Manual

2. All equipment in the explosives areas will be grounded and bonded.

3. Non-sparking construction will be used for materials contacting pyrotechnics.

4. Rapid response fire protection system shall be installed over the equipment (and inside shielded stations if necessary) and appropriate sensors will be installed to activate the system. It shall be a deluge system using water.

5. OSHA standards will be followed in the construction, guarding, and warnings used on the equipment.

6. The equipment will be designed upon "fail-safe" principles. The application of all control devices and their interconnections will permit operation only on proper and safe operative conditions.

7. Electrical and instrumentation components located within Buildings 16Y and 34Y shall be rated for operation in

Class I Division 1 Group D

Class II Division 1 Group E,F and G

8. Motors and other heat generating components shall have a maximum external temperature of 165 degrees C. (T3b motor rating)

2.7 **Quality Control Requirements.** Each product has a detailed list of items which must be checked both at the component and assembled level. The checks which are described in the existing Standard Operating Procedures and the Military Specifications are performed through manual operations. Since the objective is to minimize personnel contact, other methods will be developed for automatic checking. The objective is still to check each point, but the type of check may be modified to replace human effort.

A more accurate monitoring and logging system can be employed. This could help isolate problems in the assembly equipment as well as the component suppliers. Since most of this information is not required on the assembly line, it can be housed in the Administrative area at Longhorn AAP. Automatic communications to the assembly area can be obtained through the existing telephone system.

2.8 **Project Methods.** The methods employed to produce this report were basically chronological in nature. They allowed for understanding, research and evaluation of the various items proposed.

1. Familiarization - Understanding of the product, components, present assembly methods, and physical constraints.

2. Exploration - Developing various approaches to each step.

3. Availability - Determining the equipment that was available to perform the various approaches.

4. Evaluation - Selection of the best approach based upon price, reliability and safety.

5. Integration - Developing an overall plan including layout, system interface, and control parameters.

6. Review - Additional refinement and necessary modifications as

report objectives evolved.

7. Report Development - Documentation of the findings and the parameters used.

Throughout this process both AMCCOM and the operating company at Longhorn AAP were informed of the findings as well as needed changes to the original objectives.

3.0 Building 16Y Automation and Quality Control System.

3.1 System Description. The automation of Building 16Y shall permit assembly testing and packout of the various Hand Held Signals and 40MM Signals presently produced. The system has been modularized to group associated operations within existing rooms and create a logical flow of components and assemblies.

All equipment and assembly techniques discussed are capable of more than the required production rates. Their implementation can be done within the necessary safety requirements and building restrictions. The product coming from such automation should be of higher quality caused by the large number of internal quality checks performed.

3.2 Integration. The control system is detailed in the Control System Diagram (Diagram 11 in Appendix A). The Main Control Panel provides utilities and control interface to the other four machine control panels in Building 16Y. It also controls the Leak Testing and Packout Machine, the Case Palletizer, the Packout Conveyor, the Staging and Magazine Loading Alarm Center, and the Voice Synthesis Alarm System. The communication between the Remote Console comes through a telephone modem in the Main Control Panel.

3.3 Layout. The major parts of the Automation and Quality Control System are shown on Layout Drawing No. 1 in Appendix A and detailed below:

Room 105	Staging and Magazine Loading Alarm Center Building 16Y Paging Speaker
Room 106	Parachute - Payload Subassembly Machine Building 16Y Paging Speaker
Room 107	Hand Held Signal Motor Assembly Machine Building 16Y Paging Speaker
Room 108	Hand Held Signal Motor Inspection Station Rocket Barrel Assembly Machine Hand Held Signal Rocket Barrel Inspection Station Hand Held Signal Containerization Machine Building 16Y Paging Speaker
Room 109	Hand Held Signal Conveyor Building 16Y Paging Speaker
Room 110	40MM Assembly Machine 40MM Inspection Station Building 16Y Paging Speaker
Room 111	Main Control Panel Leak Testing and Packout Machine Case Palletizer Packout Conveyor Building 16Y Paging Speakers
Corridor	Hand Held Signal Assembly Machine Control Panel Rocket Barrel Assembly Machine and Hand Held Signal Containerization Machine Control Panel 40MM Assembly Machine Control Panel Building 16Y Paging Speakers

3.4 **Special Considerations.** The automation system proposed for Building 16Y will demand a high level of system integration as well as critical production operations. It is important that the entire system be thoroughly checked at the vendor's premise prior to shipping. This should include a continuous production of 2500 units of each type of payload assembled and packed as final product at 135% of production rate.

The above checkout will assure that the equipment once installed at Longhorn AAP will operate as required without major start-up delays. Because of the magnitude of the equipment proposed, it will be impossible to maintain even limited production within the building. It appears that a minimum of 45 days downtime would be necessary. That would not include the start-up of the equipment which could take another 15 days. Thus a total of 60 days should be allotted. Even this would require certain pre-installation preparation that should be detailed in the final design and schedule.

During the installation downtime, the equipment vendor should train the operators, maintenance personnel and engineering for a complete understanding of the equipment. This should include levels of troubleshooting and familiarization with the system documentation. Items such as action/decision diagrams should be prepared for each level of personnel. These should be incorporated with the new Standard Operating Procedures.

Complete documentation should precede start-up including programming code and O&M Manuals. The vendor should present all design notes and other information used by their personnel during the start-up.

The decision to use new weigh feeders for the black powder was made to minimize building downtime. If the existing feeders were used, the downtime would need to be increased for final integration. That would occur prior to the checkout at the vendor's. It could mean an additional 60 days downtime.

Technical specialists must be stationed at Building 16Y. They should include two Mechanical Technicians to perform necessary setup, maintenance and calibration. An Electronic and Instrumentation Technician should also be stationed at Building 16Y. He can assist in troubleshooting and maintenance of the sophisticated controls systems. He should also have time to assist in Building 34Y. Note that these must be technically competent people. They will be required to interface with robotics as well as the fixed place automation. Special training should begin once the vendor has developed a final design. It should include courses on all major equipment and controls.

As stated in Section 2.3, the production rates can easily be increased without changes in technology. It is suggested that such an increase be implemented to guarantee production rates even with extended downtimes. This will be of particular importance when initially operating the system. If this option is to be taken, increased magazine and hopper storage should be specified.

3.5 **Items Considered - Utilized/Rejected.** Many assembly methods were considered, but safety and removal of the operating personnel from the hazardous areas were the deciding factors in choosing the proposed design.

Different styles of conveyors were considered, rotary table, over-under carrousels, and power and free pallet conveyors. The rotary table was not chosen because of the shape of the existing rooms and the amount of bulk materials that need to be at the machines. The walking beam was chosen because it would have less areas to trap material than the carrousel or power and free. It was also chosen because it could index parts positively, repeatably, and gently. A basic walking beam conveyor is a system of individual stationary fixtures for holding the assemblies. These fixtures are located in a straight line forming the sequence of assembly operations. Each fixture is narrower than the assembly it holds. Two parallel bars are located outside of the fixture station. To transfer assemblies the bars are raised on each side of the fixture, raising the assemblies up above the holding fixture. The bars then traverse forward moving the assemblies above the fixture for the next operation. The bars are then lowered allowing the assemblies to settle into the next holding fixture. After the assemblies are in the fixture the bars continue to lower, so that the bars are no longer holding the assemblies. The bars then retract to the starting position so the walking beam can move the assemblies to the next station. The advantage of the walking beam design is that there are few places for the energetic materials to collect. It is also very easy to disassemble the bars and wash down the equipment.

It was considered to use the old 40MM leak test system and design a new Hand Held Signal leak tester; but after investigation, it was found that one new system could do both devices and be integrated into an automated system more easily.

Much effort was expended trying to handle the light, flimsy components (felt washers, rubber washers, and paper assemblies). It was finally decided to manufacture these items during the assembly process so that the bulk parts would not have to be oriented and placed in the devices.

The other equipment considered included:

Rocket Motor Assembly Machine

Station 1 - Horizontal hoppers and star wheels used in conjunction with a magazine and shuttle. Vibration bowls in this area would be excessive in size.

Station 3 - Special design cutter used. Vibration bowl cannot be used. Parts will jam.

Station 4 - Horizontal hopper and star wheel used. Vibration bowl too rough on propellant.

Station 5 - Special design cutter used. Vibration bowl cannot be used. Parts will jam.

Station 7 - Cleated conveyor belt used with automatic stop. Table top conveyor has excessive wear.

Station 8 - Vibration hopper and rotating rollers used.

Station 11 - Robot. Fixed-place automation too restrictive and costly.

Station 12 - Match die used. Roll cut die dulls too easily.

Rocket Barrel Assembly Machine

Station 1 - Horizontal hopper and star wheel used. Vibration bowl too large.

Station 2 - Special design applicator. Spray required ventilation, masking and loss of material.

Station 5 - Robot. Fixed-place automation too restrictive and costly.

Station 6 - Match die used. Roll cut die dulls too easily.

Station 7 - Match die used. Roll cut die dulls too easily.

Station 10 - Fixed-place automation or robot can be used.

Station 11 - Rule die used. Match die delivers bad part.

3.6 Hand Held Signal Motor Assembly Machine.

3.6.1 General. This machine will assemble the hand held signal bodies consisting of the following major components: signal body, casing tube, delay, propellant, exhaust plate, tail assembly, payload, expelling charge, and seal. The machine will operate at a rate of 15 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded that is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The conveying system will be a walking beam conveyor (Fig. 1 in Appendix A). This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to assemble and inspect the Hand Held Signal.

3.6.2 Assemble Casing Tube, Delay Assembly and Signal Body. The first station assembles the following parts - casing tube (8797921), signal body (8797963), and the delay assembly (9251412). These parts are fed to the assembly line by the following systems:

The casing tube is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the shipping containers. The capacity of the hopper will be a minimum of 225 parts. This hopper would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The signal body is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the shipping containers. The capacity of the hopper will be a minimum of 225 parts. This hopper would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The delay assembly is fed from a column magazine and transferred to the assembly fixture through a shuttle mechanism. The magazines will be loaded in the magazine loading area and the filled magazines will manually be transported to the assembly machine and installed into the shuttle mechanism (Fig. 3 in Appendix A). Each magazine will have a minimum capacity of 20 delays and the shuttle mechanism will have a minimum capacity of 12 magazines. The shuttle would be refilled a maximum of four times an hour. The delay assembly contains energetic material and should be stacked so the material can not rub against the material of another delay assembly. The delays should not be dropped a distance more than one diameter of the delay assembly during transfer. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the shuttle needs refilling; the other sensor will signal when the shuttle is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A photo sensor will be located at the discharge of the shuttle to detect the presence of the delay mixture. If there is any light showing through the delay cavity, the delay mixture is not present and the delay assembly will be rejected. Rejects will be removed before assembly onto the signal body.

The signal body is fed into a nest type fixture. A part presence sensor will tell the controller it is there and in proper position. A mandrel will be inserted into the end of the signal body (Fig. 4 in Appendix A). The delay assembly will be presented to the mandrel and will be centered on a pin that is mounted in the center of the mandrel. A part presence sensor will tell the controller it is there and in proper position. The casing tube will be fed into a nest type fixture and a part presence sensor will tell the controller it is there and in proper position. A second floating mandrel will be inserted into the end of the casing tube. This mandrel will move to the first mandrel and the center pin will align the two mandrels. After the mandrels are aligned properly, and the part sensors verify presence and position, the three parts will be pressed together. If the part sensors do not confirm the parts placement, then the assembly would be stopped and the parts removed from the assembly machine automatically and the operation would start over again. After the mandrels are withdrawn, the assembly will be discharged to the next station. The part presence sensors will verify that the assembly was transferred to the next station by the component parts being removed from their assembly position.

The second station will check the assembly for concentricity and overall length to verify the assembly was properly assembled. The signal body will be rotated 90 degrees right and left, and proximity switches will detect if the casing tube is concentric to the signal body. Parallel bars will provide a go, no-go gage for the overall length of the assembly. Assemblies failing either test will be discharged into reject containers. After the checks are verified, the assembly will be transferred to the next station.

3.6.3 **Manufacture First Propellant Spacer and Insert Into Casing Tube.** The operations at the third station consists of manufacturing the propellant spacer (9328587) from tube stock and inserting the part into the signal body assembly produced in the previous step.

The spacer tube stock will be fed on a mandrel to a cutting unit that will cut the individual spacers. The mandrel will have a minimum capacity to hold four feet of tube material. The tubes will be manually loaded onto the mandrel a maximum of four times an hour. The spacer will then be transferred to another unit that will cut the 90 degree section from the spacer. The scrap will fall into a discharge chute (Fig. 5 in Appendix A). The spacer will then be inserted into the signal body assembly. The assembly holding fixture will be tilted at a 20 degree angle so the spacer will seat properly in the bottom of the casing tube. Sensors will be located on the tube feed to indicate that more material is needed. A second sensor will signal when the mandrel is empty and the main control will shut down the operation. A part presence sensor will be installed at the section cutting station. This sensor will verify that a spacer is present to be trimmed and will verify that the spacer is no longer on the mandrel and was inserted into the casing tube. A sensor checks for presence of the component, after operation it checks if the component is not present. If these conditions do not occur, the control system will reject the assembly presently at that station. If proper operation did occur, the assembly will then move to the next station.

NOTE ALTERNATE METHOD: An alternate method would be to use the existing pre-cut spacers and use a feeder bowl to feed the spacers to the section cutting unit. A feeder bowl will feed the spacers into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 450 spacers and will be filled a maximum of twice an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The cutting of the section would be the same as above.

3.6.4 **Load Propellant Into Casing Tube.** The fourth station assembles the following parts - propellant (8887530) and the above assembly. These parts are fed to the assembly line by the following system: The propellant is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the containers currently used. The capacity of the hopper will be a minimum of 150 parts. This hopper would be refilled a maximum of seven times an hour. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The propellant is fed into a nest type fixture. A pusher with positive mechanical stops will insert the propellant into the casing tube. A part presence sensor will verify that propellant was presented to the casing tube and was not present after the insertion. The assembly will then be transferred to the next station.

3.6.5 **Manufacture Second Propellant Spacer and Insert Into Casing Tube.** The operations at the fifth station consist of manufacturing the propellant spacer (8797936) from tube stock and inserting the part into the signal body assembly produced in the previous step.

The spacer tube stock will be fed on a mandrel to a cutting unit that will cut the individual spacers. The mandrel will have a minimum capacity to hold four feet of tube material. The tubes will be manually loaded onto the mandrel a maximum of four times an hour. The spacer will then be inserted into the signal body assembly. The assembly holding fixture will be tilted at a 20 degree angle so the spacer will seat properly in the bottom of the casing tube. Sensors will be located on the tube feed to indicate that more material is needed. A second sensor will signal when the mandrel is empty and the main control will shut down the operation. A part presence sensor will be installed at the insertion station. This sensor will verify that a spacer is present and will verify that the spacer is no longer on the mandrel and was inserted into the casing tube. A sensor checks for presence of the component, after operation it checks if the component is not present. If these conditions do not occur, the control system will reject the assembly presently at that station.

NOTE ALTERNATE METHOD: An alternate method would be to use the existing pre-cut spacers. A feeder bowl will feed the spacers into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 450 spacers and will be filled a maximum of twice an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The sixth station measures the depth inside the casing tube using a probe. This will be a check of overall length of the two spacers and propellant charge. If the measurement is incorrect, the assembly will be discharged into the reject container and the information will be sent to the SPC system. The acceptable assemblies will then move to the next station.

3.6.6 Assemble Tail Assembly and Exhaust Plate to Casing Tube. The seventh station assembles the following parts - tail assembly (8797947), exhaust plate (9235026), and the above assembly. These parts are fed as follows:

The tail assembly will be fed on a cleated flat belt conveyor that will hold individual layers of the "egg crate" shipping boxes. The shipping cartons of ten layers of tail assemblies will be stripped away, and the layers will manually be placed on the conveyor. The conveyor will hold six layers of components. This will require that the conveyor be filled twice an hour. (See machine layout on Layout Drawing No. 1 in Appendix A.)

A feeder bowl will feed the exhaust plate into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 450 exhaust plates and will be filled a maximum of twice an hour.

A pick and place unit will pick the tail assembly from the "egg crate" and place it on the casing tube. Sensors will detect the presence of a part and will monitor if the part was placed on the casing tube. If a part is not detected, the pick and place will try another compartment looking for an assembly. When no assembly is found after a predetermined number of tries, an alarm will be sent by the control. Two other sensors will monitor the conveyor for low level of "egg crates" and when the conveyor is empty. This information will be sent to the controller for processing and an orderly shutdown to occur. The exhaust plate will be fed into a nest and a pusher with a center pin will transfer the exhaust plate to the casing tube and be pressed into the tube. A sensor will verify the part presence prior to the machine operation, and after operation will verify the exhaust plate was pressed onto the casing tube by no longer sensing the exhaust plates presence. The scrap "egg crates" will continue on the conveyor and be discharged on the other side of the assembly machine. The scrap will then be manually placed in a scrap container.

3.6.7 **Install Bolt Into Casing Tube Assembly.** The eighth station assembly consists of a bolt (the current part 8797928 will be modified to an external Torx head. This will eliminate possible damage to the center hole in the bolt), Loctite thread sealer (current teflon tape to be replaced), and the above assembly.

The bolts are fed from a hopper into a rotating roll orientation system (Fig. 6 in Appendix A). The hopper for this system would have a minimum capacity of 900 bolts and would need manual filling a maximum of once an hour.

The bolts would be discharged from the roll orienting system and would be presented to an applicator that would apply the sealer to the threads. A sensor will verify that the sealer applicator operated to apply sealer. The bolt would then be placed into the driver. The driver would screw the bolt into the casing tube assembly. Sensors would detect the level of bolts in the hopper, presence of the bolts in the roll orientation system, and presence of sealer in the application system. The torque driver has a torque sensor which measures the amount of torque supplied to the bolt and also a sensor to measure the depth the bolt was driven. If the torque specification was met but the depth wasn't, this would mean the bolt cross thread into the delay assembly and the whole assembly would be rejected. If the torque specification is not met but the depth was, this would mean the bolt is still loose in the delay assembly and the whole assembly would be rejected. Out of specification assemblies would be rejected and removed from the assembly line.

The ninth station checks for alignment of exhaust plate and proper spin of tail assembly. Three probes will probe the exhaust plate to verify proper alignment. Improperly aligned assemblies will be rejected. An air blast will rotate the tail assembly and a proximity switch will detect the movement. This information will determine if the tail assembly functions properly. Improperly functioning assemblies will be rejected. The reject information would be recorded in the SPC data recording system. Acceptable assemblies will be transferred to the next station.

NOTE ALTERNATE METHOD: An alternate would be to use the existing teflon tape and use the existing manual application of the tape. This would eliminate the application of the liquid thread sealer; all other operations would remain the same.

An alternate for the Torx headed bolt would be to use the existing bolt with a slotted head. Additional sensors would have to be installed to detect the presence of a burr in the hole. It would also require a special driver with a pin into the center hole for alignment and to keep the burrs out of the center hole. An electromagnet would be used during the driving operation to assist the special driver from jumping out of the slot and causing a burr.

3.6.8 **Load Expelling Charge Into Signal Body.** The tenth and eleventh stations load the expelling charge into the signal body. The components assembled during this operation are black powder (class V, MIL-P-223) and the above assembly.

A pick and place unit removes the signal body from the assembly line and places the assembly on a scale so the weight of the assembly can be tared out. After the weight is taken, the assembly is presented to a new powder feeding system so the expelling charge can be loaded into the signal body. A weigh feeding system will be added to the powder feeder and will dispense a known weight of powder to the system. This charge will be used to check the calibration of the system. The assembly is then returned to the scale so the presence of a charge can be verified. If the three weighing units agree on the proper weight of the charge, the assembly is then transferred to the next station. If the three weighing units do not agree on the weight of the charge, the control system will shut the system down and signal an alarm. The scale that verifies the presence of a charge will also be able to detect high and low charges and these assemblies can be rejected. That data would be sent to the SPC data recording system.

NOTE ALTERNATE METHOD: The existing powder feed system could be used in the new system, but it would require modification and the powder dispensing system would have to be sent out a minimum of 30 days before system installation for adaptation to the new system.

3.6.9 **Manufacture Washer Assembly and Insert Into Signal Body.** The components that will be assembled at the twelfth station are the washer (8797958-1 - this component assembly will be manufactured on the machine replacing the current pre-assembled units) and the above assembly.

The felt washer will be die cut from felt roll stock. The cutter will have the capacity to hold a minimum of sixty-five feet of felt material; this would require a material change twice an hour. It would also have a take-up roll for the waste material. A second set of feed and take-up rolls will be installed so that the refilling would not interrupt the automated assembly system. The paper lower disc (8797959) would be supplied in label form, die cut with adhesive pre-applied and on a wax paper feed strip a minimum of 900 labels per roll with a maximum of manual attention of once an hour. The cut felt washer will be presented to the labeling unit where the paper lower disk will be applied to the felt washer. The labeler will have two supply spools and two take-up spools so the automatic assembly machine will not be interrupted. After the assembly is completed, it will be inserted into the signal body. Sensors will be located on the felt roll and label roll to signal low level and when the rolls are empty. These signals will be sent to the controller and alarms will be sounded as needed. A part presence sensor will verify that a completed washer assembly was presented to the signal body and that the washer was installed. The sensor would sense that the washer was present before the assembly operation and that it was not present after the assembly operation.

NOTE ALTERNATE METHOD: An alternate would be to use the existing washer and paper assembly. An operator would be added to the line and the operator would manually insert the assembly.

3.6.10 **Install Payload Assemblies into Signal Body.** The payload assemblies (9255113, 9328576, 9295010, 8797998-1, or 8797998-2) and star assemblies (8797956, 8839489-X, or 8839489-Y) are assembled into a tube in another area. They are inserted into the signal body at the thirteenth station.

The payload is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the containers currently used to handle these components; the capacity of the hopper will be a minimum of 150 parts. This hopper would be refilled a maximum of seven times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The signal body is aligned with the subassembly tube prior to insertion. Part presence sensors verify their correct position. An insertion tool with positive mechanical stops then inserts the payload into the signal body. After insertion, the subassembly tube is discharged into a bin for reuse and the signal body assembly is transferred to the next station.

3.6.11 **Insert Cork into Signal Body.** The fourteenth station inserts the cork into the above assembly. A feeder bowl will feed the cork seal into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 450 cork seals and will be filled a maximum of twice an hour.

The cork seal will be fed to the insertion tool with positive mechanical stops, and then inserted into the signal body. A part presence sensor would sense that the cork was present before the assembly operation and that it was not present after assembly operation. The signal body assembly is then transferred to the next station.

3.6.12 **Tape Cork to Signal Body.** The fifteenth station applies pressure tape (Spec. L-T-90) to the above assembly.

Two tape dispensers will be used to automatically apply a tape "x" over the end of the signal body to secure the cork seal. Each tape dispenser will have a capacity to tape 500 assemblies between refills. The tape dispensers will have two supply spools so the automatic assembly machine will not be interrupted during refilling. Sensors will be located on the tape dispenser to signal low level and when the dispenser is empty. These signals will be sent to the controller and alarms will be sounded as needed. After the tape is applied, the Hand Held Motor Assembly would then be conveyed to the Hand Held Signal Rocket Barrel Assembly Machine.

3.6.13 **Control Overview.** The control overview covers the control description, control panel major components, and machine control devices.

3.6.13.1 **Control Description.** The control operations are detailed in the following:

Start up procedures are as follows:

1) Make sure all machines are empty and are ready to receive parts

for assembly.

2) Manually load assembly components into machines. Jog to index feed components to their proper position for automatic operation.

3) Push "start-up" push button located at the local control panel for that area. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present.

4) Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

Stop sequence procedures are as follows: Pressing the "stop" button in an assembly area lets the machines finish their operations in that area but does not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a part that is jammed, or a station that is misfeeding components). Pressing the "start" button restarts the operation by transferring parts to the next station and continuing operations.

Emergency stop procedures are as follows: Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

Emergency Restart. Push "start-up" to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start up automatic operation.

Shut-down. Press "shut-down" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought back into the staging and magazine loading area. The control system shall sense for all empty and indicate on the display if there are any components present.

Product reject and reinsert procedures are as follows:

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the components assembly (e.g. missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operations. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

Assemblies that were rejected and have been manually repaired may be reinserted into the automated operation. Several station work areas in each room shall have a remote start-stop control station which will allow the stopping of the previous station to allow room for assembly insertion. The following station will perform the needed operation for the previously rejected part. This procedure may be repeated as necessary to reinsert rejected assemblies back into the automated operation. The remote start-stop control stations shall be located at the following stations in the Signal Motor Assembly Room (3, 10, 13 and 15). They can also be reinserted at the manual inspection station for the Hand Held Signal Motor Assembly.

3.6.13.2 **Control Panel Major Components.** The control panel is located outside room 107. It shall house the following:

480 volt, 3 phase power distribution system. The distribution system shall protect and distribute power to all the 480 volt 3 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide over current protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. A disconnect means shall be used to interrupt power to gain control panel access.

120 volt, 1 phase power distribution system. The distribution system shall protect and distribute power to all the 120 volt 1 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized by applicable codes and standards. A disconnect means shall be used to interrupt power to gain control panel access.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Central Processing Unit. The central processing unit shall control all the machine functions for the room utilizing input/output devices. The central processing unit will use analog and serial interfaces for machine control, communications and display capabilities. It shall be able to be programmed easily at the plant location.

Input/Output Rack. The input/output rack shall control and monitor the field devices and motors located in the room.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations.

Control System Display. The local control panel shall have a display capable of showing all the necessary data for operations.

Motor Starters. The control panel shall contain the necessary motor starters and contactors for all controlled operations in the room. The motor starters shall be sized to conform to applicable codes and standards.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

3.6.13.3 **Machine Control Devices.** The first station assembles casing tube, delay assembly and signal body. The casing tube hopper has a low level sensor to alarm and indicate the hopper needs refilling. It also has a sensor signalling the controller that the hopper is empty. The signal body hopper has a low level sensor to alarm and indicate the hopper needs refilling. The hopper also has a sensor signalling the controller that it is empty. The magazine system for the delay assembly has two sensors. One is a low alarm to indicate when the magazines need refilling; the other sensor will signal when the magazines are out of parts. A photo sensor is located at the discharge of the shuttle to detect the presence of the delay mixture. If there is any light showing through the delay cavity, the delay mixture is not present and the delay assembly will be rejected. There will be three part presence sensors on the mandrels to determine if the parts were fed onto the mandrels. These sensors will also verify that the assembly was transferred to the next station. If assembly is rejected, a sensor detects placement into the reject container.

The second station checks the assembly for concentricity and overall length. The signal body will be rotated 90 degrees right and left, and proximity switches will detect if the casing tube is concentric to the signal body. Parallel bars will provide a go no-go gage for the overall length of the assembly. Assemblies failing either test will be discharged into reject containers. If assembly is rejected, a sensor detects placement into the reject containers.

The third station manufactures the first propellant spacer and inserts it into the casing tube. The tube feed for the propellant spacer has two sensors. One is a low alarm to indicate when the tube stock should be refilled; the other sensor will signal when the mandrel is empty and an orderly shutdown is necessary. A part presence sensor will be installed at the spacer section cutting station. This sensor will verify that a spacer is present to be trimmed and will verify that the spacer is no longer present on the mandrel and was inserted into the casing tube. If assembly is rejected, a sensor detects placement into the reject container.

The fourth station loads the propellant into the casing tube. The propellant feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts. A parts presence sensor will verify that the propellant was presented to the casing tube and was not present after the insertion. If assembly is rejected, a sensor detects placement into the reject container.

The fifth station manufactures the second propellant spacer and inserts it into the casing tube. The tube feed for the propellant spacer has two sensors. One is a low alarm to indicate when the tube stock should be refilled; the other sensor will signal when the mandrel is empty and an orderly shutdown is necessary. A part presence sensor will be installed at the insertion station. This sensor will verify that a spacer is present and will verify that the spacer is no longer on the mandrel and was inserted into the casing tube. If assembly is rejected, a sensor detects placement into the reject container.

The sixth station tests the overall length of the two spacers and propellant charge that were inserted into the casing tube. A probe measures the depth inside the casing tube for correct components and placement in the casing tube. If the measurement is incorrect, the assembly will be discharged into the reject container. If assembly is rejected, a sensor detects placement into the reject container.

The seventh station will assemble the tail section and exhaust plate to the casing tube. A pick and place unit will pick the tail assembly from the "egg crate" and place it on the casing tube. Sensors will detect the presence of a tail assembly and will monitor if the part was placed on the casing tube. If a part is not detected, the pick and place will try another compartment looking for an assembly. The tail assembly conveyor will have two sensors, one indicating low level of "egg crates" on the conveyor signalling refilling is necessary; the other sensing the conveyor is empty and that an orderly shutdown is necessary. A part presence sensor will sense for placement of the tail assembly on the casing tube in proper position. The exhaust plate feeder bowl will have a low level sensor indicating the necessity to be refilled. The exhaust plate feeder track will also have a sensor indicating no parts present to signal an orderly shutdown. A part presence sensor will verify the part presence prior to the machine operation, and after operation will verify the exhaust plate was pressed onto the casing tube by no longer sensing the presence of the exhaust plate. If assembly is rejected, a sensor detects placement into the reject container.

The eighth station installs the bolt into casing tube assembly along with thread sealer. The bolt hopper will have a low level sensor to alarm and indicate the hopper needs refilling. The rotating roll orientation system will have a sensor indicating no parts present to signal an orderly shutdown. The sealer tank will have a low level sensor to alarm and indicate the tank needs refilling. It will also have a sensor indicating "out of" sealer to signal for an orderly shutdown. A part presence sensor verifies placement of the bolt on the casing tube assembly. The torque driver that drives the bolt into the casing tube assembly would have a torque sensor which measures the amount of torque supplied to the bolt and also a sensor to measure the depth the bolt was driven. This information would determine if the bolt was properly installed. If assembly is rejected, a sensor detects placement into the reject container.

The ninth station checks for alignment of exhaust plate and proper spin of tail assembly. Three probes will probe the exhaust plate to verify proper alignment. Improperly aligned assemblies will be rejected. An air blast will rotate the tail assembly and a sensor will detect the movement. This information will determine if the tail assembly functions properly. Improperly functioning assemblies will be rejected. If assemblies are rejected, a sensor detects placement into the reject container.

The tenth and eleventh station loads the expelling charge into signal body. The scale that weighs the assembly has a sensor detecting presence of the assembly. The scale then tares out the assembly's weight. A weigh feeding system will be added to the powder feeder and will dispense a known weight of powder to the system. This charge will be used to check the calibration of the system. The assembly is then presented to the powder feeding system with a sensor there detecting the assembly. The powder feeder will then dispense powder into the assembly. The assembly is then returned to the scale so the presence of a charge can be verified. This value from the scale is sent to the industrial computer along with the value or limits of the powder charge. If the three weighing units agree on the proper weight of the charge, the assembly is then transferred to the next station. If the three weighing units do not agree on the weight of the charge, the control system will shut the system down and signal an alarm. The scale that verifies the presence of a charge will also be able to detect high and low charges and these assemblies can be rejected. If assemblies are rejected, a sensor detects placement into the reject container.

The twelfth station manufactures the washer assembly and inserts into signal body. The felt washer material shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. They shall also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. The paper disk shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. They shall also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A part presence sensor will verify that a completed washer assembly was presented to the signal body and that the washer was installed. The sensor would sense that the washer was present before the assembly operation and that it was not present after assembly operations. If assemblies are rejected, a sensor detects placement into the reject container.

The thirteenth station installs the payload assembly into the signal body. The payload hopper will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the hopper is out of parts and signal to shut down the operation in an orderly manner. The signal body is aligned with the subassembly tube prior to insertion. Part presence sensors verify their correct position. After insertion, the subassembly tube is discharged into a bin for reuse and the signal body assembly is transferred to the next station. If assemblies are rejected, a sensor detects placement into the reject container.

The fourteenth station inserts the cork into the signal body. A feeder bowl will feed the cork into a track for delivery to the assembly fixture. The feeder bowl will have two sensors to detect part levels; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the track is out of parts and signal to shut down the operation in an orderly manner. A part presence sensor will verify correct positioning for the cork prior to insertion. After insertion, the sensor will indicate absence of the cork to verify placement into the signal body. If assemblies are rejected, a sensor detects placement into the reject container.

The fifteenth station tapes the cork to the signal body. Two tape dispensers with two supply spools will be used for taping cork. Each supply spool shall have two sensors; one will be a low alarm to indicate when the dispenser needs refilling, the other sensor will signal when the dispenser is out of tape and signal to shut down the operation in an orderly manner. If assemblies are rejected, a sensor detects placement into the reject container.

3.6.14 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-133036, MIL-S-13261G, and MIL-S-13257H are covered by either a manual inspection prior to or while loading the component into the machine or as detailed below:

The delay assembly component is visually inspected while being loaded into the parts magazine. The assembly machine also does 100% inspection for the delay mixture using a photo sensor at the discharge of the shuttle. The delays lacking the delay mixture will be rejected before assembly. The assembly must pass an overall length test to assure proper assembly. Parallel bars with sensors will provide a go, no-go gage for the overall length of the assembly. The assembly will be rejected if the length is over or under specification. The signal body is inspected by a probe after two propellant spacers and the propellant charge are installed. The probe determines that the assembly is installed correctly and is not loose. The assembly would be rejected if value is not within tolerance. The manual inspection station would also reject any assemblies with a loose propellant charge. During the installation of the exhaust plate, a sensor verifies placement of the exhaust plate for insertion. Three probes will also verify proper alignment of the exhaust plate. The manual inspection station would also examine the holes on the exhaust plate for obstructions and reject any assemblies that do not conform. An air blast will rotate the tail assembly after its assembly onto the body and a proximity switch will detect its movement. This information will determine if the tail assembly functions properly. The assembly will be rejected if these conditions are not met. The manual inspection station will reject any assemblies that have bent tail fins. During the installation of the bolt, the torque driver would have a torque sensor which measures the amount of torque supplied to the bolt and also a sensor to measure the depth the bolt was driven. If the torque specification was met but the depth was not, this would mean the bolt cross thread into the delay assembly and the whole assembly would be rejected. If the torque specification is not met, but the depth was, this would mean the bolt is still loose in the delay assembly and the whole assembly would be rejected. Out of specification assemblies would be rejected and removed from the assembly line.

The operator at the manual inspection station will reject any assemblies with a loose casing tube. The assembly would also be examined at the manual inspection station for missing, insufficient amount or incorrectly applied tape to the cork seal. The assembly will be rejected if it fails this criteria. The assembly machine checks the signal body for the correct amount of expelling charge. A pick and place unit removes the signal body from the assembly line and places the assembly on a scale. The scale tares out the assembly's weight. The assembly is then presented to the powder feeding system with a sensor there detecting the assembly. The powder feeder will then dispense powder into the assembly. A weigh feeding system will be added to the powder feeder and will dispense a known weight of powder to the system. This charge will be used to check the calibration of the system. The assembly is then returned to the scale so the presence of a charge can be verified. This value from the scale is sent to the industrial computer along with the value or limits of the powder charge. If the three weighing units agree on the proper weight of the charge, the assembly is then transferred to the next station. If the three weighing units do not agree on the weight of the charge, the control system will shut the system down and signal an alarm. The scale that verifies the presence of a charge will also be able to detect high and low charges and these assemblies are rejected. The assembly machine verifies placement of the washer assembly into the signal body using a part presence sensor. The assembly will be rejected if the washer is not presented for insertion. The assembly machine verifies placement of the illuminant assembly into the signal body using a part presence sensor. The assembly will be rejected if the illuminant is not presented for insertion. The assembly will be rejected for any other signs of poor workmanship.

3.6.15 **Risk Assessment of System.** All the devices and concepts that have been chosen for this proposal are low risk. All concepts are currently used in industries such as drug manufacturing and packaging, and various food packaging plants. The tooling for nest, feeder bowls, and hoppers would be unique to these components, but the concepts have been successfully used for years.

3.7 Manual Inspection Station - Hand Held Signal Motor Examination

3.7.1 General. The Manual Inspection Station for the Hand Held Signal Motor will cover the following areas for inspection. It is referenced on Diagram No. 1 in Appendix A as Station 1.

The assembly will be inspected for proper assembly of the casing tube, delay assembly and the signal body. There shall be no gaps between these components above the specification for this assembly. The components shall be compressed together and shall not be loose. The assembly will be inspected for proper assembly of the exhaust plate and the tail assembly to the casing tube. The exhaust plate shall be inspected for no obstructions or burrs in the holes of the exhaust plate. The tail assembly shall spin freely on the casing tube and shall not have any bent tail fins. The assembly will be inspected for proper assembly of the bolt into the casing tube. The assembly will be inspected for proper insertion of the cork into the signal body. The payload assembly shall be installed within the signal body by the cork. The operator will check for missing, insufficient amount or incorrectly applied tape to the cork seal. Any assemblies not meeting the above criteria or any poor workmanship shall be rejected.

3.7.2 **Automatic SPC Reporting System.** The automatic SPC reporting system shall report rejected assemblies back to the main control panel automatically from the manual inspection station. Manual inspection stations shall have a minimum of ten reject containers which categorize the rejected assemblies as to their defect. The reject containers shall have sensors that automatically report an assembly has been inserted. No other operator interface shall be necessary to categorize assemblies that need rework. The operator will be able to focus their attention on looking for nonconforming assemblies not on entering that data into the system. The main control panel will utilize this information for its SPC report generation. The number of particular rejected assemblies along with their frequency will be sent back from each manual inspection station with automatic SPC reporting system to the main control panel.

3.8 Hand Held Signal Rocket Barrel Assembly.

3.8.1 General. This machine will assemble the hand held signal rocket barrels consisting of the following major components: rocket barrel, primer, expelling charge, seal and signal motors. The machine will operate at a rate of 15 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded which is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The conveying system will be a walking beam conveyor (Fig. 1 in Appendix A). This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to assemble and inspect the Hand Held Signal rocket barrel.

3.8.2 Assemble Primer Into Rocket Barrel. The first station assembles the following parts - rocket barrel (8797929) and primer (8797926). These parts are fed into the assembly line by the following systems:

The rocket barrel is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the shipping containers. The capacity of the hopper will be a minimum of 225 parts. This hopper would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

A feeder bowl will feed the primers into a track for delivery to the assembly fixture. The primers will only feed onto the track with proper orientation for insertion into the rocket barrel. The bowl will have a minimum capacity of 450 primers and will be filled a maximum of twice an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The rocket barrel is fed into a nest type fixture. A part presence sensor will tell the controller it is there and in proper position. A mandrel will be inserted into the rocket barrel. A primer will be taken from the track and loaded into a seating tool. A part presence sensor will tell the controller it is there and in proper position for insertion. The tool will then insert the primer into the rocket barrel. The sensor will verify placement of the primer into the rocket barrel by the absence of the primer in the seating tool. The assembly will be transferred to the next station.

3.8.3 **Application of Waterproof Varnish.** At the second station the rocket barrel assembly is probed to verify the presence of a primer and a waterproofing varnish (MIL-V-13750) is applied to the rocket barrel assembly. The rocket barrel shall be positioned and sensed by a part presence sensor telling the controller it is in position. A probe will then check for insertion of the primer. This will be sent to the controller. If no primer is present, the assembly would be rejected before any waterproofing varnish is applied. If the primer is present, the waterproofing varnish will be applied with a pad applicator. The pad will be supplied by a pumping system that will transfer the varnish from a tank to the pad. Then the assembly will be transferred to the next station.

The third station detects the application of the waterproofing varnish to the primer on the rocket barrel. A "sniffing" probe will verify the presence of solvent vapors indicating the presence of the waterproofing varnish. The rocket barrel is positioned and sensed by a part presence sensor telling the controller it is in position. A sensing chamber will be placed over the primer end of the rocket barrel. Air will then be used to purge the sensing chamber of any previous vapors. The "sniffing" probe then looks for a change in the resistivity of the air in the sensing chamber. The presence of vapor from the waterproofing varnish would trigger the probe to indicate to the controller that varnish is applied. Assemblies failing test will be rejected into a reject bin and the information will be recorded on the SPC data recorder.

3.8.4 **Load Initiating Charge into Rocket Barrel.** The fourth and fifth stations load the initiating charge into the rocket barrel. The components assembled during this operation are black powder (class V, MIL-P-223) and the above assembly.

A pick and place unit removes the rocket barrel from the assembly line and places the assembly on a scale so the weight of the assembly can be tared out. After the weight is taken, the assembly is presented to a new powder feeding system so the initiating charge can be loaded into the rocket barrel. A weigh feeding system will be added to the powder feeder and will dispense a known weight of powder to the system. This charge will be used to check the calibration of the system. The assembly is then returned to the scale so the presence of a charge can be verified. If the three weighing units agree on the proper weight of the charge, the assembly is then transferred to the next station. If the three weighing units do not agree on the weight of the charge, the control system will shut the system down and signal an alarm. The scale that verifies the presence of a charge will also be able to detect high and low charges and these assemblies can be rejected. That data would be sent to the SPC data recording system.

NOTE ALTERNATE METHOD: The existing powder feed system could be used in the new system, but it would require modification and the powder dispensing system would have to be sent out a minimum of 30 days before system installation for adaptation to the new system.

3.8.5 **Manufacture Rocket Barrel Washer and Insert into Rocket Barrel.** The components that will be assembled at the sixth station are the washer (8797937 - this component assembly will be manufactured on the machine replacing the current pre-cut washers) and the above assembly.

The felt washer will be die cut from felt roll stock. The cutter will have the capacity to hold a minimum of sixty-five feet of felt material; this would require a material change twice an hour. It would also have a take-up roll for the waste material. A second set of feed roll and take-up roll will be installed so that the refilling would not interrupt the automated assembly system. After the washer is cut, it will be inserted into the rocket barrel. Sensors will be located on the felt roll to signal low level and when the roll is empty. These signals will be sent to the controller and alarms will be sounded as needed. A part presence sensor will verify that a completed washer was presented to the signal body and that the washer was installed. The sensor would sense that the washer was present before the assembly operation and that it was not present after the assembly operation.

3.8.6 **Manufacture Washer Assembly and Insert into Rocket Barrel.** The seventh station manufactures the washer assembly and inserts it into the rocket barrel. This assembly consists of the washer assembly (8797938 - this component assembly will be manufactured on the machine replacing the current pre-assembled components) and the above assembly.

A feeder bowl will feed the washer into a track for delivery to the labeling fixture. The bowl will have a minimum capacity of 450 washers and will be filled a maximum of twice an hour. The paper lower disk (8797940) would be supplied in label form, die cut with adhesive pre-applied and on a wax paper feed strip, a minimum of 900 labels per roll with a maximum of manual attention of once an hour. The washer will be presented to the labeling unit where the paper lower disk will be applied to the washer. The labeler will have two supply spools and two take-up spools so the automatic assembly machine will not be interrupted. After the assembly is completed, it will be inserted into the rocket barrel. Sensors will be located on the label roll to signal low level and when the roll is empty. These signals will be sent to the controller and alarms will be sounded as needed. A part presence sensor will verify that a completed washer assembly was presented to the rocket barrel and that the washer was installed. The sensor would sense that the washer was present before the assembly operation and that it was not present after the assembly operation.

NOTE ALTERNATE METHOD: An alternate would be to use the existing washer and paper assembly. An operator would be added to the line and the operator would manually insert the assembly.

3.8.7 **Insert Retaining Washer into Rocket Barrel.** The eighth station inserts the retaining washer (8797927) into the rocket barrel. A feeder bowl will feed the retaining washer into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 900 retaining washers and will be filled a maximum of once an hour.

The retaining washer needs no orientation due to it being formed when inserted into the rocket barrel. After the rocket barrel is positioned and a part presence sensor verifies its placement, the retaining washer will be fed into a nest type fixture where a pusher will insert it into the rocket barrel. A part presence sensor will verify position of the retaining washer prior to insertion and verify its placement into the rocket barrel by its absence at the insertion point. The rocket barrel assembly is then transferred to the next station.

The ninth station checks for correct placement of all washers inserted into the rocket barrel. A probe will check the rocket barrel for the presence of the washers installed above and check their correct position in the rocket barrel. This information will be sent to the controller and any assemblies not conforming to the correct specifications will be rejected. Rejected assemblies will be discharged into a reject bin and the information will be recorded on the SPC data recorder.

3.8.8 **Position Signal Motor Assembly.** Station ten positions the signal motor assembly for assembly into the rocket barrel. The signal motor assembly is conveyed from the Manual Inspection Station beside the assembly stations of the rocket barrel to this station. A part presence sensor verifies correct position of the signal motor assembly with the tail assembly fins up.

Station eleven manufactures the rubber protector (8797942) onto the signal motor assembly. The rubber protector will be die cut from rubber roll stock. The cutter will have the capacity to hold a minimum of sixty-five feet of rubber material; this would require a material change twice an hour. It would also have a take-up roll for the waste material. A second set of feed and take-up rolls will be installed so that the refilling would not interrupt the automated assembly system. The cut rubber protector will be inserted onto the signal motor assembly. Sensors will be located on the rubber roll with signal low level and when the roll is empty. This signal will be sent to the controller and alarms will be sounded as needed. A part presence sensor will verify that a rubber protector was presented to the signal motor assembly and that the rubber protector was properly placed.

The twelfth station positions the wooden protector (8797942) onto the signal motor assembly. A feeder bowl will feed the wooden protector into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 450 wooden protectors and will be filled a maximum of twice an hour. The feed system will have two sensors to detect part levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A pick and place unit will place the wooden protector onto the signal motor assembly. A part presence sensor verifies correct position of the wooden protector and its proper placement.

NOTE ALTERNATE METHOD: An alternate would be to use the existing wooden protector assembly. An operator would be added to the line and the operator would manually insert the assembly.

3.8.9 **Insert Signal Motor Assembly, Rubber Protector & Wooden**

Protector into Rocket Barrel. The thirteenth station inserts the signal motor assembly, rubber protector and wooden protector into the rocket barrel. The signal motor assembly is presented with the tail assembly fins up along with the rubber protector and the wooden protector placed on top of the signal motor assembly. Part presence sensors verify correct position of these components. The rocket barrel is positioned with the opening down so the assembly can be inserted into it. A part presence sensor will verify the correct position of the rocket barrel prior to insertion. The signal motor assembly, rubber protector, and the wooden protector would then be inserted into the rocket barrel. The assembly will then be transferred to the next station.

3.8.10 **Insert Cork Seal into Rocket Barrel.** The fourteenth station inserts the cork seal into the rocket barrel. The components in this assembly are the cork seal (8797922) and assembly from above.

A feeder bowl will feed the cork seal into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 450 cork seals and will be filled a maximum of twice an hour. The feed system will have two sensors to detect part levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

The cork seal will be fed into a nest type fixture and then will be inserted into the rocket barrel. A part presence sensor will verify that the cork seal was present before the assembly operation and that it was not present after the assembly operation. The assembly will then be transferred to the next station.

NOTE ALTERNATE METHOD: An alternate would be to eliminate the cork seal from the assembly and use just the hot melt sealer as the final seal for the rocket barrel assembly.

The fifteenth station probes the rocket barrel for the presence of the signal motor assembly and the cork seal. A part presence sensor will verify the rocket barrel at the station. A probe will then check the open end of the rocket barrel for the signal motor assembly and the cork seal. An improper depth reading will determine their absence in the rocket barrel. Assemblies with an incorrect depth reading will be rejected; otherwise, the assembly will be transferred to the next station.

3.8.11 **Apply Label to Rocket Barrel.** The sixteenth station applies the label to the rocket barrel. The label (8797931-1, 2, 3, 4, 5, 6, 7, 10) would be supplied in label form, die cut with adhesive pre-applied and on a wax paper feed strip, a minimum of 900 labels per roll with a maximum of manual attention of once an hour. The rocket barrel will be presented to the labeling unit where the label will be applied to the rocket barrel. The labeler will have two supply spools and two take-up spools so the automatic assembly machine will not be interrupted. The assembly will then be transferred to the next station.

3.8.12 **Expel Air From Rocket Barrel.** The seventeenth station will evacuate any air compressed into the rocket barrel during the previous operations. A plunger slightly smaller than the cork seal will press on the seal. The face of the plunger will have channels so that a vacuum can be pulled on the cork seal. A vacuum of a minimum 4 inches of mercury will be pulled on the cork seal for approximately two seconds. The vacuum will be released before the plunger is removed from the seal face. The assembly is then transferred to the next station.

3.8.13 Apply Sealant to End of Rocket Barrel. The eighteenth station will use a commercially available hot melt sealant to seal the end of the rocket barrel. This sealant will be color coded to match the current color codes. The sealant dispenser will dispense a measured amount of sealant to the end of the rocket barrel. The assembly will be transferred to the next station.

NOTE ALTERNATE METHOD: An alternate would be to use the existing lacquer sealer. This would require the addition of a drying system to force dry the sealer. The dryer would add cost to the equipment and would require substantial floor space.

3.8.14 Control Overview. The control overview covers the control description, control panel major components, and machine control devices.

3.8.14.1 Control Description. The control operations are detailed in the following:

Start up procedures are as follows:

1) Make sure all machines are empty and are ready to receive parts for assembly.

2) Manually load assembly components into machines. Jog to index feed components to their proper position for automatic operation.

3) Push "start-up" push button located at the local control panel for that area. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present.

4) Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

Stop sequence procedures are as follows: Pressing the "stop" button in an assembly area lets the machines finish their operations in that area but does not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a part that is jammed, or a station that is misfeeding components). Pressing the "start" button restarts the operation by transferring parts to the next station and continuing operations.

Emergency stop procedures are as follows: Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

Emergency Restart. Push "start-up" to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start up automatic operation.

Shut-down. Press "shut-down" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought back into the staging and magazine loading area. The control system shall sense for all empty and indicate on the display if there are any components present.

Product reject and reinsert procedures are as follows:

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the components assembly (e.g. missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operations. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

Assemblies that were rejected and have been manually repaired may be reinserted into the automated operation. Several station work areas in each room shall have a remote start-stop control station which will allow the stopping of the previous station to allow room for assembly insertion and then its following station that will be performing the needed operation for the previously rejected part. This procedure may be repeated as necessary to reinsert rejected assemblies back into the automated operation. The remote start-stop control stations shall be located at the following stations in the Rocket Barrel Assembly Room (2, 4, 11, 14, 16 and 17.) They can also be reinserted at the manual inspection station for the rocket barrel assembly.

3.8.14.2 **Control Panel Major Components.** The control panel is located outside room 108. It shall house the following:

480 volt, 3 phase power distribution system. The distribution system shall protect and distribute power to all the 480 volt 3 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide over current protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. A disconnect means shall be used to interrupt power to gain control panel access.

120 volt, 1 phase power distribution system. The distribution system shall protect and distribute power to all the 120 volt 1 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized by applicable codes and standards. A disconnect means shall be used to interrupt power to gain control panel access.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Central Processing Unit. The central processing unit shall control all the machine functions for the room utilizing input/output devices. The central processing unit will use analog and serial interfaces for machine control, communications and display capabilities. It shall be able to be programmed easily at the plant location.

Input/Output Rack. The input/output rack shall control and monitor the field devices and motors located in the room.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations.

Control System Display. The local control panel shall have a display capable of showing all the necessary data for operations.

Motor Starters. The control panel shall contain the necessary motor starters and contactors for all controlled operations in the room. The motor starters shall be sized to conform to applicable codes and standards.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

3.8.14.3 **Machine Control Devices.** The Rocket Barrel Assembly Machine has the following machine control devices.

The first station inserts the primer into the rocket barrel. The rocket barrel is fed from a horizontal hopper which has two sensors; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the hopper is out of parts and signal to shut down the operation in an orderly manner. A feeder bowl will feed the primers into a track for delivery to the assembly machine. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will determine that the rocket barrel is in proper position. A part presence sensor will verify that the primer is present and ready for insertion; and then after insertion, that it was delivered. If the assembly is rejected, a sensor detects placement into the reject container.

At the second station the rocket barrel assembly is probed to verify the presence of a primer and a waterproofing varnish is applied to the rocket barrel assembly. The rocket barrel shall be positioned and sensed by a part presence sensor telling the controller it is in position. A probe will then check for insertion of the primer. This will be sent to the controller. If no primer is present, the assembly would be rejected before any waterproofing varnish is applied. If the primer is present, the waterproofing varnish will be applied with a pad applicator. The tank for the varnish will have two sensors detecting tank levels; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is empty and will send a signal to the main controller to shut down the operation in an orderly manner. If the assembly is rejected, a sensor detects placement into the reject container.

The third station detects for varnish application. A "sniffing" probe will verify the presence of solvent vapors indicating the presence of the waterproofing varnish. The rocket barrel is positioned and sensed by a part presence sensor telling the controller it is in position. A sensing chamber will be placed over the primer end of the rocket barrel. Air will then be used to purge the sensing chamber of any previous vapors. The "sniffing" probe then looks for a change in the resistivity of the air in the sensing chamber. The presence of vapor from the waterproofing varnish would trigger the probe to indicate to the controller that varnish is applied. The assembly shall be rejected if no varnish is detected and a sensor detects placement into the reject container.

The fourth and fifth station loads the initiating charge into the rocket barrel. The scale that weighs the assembly has a sensor detecting presence of the assembly. The scale then tares out the assembly's weight. A weigh feeding system will be added to the powder feeder and will dispense a known weight of powder to the system. This charge will be used to check the calibration of the system. The assembly is then presented to the powder feeding system with a sensor there detecting the assembly. The powder feeder will then dispense powder into the assembly. The assembly is then returned to the scale so the presence of a charge can be verified. This value from the scale is sent to the industrial computer along with the value or limits of the powder charge. If the three weighing units agree on the proper weight of the charge, the assembly is then transfered to the next station. If the three weighing units do not agree on the weight of the charge, the control system will shut the system down and signal an alarm. The scale that verifies the presence of a charge will also be able to detect high and low charges and these assemblies can be rejected. If assemblies are rejected, a sensor detects placement into the reject container.

The sixth station manufactures the rocket barrel washer and inserts it into the rocket barrel. The felt washer material shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. They shall also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A part presence sensor will verify that a washer was presented to the rocket barrel and that the washer was installed. If assemblies are rejected, a sensor detects placement into the reject container.

The seventh station manufactures the washer assembly and inserts it into the rocket barrel. A feeder bowl will feed the washer into a track for delivery to the labeling fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The paper disk shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. The feed rollers will also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A sensor will be used in the application of the paper disk to the washer. A part presence sensor will verify that a completed washer assembly was presented to the rocket barrel and that the washer was installed. If any assemblies are rejected, a sensor detects placement into the reject container.

The eighth station inserts the retaining washer into the rocket barrel. A feeder bowl will feed the retaining washer into a track for delivery to the assembly fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A sensor will determine that the rocket barrel is in proper position. A sensor will verify that the retaining washer is present and ready for insertion; and then after insertion, that it was delivered. If the assembly is rejected, a sensor detects placement into the reject container.

The ninth station inspects the rocket barrel for the correct placement of all the washers inserted into the rocket barrel. A probe will verify the presence and position of the washers in the rocket barrel. This information will be sent to the controller and any assemblies not conforming to the correct specifications will be rejected. If the assembly is rejected, a sensor detects placement into the reject container.

The tenth station aligns signal motor assembly with the tail fins up for further operations. A sensor will verify that the signal motor assembly is in proper position.

The eleventh station manufactures the rubber protector and positions it for placement on the signal motor assembly. The rubber protector will be die cut from rubber roll stock. There shall be two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. The feed rollers will also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A sensor shall be used to determine if the rubber seal is in proper position. If any assemblies are rejected, a sensor detects placement into the reject container.

The twelfth station positions the wooden protector for placement on the signal motor assembly. A feeder bowl will feed the wooden protector into a track for delivery to the assembly fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A sensor shall be used to determine if the wooden protector is in proper position. If any assemblies are rejected, a sensor detects placement into the reject container.

The thirteenth station inserts the signal motor assembly, rubber seal and the wooden protector into the rocket barrel. A sensor shall be used to determine if the rocket barrel is in proper position. Once everything is in proper position, compression takes place and a sensor will detect for proper compression. If any assemblies are rejected, a sensor detects placement into the reject container.

The fourteenth station inserts cork seal into rocket barrel. A feeder bowl will feed the cork seal into a track for delivery to the assembly fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will verify that a cork seal was presented to the rocket barrel and that the cork seal was installed. If any assemblies are rejected, a sensor detects placement into the reject container.

The fifteenth station checks for insertion of signal motor assembly and cork seal into rocket barrel. A part presence sensor will verify the rocket barrel is present and in position at the station. A probe will then check the open end of the rocket barrel for the signal motor assembly and the cork seal. An improper depth reading will determine their absence in the rocket barrel. Assemblies with an incorrect depth reading will be rejected; otherwise, the assembly will be transferred to the next station. If any assemblies are rejected, a sensor detects placement into the reject container.

The sixteenth station applies label to the rocket barrel. The labels shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. The feed rollers will also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A sensor may be used in the application of the label to the rocket barrel to determine proper positioning. If any assemblies are rejected, a sensor detects placement into the reject container.

The seventeenth station applies a vacuum to the rocket barrel to expel any air in the rocket barrel. A sensor will be utilized to test for the presence of a vacuum being applied to the rocket barrel while the test is being performed. If any assemblies are rejected, a sensor detects placement into the reject container.

The eighteenth station applies a hot melt sealant to the end of the rocket barrel. A sensor will determine that an amount of sealant was applied. If any assemblies are rejected, a sensor detects placement into the reject container.

3.8.15 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, and MIL-S-13257H are covered by either a manual inspection prior to or while loading the component into the machine or as detailed below:

After the primer is inserted into the rocket barrel and before the waterproofing varnish applied, the rocket barrel is probed to verify the presence of the primer. A "sniffing" probe will verify presence of solvent vapors indicating the presence of the waterproofing varnish. Assemblies failing either test will be rejected. The assembly machine checks the rocket barrel for the correct amount of the initiating charge. The scale tares out the assembly's weight. A weigh feeding system will be added to the powder feeder and will dispense a known weight of powder to the system. This charge will be used to check the calibration of the system. The assembly is then presented to the powder feeding system with a sensor there detecting the assembly. The powder feeder will then dispense powder into the assembly. The assembly is then returned to the scale so the presence of a charge can be verified. This value from the scale is sent to the industrial computer along with the value or limits of the powder charge. If the three weighing units do not agree on the weight of the charge, the control system will shut the system down and signal an alarm. The scale that verifies the presence of a charge will also be able to detect high and low charges and these assemblies can be rejected. The assembly machine verifies placement of the rocket barrel washer into the rocket barrel using a part presence sensor. The assembly will be rejected if the washer is not presented for insertion. The assembly machine verifies placement of the rocket barrel washer assembly into the rocket barrel using a part presence sensor. The assembly will be rejected if the washer assembly is not presented for insertion. The assembly machine verifies the application of the rocket barrel seal with a sensor checking that the rocket sealing compound was applied. The assembly will be rejected if the rocket barrel seal was not applied properly. The assembly will be rejected for any other signs of poor workmanship.

3.8.16 **Risk Assessment of System.** All the devices and concepts that have been chosen for this proposal are low risk. All concepts are currently used in industries such as drug manufacturing and packaging, and various food packaging plants. The tooling for nest, feeder bowls, and hoppers would be unique to these components, but the concepts have been successfully used for years.

3.9 Manual Inspection Station - Hand Held Signal Rocket Examination

3.9.1 **General.** The Manual Inspection Station for the Hand Held Signal Rocket will cover the following areas for inspection. It is referenced on Diagram No. 2 in Appendix A as Station 1.

The assembly will be inspected for the presence and proper insertion of the primer into the rocket barrel. A visual inspection will be performed for the application of the waterproofing varnish on the rocket barrel. The assembly will be inspected for the presence and proper insertion of the cork into the rocket barrel. The assembly will be inspected for the application of the correct label applied properly and legibly. The assembly will be inspected for the correct color of sealant and its application onto the rocket barrel. Any assemblies not meeting the above criteria or any poor workmanship shall be rejected.

3.9.2 **Automatic SPC Reporting System.** The automatic SPC reporting system shall report rejected assemblies back to the main control panel automatically from the manual inspection station. Manual inspection stations shall have a minimum of ten reject containers which categorize the rejected assemblies as to their defect. The reject containers shall have sensors that automatically report an assembly has been inserted. No other operator interface shall be necessary to categorize assemblies that need rework. The operator will be able to focus their attention on looking for non-conforming assemblies not on entering that data into the system. The main control panel will utilize this information for its SPC report generation. The number of particular rejected assemblies along with their frequency will be sent back from each manual inspection station with automatic SPC reporting system to the main control panel.

3.10 Hand Held Signal Containerization Machine.

3.10.1 General. This machine will containerize the Hand Held Signal consisting of the following major components: Rocket barrel and motor assembly, rocket barrel cap, and the container and cap. The machine will operate at a rate of 15 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded which is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The conveying system will be a walking beam conveyor (Fig.1 in Appendix A). This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to containerize and inspect the Hand Held Signal.

3.10.2 Install Rocket Barrel Cap. The first station installs the barrel cap onto the rocket barrel assembly. The components for this assembly are the rocket barrel cap (8797953) and the finished assembly from the rocket barrel assembly machine. The barrel cap is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the shipping containers. The capacity of the hopper will be a minimum of 225 parts. This hopper would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The rocket barrel assemblies will be hand fed into the assembly fixture by the inspector that is inspecting the assemblies at the end of the rocket barrel assembly machine. The cap will be fed into a nest type fixture and a pusher will insert the cap onto the completed rocket barrel assembly. A part presence sensor will detect that a cap was installed on the rocket barrel. The second station detects the barrel cap presence and overall length of the assembly. Parallel bars will provide a go, no-go gage for the overall length of the assembly. Sensors will be used to verify the overall length. The assembly will be rejected if the length is over or under specification.

3.10.3 Insert Rocket Barrel Assembly into Container. The third station inserts the rocket barrel assembly into the container. The components for this assembly are the container (12900003) and the finished assembly from above. The container is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the shipping containers. The capacity of the hopper will be a minimum of 225 parts. This hopper would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The Hand Held Signal and the container will be in nest type fixtures, and a pusher will insert the Hand Held Signal into the container. Sensors will verify that the two components were assembled. Then the assembly will be transferred to the next station.

3.10.4 **Install O-ring onto Container.** The fourth station lubricates the o-ring and places it on the container. The components for this assembly are an o-ring (12900007), lubricant (12900008), and the Hand Held Signal and container.

A feeder bowl will feed the o-rings into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 900 o-rings and will be filled a maximum of once an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The o-ring is track fed to a fixture where an applicator applies the lubricant to the o-ring. Then a pick and place unit with expanding fingers places the ring over the container. A stripper slides the ring off of the fingers onto the container neck. The assembly is then transferred to the next station.

3.10.5 **Install Cap onto Container.** The fifth station installs the cap onto the container. The components of this assembly are the container cap (12900013) and the above assembly.

The caps and container are fed into a commercially available capping machine that will install the screw-on cap and torque it to the correct torque. The capping machine will have two hoppers to supply parts to the machine. Each hopper will have two sensors to detect part levels; one will be a low alarm to indicate when the hoppers need refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. This unit will have sensors that will verify installation of the cap and that it is installed to the specification. The finished assembly will be transferred to the next station. Rejected assemblies will be discharged into a reject bin.

3.10.6 **Apply Label to Container.** The sixth station applies the label to the Hand Held Signal container. The components for this assembly are the label (12900005) and containerized Hand Held Signal. The label would be supplied in label form, die cut with adhesive pre-applied and on a wax paper feed strip, a minimum of 900 labels per roll with a maximum of manual attention of once an hour. The container will be presented to the labeling unit where the label will be applied to the container. The labeler will have two supply spools and two take-up spools so the automatic assembly machine will not be interrupted.

Sensors will verify that the label was applied. The assembly will then be transferred to the next station.

3.10.7 Control Overview. The Control Overview for the Hand Held Signal Containerization Machine utilizes the same control description as detailed in Section 3.8.14.1 and the same control panel major components as detailed in Section 3.8.14.2 since the Hand Held Signal Containerization Machine uses the same control panel as the Rocket Barrel Assembly Machine. The machine control devices are described in the following section.

3.10.7.1 Machine Control Devices. The Hand Held Signal Containerization Machine has the following machine control devices.

The first station installs the barrel cap onto the rocket barrel assembly. The barrel cap will be fed from a horizontal hopper. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will verify correct orientation of the barrel cap. A part presence sensor will detect that a cap was installed on the rocket barrel. If any assemblies are rejected, a sensor detects placement into the reject containers.

The second station detects caps presence and overall length of the assembly. A sensor will be used to detect caps presence and sensors will verify correct length of assembly. The assembly will be rejected if the length is over or under specification. If any assemblies are rejected, a sensor detects placement into the reject containers.

The third station inserts the rocket barrel assembly into the container. The container is fed from a horizontal hopper. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. Part presence sensors will verify that the two components were assembled. If any assemblies are rejected, a sensor detects placement into the reject containers.

The fourth station lubricates the o-ring and places it on the container. A feeder bowl will feed the o-rings into a track for delivery to the assembly fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The o-ring is track fed to a fixture where an applicator applies the lubricant to the o-ring. The lubricant is pressure pumped to the assembly fixture. The lubricant tank will have two sensors to detect tank level; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is out of lubricant and will send a signal to the main controller to shut down the operation in an orderly manner. A sensor will be utilized to verify that the lubricant has been dispensed. A part presence sensor will check for the presence of the o-ring before assembly and then check for its absence after assembly. If any assemblies are rejected, a sensor detects placement into the reject containers.

The fifth station installs the cap on the container. A horizontal hopper feeds the container cap into a track for delivery to the assembly fixture. The hopper will have a low alarm sensor to indicate when the hopper needs refilling. The feed system will also have a sensor to indicate when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will verify the presence of the part and position for capping. The capping unit will have sensors that will verify installation of the cap and that it is installed to the correct torque specification. If any assemblies are rejected, a sensor detects placement into the reject containers.

The sixth station applies the label to the container. The labels shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. The feed rollers will also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A sensor will be used in the application of the label to the container to verify its placement. If any assemblies are rejected, a sensor detects placement into the reject container.

3.10.8 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, and MIL-S-13257H are covered by either a manual inspection prior to or while loading the component into the machine or as detailed below:

The assembly machine verifies placement of the firing cap on the correct end of the rocket barrel. A sensor will check orientation before placement of cap. The assembly will be checked for correct overall length after the rocket barrel cap has been installed. Sensors will be used to verify correct length as a go, no-go operation. The assembly will be rejected if the length is over or under specification. The assembly will be rejected for any other signs of poor workmanship.

3.10.9 **Risk Assessment of System.** All the devices and concepts that have been chosen for this proposal are low risk. All concepts are currently used in industries such as drug manufacturing and packaging and various food packaging plants. The tooling for nest, feeder bowls, and hoppers would be unique to these components, but the concepts have been successfully used for years.

3.11 40MM Assembly Machine.

3.11.1 **General.** This machine will assemble the 40MM Signal consisting of the following major components: delay, body, payload, ogive, and cartridge case. The machine will operate at a rate of 15 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded which is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The conveying system will be a walking beam conveyor (Fig. 1 in Appendix A). This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to assemble and inspect the 40MM Signal.

3.11.2 Load Body onto Conveyor. The first station positions the body (9243900) onto the conveyor. The body is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the shipping containers. The capacity of the hopper will be a minimum of 225 parts. This hopper would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner.

3.11.3 Torque Delay into Body. The second station torques the delay into the 40MM body. This assembly consists of the following parts - sealant (9243893), delay (9243885), and the body from above.

The delay assembly is fed from a column magazine and transferred to the assembly fixture through a shuttle mechanism. The magazines will be loaded in the magazine loading area and the filled magazines will manually be transported to the assembly machine and installed into the shuttle mechanism (Fig. 3 in Appendix A). Each magazine will have a minimum capacity of 30 delays and the shuttle mechanism will have a minimum capacity of 10 magazines. The shuttle would be refilled a maximum of four times an hour. The delay assembly contains energetic material and should be stacked so the material can not rub against the material of another delay assembly. The delays should not be dropped a distance more than one diameter of the delay assembly during transfer. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the shuttle needs refilling; the other sensor will signal when the shuttle is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A photo sensor will be located at the discharge of the shuttle to detect the presence of the delay mixture. If there is any light showing through the delay cavity, the delay mixture is not present and the delay assembly will be rejected. Rejects will be removed before assembly into the body.

The delay would be discharged from the shuttle system and would be held captive until the driver with expanding jaws clamps onto the delay. The driver would then pick up the delay and move over to the sealer applicator. The sealer is then applied to the threads as the delay is rotated. A sensor will verify that the applicator operated. The driver would then screw the delay into the body assembly. The torque driver has a torque sensor which measures the amount of torque supplied to the delay and also a sensor to measure the depth the delay was driven. If the torque specification was met but the depth was not, this would mean the delay cross thread into the body and the assembly would be rejected. If the torque specification is not met but the depth was, this would mean the delay is still loose in the body and the whole assembly would be rejected. Out of specification assemblies would be rejected and removed from the assembly line. The part presence sensors will verify that the assembly was transferred to the next station.

3.11.4 **Insert Spacer into Body.** The third station inserts the spacer into the body. The components that will be assembled at this station are the spacer (9243892 - to be manufactured on line) and the body assembly.

The spacer will be die cut from rubber roll stock. The cutter will have the capacity to hold a minimum of sixty-five feet of rubber material; this would require a material change twice an hour. It would also have a take-up roll for the waste material. A second set of feed roll and take-up roll will be installed so that the refilling would not interrupt the automated assembly system. The cut spacer will be inserted into the body assembly. The body assembly will be transported to this station by a conveyor that will run beside the conveyor that is carrying the rocket barrels. Sensors will be located on the rubber roll and will signal low level and when the roll is empty. This signal will be sent to the controller and alarms will be sounded as needed. A part presence sensor will verify that a completed spacer was presented to the body assembly and was installed.

3.11.5 **Insert Payload Assembly into Body.** The fourth station installs the payload assembly and star assembly into the body (9317510, 9255145, 9243881, or 9212688). These are assembled into a tube in another area.

The payload is fed horizontally from a hopper with a bottom discharge (Fig. 2 in Appendix A). The hopper is filled manually by a material handler from the containers currently used to handle these components; the capacity of the hopper will be a minimum of 150 parts. This hopper would be refilled a maximum of seven times an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will verify that a payload assembly was presented to the body and that the payload was installed.

3.11.6 **Apply O-ring to Ogive and Press Ogive into Body.** The fifth station applies lubricant to the o-ring, installs the o-ring onto the ogive and presses the ogive into the body. The components for this assembly are an o-ring (9243894), lubricant (MIL-S-8660), and the ogive (9243882, 9317511, or 9255145) and the above assembly.

A feeder bowl will feed the o-rings into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 900 o-rings and will be filled a maximum of once an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The o-ring is track fed to a fixture where an applicator applies the lubricant to the o-ring. The lubricant is pressure pumped to the assembly fixture.

A feeder bowl will feed the ogive into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 900 ogives and will be filled a maximum of once an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. Then a pick and place unit with expanding fingers places the ring over the ogive. A stripper slides the ring off of the fingers onto the ogive neck.

The ogive is positioned for placement into the body. Part presence sensors will verify correct positioning of the ogive and the body assembly for compression. The assemblies will be compressed together. The assembly is then transferred to the next station.

3.11.7 Apply O-ring to Body and Crimp Cartridge Case to Body. The sixth station places the o-ring on the body and crimps the cartridge case to the body. The components for this assembly are an o-ring (MS-28900), and the cartridge case (9207988) and the above assembly.

A feeder bowl will feed the o-rings into a track for delivery to the assembly fixture. The bowl will have a minimum capacity of 900 o-rings and will be filled a maximum of once an hour. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor verifies correct position of the body assembly. A pick and place unit with expanding fingers places the o-ring over the body assembly. A stripper slides the o-ring off of the fingers onto the body assembly. The cartridge case assembly is fed from a column magazine and transferred to the assembly fixture through a shuttle mechanism. The magazines will be loaded in the magazine loading area and the filled magazines will manually be transported to the assembly machine and installed into the shuttle mechanism (Fig. 3 in Appendix A). Each magazine will have a minimum capacity of 20 cartridges and the shuttle mechanism will have a minimum capacity of 12 magazines. The shuttle would be refilled a maximum of four times an hour. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the shuttle needs refilling; the other sensor will signal when the shuttle is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The cartridge case would be discharged from the shuttle system to the assembly fixture. A part presence sensor will verify proper positioning for placement onto the body assembly.

The two component assemblies would be inserted together, and then the crimping press would crimp the assembly producing the finished assembly. Sensors would be present to verify component presence and to verify proper crimping action. This data would be sent back to the main control.

The seventh station checks the assembly for concentricity and overall length to verify the assembly was properly assembled. The signal body will be rotated 90 degrees right and left, and proximity switches will detect if the body is concentric. Parallel bars will provide a go, no-go gage for the overall length of the assembly. Assemblies failing either test will be discharged into reject containers.

3.11.8 **Control Overview.** The control overview covers the control description, control panel major components, and machine control devices.

3.11.8.1 **Control Description.** The control operations are detailed in the following paragraphs. The operation of the 40MM Assembly Machine is selected at the Main Control Panel and at the 40MM Signal Control Panel. After this selection has been made, start-up procedures can begin.

Start-up operations shall operate in the following manner. All machines are to be empty and ready to receive parts for assembly. Components are manually loaded into the machines, and are jogged to index feed components to their proper position for automatic operation. Push "start-up" push button located at the 40MM Assembly Machine Control Panel. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present. Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

A stop sequence shall operate in the following manner. By pressing the "stop" button in an assembly area, the machines will finish their operation at each station but will not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a component that is jammed, or a station that is misfeeding components.) Pressing the "start" push button restarts the operation by transferring parts to the next station and continuing operations.

The emergency stop procedures shall operate in this manner. Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

An emergency restart will be used to start operation after an emergency stop has occurred. Push "start-up" push button to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start-up automatic operation.

The shutdown procedures shall be used to shut down automatic operation in an orderly manner. Press the "shutdown" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought back into the staging and magazine loading area. The control system shall sense for "all empty" and indicate on the display if there are any components present.

Product reject and reinsert procedures are used to remove rejected assemblies and once repaired, they may be reinserted back into automatic operation.

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the component's assembly (e.g.

missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operation. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room, shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

Assemblies that were rejected and have been manually repaired may be reinserted into the automated operation. Several station work areas in each room shall have a remote start-stop control station which will allow the stopping of the previous station to allow room for assembly insertion. The following station will perform the needed operation for the previously rejected part. This procedure may be repeated as necessary to reinsert rejected assemblies back into the automated operation. The remote start-stop control stations shall be located at the following stations in the 40MM Signal Assembly Room (3, 5, and 6). The signals can also be reinserted at the manual inspection station for the 40MM Signal assembly.

3.11.8.2 **Control Panel Major Components.** The control panel is located outside room 110. It shall house the following:

480 volt, 3 phase power distribution system. The distribution system shall protect and distribute power to all the 480 volt 3 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide over current protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. A disconnect means shall be used to interrupt power to gain control panel access.

120 volt, 1 phase power distribution system. The distribution system shall protect and distribute power to all the 120 volt 1 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized by applicable codes and standards. A disconnect means shall be used to interrupt power to gain control panel access.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Central Processing Unit. The central processing unit shall control all the machine functions for the room utilizing input/output devices. The central processing unit will use analog and serial interfaces for machine control, communications and display capabilities. It shall be able to be programmed easily at the plant location.

Input/Output Rack. The input/output rack shall control and monitor the field devices and motors located in the room.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations.

Control System Display. The local control panel shall have a display capable of showing all the necessary data for operations.

Motor Starters. The control panel shall contain the necessary motor starters and contactors for all controlled operations in the room. The motor starters shall be sized to conform to applicable codes and standards.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

3.11.8.3 **Machine Control Devices.** The 40MM Assembly Machine has the following machine control devices.

The first station loads the body onto the conveyor. The body is fed from a hopper, which will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will detect that a body has been delivered to the conveyor. If any assemblies are rejected, a sensor detects placement into the reject containers.

The second station torques the delay into the body. The delay assembly is fed from a column magazine and transferred to the assembly fixture through a shuttle mechanism. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the magazine needs refilling; the other sensor will signal when the magazine is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The sealer tank will have two sensors; one will be a low alarm to indicate the tank needs refilling; the other sensor will indicate "tank empty" to signal for an orderly shutdown. A photo sensor will be located at the discharge of the shuttle to detect the presence of the delay mixture. If there is any light showing through the delay cavity, the delay mixture is not present and the delay assembly would be rejected. Part presence sensors verify positioning of the delay and the body. The torque driver that drives the delay into the body would have a torque sensor which measures the amount of torque supplied to the delay and also a sensor to measure the depth the delay was driven. If the torque specification was met but the depth was not, this would mean the delay cross thread into the body and the assembly would be rejected. If the torque specification is not met but the depth was, this would mean the delay is still loose in the body and the whole assembly would be rejected. A sensor will also be used to verify that the sealer applicator operated. If any assemblies are rejected, a sensor detects placement into the reject containers.

The third station inserts the spacer into the body. The spacer will be die cut from rubber roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor and indicate refilling is necessary. They shall also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A part presence sensor will verify that a completed spacer was presented to the body and that the spacer was installed. If any assemblies are rejected, a sensor detects placement into the reject container.

The fourth station installs the payload assembly into the body. The payload hopper will have two sensors to detect parts levels; one will be a low alarm to indicate when the hopper needs refilling, the other sensor will signal when the hopper is out of parts and signal to shut down the operation in an orderly manner. A part presence sensor will verify that a payload assembly was presented to the body and that the payload was installed. If any assemblies are rejected, a sensor detects placement into the reject container.

The fifth station applies lubricant to the o-ring, installs the o-ring onto the ogive and presses the ogive into the body. A feeder bowl will feed the o-rings into a track for delivery to the assembly fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The o-ring is track fed to a fixture where an applicator applies the lubricant to the o-ring. The lubricant is pressure pumped to the assembly fixture. The lubricant tank will have two sensors to detect tank level; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is out of lubricant and will send a signal to the main controller to shut down the operation in an orderly manner. A sensor will be utilized to verify that the lubricator operated. A feeder bowl will feed the ogive into a track for delivery to the assembly fixture. The feed system will have two sensors to detect part levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the bowl is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. Part presence sensors will be used for positioning the ogive and the o-ring. The o-ring will then be placed on the ogive. The ogive will then be repositioned for placement into the body. Part presence sensors will be used for positioning the body and the ogive. The ogive will then be inserted into the body. If any assemblies are rejected, a sensor detects placement into the reject containers.

The sixth station applies the o-ring to the body and crimps the cartridge case to the body. A feeder bowl will feed the o-rings into a track for delivery to the assembly fixture. The feed system will have two sensors to detect parts levels; one will be a low alarm to indicate when the bowl needs refilling; the other sensor will signal when the feed system is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. The cartridge case assembly is fed from a column magazine and transferred to the assembly fixture through a shuttle system. The feed system will have two sensors to detect parts levels. One will be a low alarm to indicate when the magazine needs refilling; the other sensor will signal when the shuttle is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. Part presence sensors will b used for positioning the body and the o-ring. The o-ring will the[illegible] placed on the body. The body will be repositioned for placemen[illegible] into the cartridge case. Part presence sensors will be used for po[illegible]oning the body and the cartridge case. The cartridge case [illegible] be crimped onto the body. A sensor will be used for veri[illegible] of proper crimping action. If any assemblies are rejected, a [illegible]etects placement into the reject container.

The seventh station checks th[illegible] assembly for concentricity and overall length. The body will be rotated 90 degrees right and left, and proximity switches will detect if the body is concentric. Parallel bars will provide a go, no-go gage for the overall length of the assembly. Assemblies failing either test will be discharged into reject containers. If any assemblies are rejected, a sensor detects placement into the reject containers.

3.11.9 Quality Conformance Inspection Points. All the various inspections required by military specification MIL-C-63092 are covered by either a manual inspection prior to or while loading the component into the machine or as detailed below:

The assembly will be checked for proper installation of the delay assembly. The torque driver would have a torque sensor which measures the amount of torque supplied to the delay and also a sensor to measure the depth the delay was driven. If the torque specification was met but the depth was not, this would mean the delay cross thread into the body and the assembly would be rejected. If the torque specification is not met, but the depth was, this would mean the delay is still loose in the body and the assembly would be rejected. Out of specification assemblies would be rejected and removed from the assembly line. The assembly must pass an overall length test to assure proper assembly. Parallel bars with sensors will provide a go, no-go gage for the overall length of the assembly. The assembly will be rejected if the length is over or under specification. The assembly will be checked at the manual inspection station for a gap between the delay assembly and the body, the parachute assembly improperly installed and protruding from the body, proper position and installation of the ogive, and the cartridge case crimped properly onto the assembly. The assembly will be rejected if it fails any of the above criteria at the manual inspection station. Assemblies will be rejected for any other signs of poor workmanship.

3.11.10 Risk Assessment of System. All the devices and concepts that have been chosen for this proposal are low risk. All concepts are currently used in industries such as drug manufacturing and packaging, and various food packaging plants. The tooling for nest, feeder bowls, and hoppers would be unique to these components, but the concepts have been successfully used for years.

3.12 Manual Inspection Station - 40MM Assembly Examination

3.12.1 General. The Manual Inspection Station for the 40MM Signal will cover the following areas for inspection. It is referenced on

Diagram No. 4 in Appendix A as Station 1.

The assembly will be inspected for the proper assembly of the ogive into the body assembly. There shall be no gaps between these components above the specification for this assembly. The components shall be compressed together and shall not be loose. The assembly shall be inspected for the parachute improperly installed and protruding from the body and the proper position and installation of the ogive. The assembly will be inspected for the proper assembly of the cartridge case onto the signal body. The cartridge case should be securely crimped onto the signal body. Any assemblies not meeting the above criteria or any poor workmanship shall be rejected.

40MM Signal assemblies will be pulled to run the crimp pull test on the completed 40MM Signal. The crimp pull test will be done manually by an operator. The manual inspection operator shall pull the 40MM Signal as needed per specification MIL-C-63092.

3.12.2 **Automatic SPC Reporting System.** The automatic SPC reporting system shall report rejected assemblies back to the main control panel automatically from the manual inspection station. Manual inspection stations shall have a minimum of ten reject containers which categorize the rejected assemblies as to their defect. The reject containers shall have sensors that automatically report an assembly has been inserted. No other operator interface shall be necessary to categorize assemblies that need rework. The operator will be able to focus their attention on looking for non-conforming assemblies, not on entering that data into the system. The main control panel will utilize this information for its SPC report generation. The number of particular rejected assemblies along with their frequency will be sent back from each manual inspection station with automatic SPC reporting system to the main control panel.

3.13 Leak Testing and Packout Machine.

3.13.1 **General.** This machine will leak test and packout the Hand Held Signal and the 40MM Signal. The machine will operate at a rate of 15 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded that is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The conveying system will be a conventional belt type with holding figures for the signals. This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to test and packout the Hand Held Signal and the 40MM Signal.

The conveyors for the boxes, cans, and pallets will be a roller type with power and free sections as needed for staging of components and staging before the filling, banding, and palletizer.

3.13.2 **Leak Tester.** The first station will leak test Hand Held Signals and 40MM Signals. The leak tester will consist of four pressure chambers. The signal (either Hand Held Signal or 40MM) will be picked off the conveyor by a robot with tactile sensing and placed in one of the chambers. The leak tester will function differently according to the signal type (either Hand Held Signal or 40MM) being worked on.

The containerized Hand Held Signal will be placed into one of the chambers. The lid for the chamber will be closed. Pressure will be applied and maintained per specification. Pressure sensors will verify if the containerized Hand Held Signal is sealed properly. The data will be monitored by the main controller. The pressure will then be released and the lid on the chamber will be opened. The containerized Hand Held Signal will then be picked up by the robot and placed into the packout fixture or into a reject container. The data will be recorded in the SPC data recorder.

The leak tester will be fitted with a chamber gage fitting when manufacturing the 40MM Signal. The robot will be equipped with sensors for tactile sensing. The robot will pick and place a 40MM Signal into the leak tester chamber, if resistance is encountered upon insertion of the 40MM Signal, the signal is improperly manufactured and is placed into a reject container. If minimal resistance is encountered upon insertion of the 40MM Signal, the lid for the chamber will be closed. Pressure will be applied and maintained per specification. Pressure sensors will verify if the 40MM Signal is sealed properly. The data will be monitored by the main controller. The pressure will then be released and the lid on the chamber will be opened. The 40MM Signal will then be picked up by the robot and placed into the stenciling unit or into a reject container. The data will be recorded in the SPC data recorder.

3.13.3 **Stencil 40MM Signal and Insert into Packing Tube (40MM only).** 40MM Signal Packout - The second and third station will stencil the 40MM Signal and insert it into the packing tube. A pick and place robot will load the signals into a pad stenciling unit to mark the body, from there the signal will be placed into the shipping tubes (929204), which will be hopper fed to the packout fixture. The fourth station for 40MM packout will load the 40MM Signals into the metal ammo box. The fillers (PPP-F-320) and labeling will be manually applied to the metal ammo box (9209204). The metal ammo box will be placed on a conveyor; the box will stop in front of the packing tube operation so an operator can fill the box and place the desiccant (MIL-D-3464) in proper position and place the remaining fillers on top. The filled box will be transferred to the next station.

3.13.4 **Product Packout.** Hand Held Signal Packout - The fourth station for Hand Held Signal Packout will load the containerized Hand Held Signal into the wooden packout box. The fillers (7548415), divider partitions (9378429), and black ink (TT-I-1795) for labeling will be manually applied to the wooden packout box (9378428). The wooden packout box will be placed on a conveyor that will present the box to the loading fixture. The robot will load the containerized Hand Held Signal from the leak tester into a matrix fixture that will load the containerized Hand Held Signal into the wooden packout box. Sensors on the fixture will verify that the containerized Hand Held Signals are present and have been loaded into the wooden packout box. The filled box will be transferred to the next station.

3.13.5 **Close Packout Container.** The fifth station will place the remaining fillers and close the packout containers.

The filled wooden packout box will be closed manually by an operator. The wooden packout box would then be transferred to the next station.

The metal ammo box will have remaining fillers placed on top and the metal ammo box closed manually by an operator. The metal ammo box would then be transferred to the next station.

3.13.6 **Place Metal Ammunition Boxes in Wirebound Box (40MM Only).** The sixth station places two metal ammo boxes into the wirebound box (9209205). An operator will manually stencil wirebound box with black ink (TT-I-1795) and load the wirebound box with the two metal ammo boxes. The operator will place the fillers (MIL-F-50449) and the separator (MIL-F-50449) into the wirebound box for a tight pack. The operator will close the wirebound box and bend the wire loops to seal the box.

3.13.7 **Security Seal Application.** The seventh station will place a metal security seal (8794342) on the packout containers.

The metal security seal (8794342) would manually be applied to the Hand Held Signal wooden packout box hasp. The box would be transferred to the next station.

The metal security seal would manually be applied to the 40MM wirebound box center wire loop. The box would be transferred to the next station.

3.13.8 **Banding Machine (Hand Held Signal Only).** The eighth station bands the wooden packout boxes of Hand Held Signals. The sealed wooden packout boxes will enter a commercially available banding machine. This unit will automatically place the band around the box. The box would be transferred to the next station.

3.13.9 **Bar Code Application.** The ninth station places a bar code onto the packout container. An operator will place the bar code labels on either the Hand Held Signal wooden packout boxes or the 40MM wirebound box. The box would be transferred to the next station

3.13.10 **Control Overview.** The Control Overview for Leak Testing and Packout Machine covers the control description, control panel major components, and machine control devices.

3.13.10.1 **Control Description.** The control operations are detailed in the following paragraphs.

Start-up operations shall operate in the following manner. All machines are to be empty and ready to receive parts for assembly. Components are manually loaded into the machines, and are jogged to index feed components to their proper position for automatic operation. Push "start-up" push button located at the 40MM Assembly Machine Control Panel. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present. Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

A stop sequence shall operate in the following manner. By pressing the "stop" button in an assembly area, the machines will finish their operation at each station but will not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a component that is jammed, or a station that is misfeeding components. Pressing the "start" push button restarts the operation by transferring parts to the next station and continuing operations.

The emergency stop procedures shall operate in this manner. Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

An emergency restart will be used to start operation after an emergency stop has occurred. Push "start-up" push button to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start-up automatic operation.

The shutdown procedures shall be used to shut down automatic operation in an orderly manner. Press the "shutdown" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought ck into the staging and magazine loading area. The control system shall sense for "all empty" and indicate on the display if there are any components present.

Product reject and reinsert procedures are used to remove rejected assemblies and once repaired they may be reinserted back into automatic operation.

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the components assembly (e.g. missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operations. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room, shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

Assemblies that were rejected and have been manually repaired may be reinserted into the automated operation. The manual inspection stations located in Rooms 109 and 110 is where assemblies can be reinserted into the assembly process before packout.

3.13.10.2 Control Panel Major Components. The control panel is located in Room 111. It shall house the following:

480 volt, 3 phase Power Distribution System. The distribution system shall protect and distribute power to all the 480 volt 3 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide overcurrent protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. A disconnect means shall be used to interrupt power to gain control panel access.

120 volt, 1 phase Power Distribution System. The distribution system shall protect and distribute power to all the 120 volt 1 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized by applicable codes and standards. A disconnect means shall be used to interrupt power to gain control panel access.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Central Processing Unit. The central processing unit shall control all the machine functions for the room utilizing input/output devices. The central processing unit will use analog and serial interfaces for machine control, communications and display capabilities. It shall be able to be programmed easily at the plant location.

Input/Output Rack. The input/output rack shall control and monitor the field devices and motors located in the room.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations.

Control System Display. The local control panel shall have a display capable of showing all the necessary data for operations.

Motor Starters. The control panel shall contain the necessary motor starters and contactors for all controlled operations in the room. The motor starters shall be sized to conform to applicable codes and standards.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

3.13.10.3 Machine Control Devices. The Leak Testing and Packout Machine has the following machine control devices.

The first station will test the container seal for either Hand Held Signals or 40MM Signals at four testing chambers. The signal (either Hand Held Signal or 40MM) will be picked off the conveyor by a robot with tactile sensing and placed in one of the chambers. The leak tester will function differently according to the signal type (either Hand Held

Signal or 40MM) being worked on.

The containerized Hand Held Signal will be placed into one of the chambers. A part presence sensor will verify its presence. The lid for the chamber will be closed. A sensor will verify that it is closed. Pressure will be applied and maintained per specification. Pressure sensors will monitor any pressure loss and will verify if the containerized Hand Held Signal is sealed properly. The data will be monitored by the main controller. The pressure will then be released and the lid on the chamber opened. The containerized Hand Held Signal will then be picked up by the robot and placed into the packout fixture or into a reject container. A sensor will verify its removal from the chamber and its proper placement into either the packout fixture or into the reject container.

The leak tester will be fitted with a chamber gage fitting when manufacturing the 40MM Signal. The robot will be equipped with sensors for tactile sensing. The robot will pick and place a 40MM Signal into the leak tester chamber. If resistance is encountered upon insertion, the signal is improperly manufactured and is placed into a reject container. If minimal resistance is encountered upon insertion, the robot will finish placing the signal into the chamber. A part presence sensor will verify its presence. The lid for the chamber will be closed. A sensor will verify that it is closed. Pressure will be applied and maintained per specification. Pressure sensors will monitor any pressure loss and will verify if the 40MM Signal is sealed properly. The data will be monitored by the main controller. The pressure will then be released and the lid on the chamber opened. The 40MM Signal will then be picked up by the robot and placed into the stenciling unit or into a reject container. A sensor will verify its removal from the chamber and its proper placement into either the stenciling unit or into the reject container.

The second station stencils the outside of the 40MM Signal. The stencil ink tank will have two sensors detecting tank level; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is out of ink and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will verify the assembly's presence in the stenciler. If any assemblies are rejected, a sensor detects placement into the reject containers.

The third station inserts the 40MM Signal into shipping tubes. The shipping tubes will be fed from a horizontal hopper, which has two sensors; one will be a low alarm to indicate when the hopper needs refilling; the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor verifies placement of the tube onto the assembly. If any assemblies are rejected, a sensor detects placement into the reject containers.

The fourth station inserts the Hand Held Signals into the wooden packout box. The robot will load the containerized Hand Held Signal from the leak tester into a matrix fixture that will load the containerized Hand Held Signal into the wooden packout box. Sensors will verify that the signals are present and have been loaded into the wooden box. The quantity of signals in the wooden box will be reported to the main controller. The controller will reject a wooden box that does not have the proper amount of signals inside. If any boxes are rejected, a sensor detects placement into a reject area.

The fifth station is a manual operation which adds the filler to the packout containers and closes the container.

The sixth station is a manual operation on the 40MM Signals in which two metal ammo cans will be placed into a wirebound box.

The seventh station is a manual operation where the metal security seal is placed on the packout containers.

The eighth station places banding material around the wooden box. The banding material is on roll stock and will have two sensors determining its level. One sensor will be a low alarm indicating the banding machine needs to be refilled; the other sensor will signal when the machine is out of material and signal to shut down the operation in an orderly manner. A part presence sensor will sense when a wooden box is in place to apply banding material. After operation, the wooden box will be discharged to the next station. If any boxes are rejected, a sensor detects placement into a reject area.

The ninth station is a manual operation which applies the bar code labels to the packout containers.

3.13.11 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, MIL-S-13257H, and MIL-C-63092 are covered by a manual inspection prior to and while loading machine and while in operation, or as detailed below.

The assemblies and their containers shall be inspected and rejected for any signs of poor workmanship.

The leak tester will consist of four pressure chambers. The signal (either Hand Held Signal or 40MM) will be picked off the conveyor by a robot with tactile sensing and placed in one of the chambers. The leak tester will function differently according to the signal type (either Hand Held Signal or 40MM) being worked on.

The containerized Hand Held Signal will be placed into one of the chambers. The lid for the chamber will be closed. Pressure will be applied and maintained per specification. Pressure sensors will verify if the containerized Hand Held Signal is sealed properly. The data will be monitored by the main controller. The pressure will then be released and the lid on the chamber will be opened. The containerized Hand Held Signal will then be picked up by the robot and placed into the packout fixture or into a reject container. The data will be recorded in the SPC data recorder.

The leak tester will be fitted with a chamber gage fitting when manufacturing the 40MM Signal. The robot will be equipped with sensors for tactile sensing. The robot will pick and place a 40MM Signal into the leak tester chamber, if resistance is encountered upon insertion of the 40MM Signal, the signal is improperly manufactured and is placed into a reject container. If minimal resistance is encountered upon insertion of the 40MM Signal, the lid for the chamber will be closed. Pressure will be applied and maintained per specification. Pressure sensors will verify if the 40MM Signal is sealed properly. The data will be monitored by the main controller. The pressure will then be released and the lid on the chamber will be opened. The 40MM Signal will then be picked up by the robot and placed into the stenciling unit or into a reject container. The data will be recorded in the SPC data recorder.

3.13.12 Risk Assessment of System. All the devices and concepts that have been chosen for this proposal are low risk. All concepts are currently used in industries such as food packaging plants. The tooling for nest and hoppers would be unique to these components, but the concepts have been successfully used for years. Several of the manual steps will not change from the methods used today.

3.14 Case Palletizer.

3.14.1 General. The conveyors for the pallets will be a roller type both power and free sections. The system will be designed so that the control system will control the conveyor to advance to the pallets to the next station.

3.14.2 Palletizing. At the first station a commercially available palletizer machine will take the boxes and stack them per the pre-programmed sequence. The pallets will be manually loaded into the machine. The boxes will be supplied on a power or gravity roller conveyor. The fillers will be manually placed on the pallet. The filled pallets will be discharged to the banding machine.

NOTE ALTERNATE METHOD: The alternate would be to manually palletize the boxes and then discharge to the banding machine.

3.14.3 Pallet Banding Machine. At the second station the banding machine will position the filled pallets and place the bands around the boxes. There are several commercially available banding machines that are capable of banding these products.

The third station does a manual inspection of the pallet, application of bar code labels and then removes the pallet to the shipping area.

3.14.4 Control Overview. The Control Overview for the Case Palletizer utilizes the same control description as detailed in section 3.13.10.1 and the same control panel major components as detailed in section 3.13.10.2 since the Case Palletizer uses the same control panel as the Leak Testing and Packout Machine. The machine control devices are described in the following section.

3.14.4.1 Machine Control Devices. The Case Palletizer shall use the following machine control devices.

The first station places the boxes on a pallet in layers. The pallet shall be manually placed on the palletizer. The case palletizer may be configured as a stand alone machine with its own processor, an industrial robot with its own control or the main control system may be used to perform the functions necessary to load the pallets. Sensors will be used to sense a pallet in position. A layer of boxes shall be placed on the pallet using sensors. A sensor will verify that a cardboard separator has been positioned manually. Sensors will be used to sense when three layers are placed on a pallet. When the pallet is full, it will be discharged from the palletizer by a power roller conveyor. This conveyor will deliver the pallet to the banding machine.

The second station bands the boxes together on the pallet. When the pallet is delivered to the banding machine, a sensor will verify its proper location. Sensors are utilized to apply the necessary banding to the pallet. The pallet is then discharged.

The third station does a manual inspection of the pallet, application of bar code labels, and then removes the pallet to the shipping area.

3.14.5 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, MIL-S-13257H, and MIL-C-63092 are covered by a manual inspection prior to and while loading machine and while in operation. The assemblies and their containers shall be inspected and rejected for any signs of poor workmanship.

3.14.6 **Risk Assessment of System.** This equipment is low risk. It is used daily in all industries that ship boxes on pallets.

3.15 Manual Inspection Station - Packout Area Examination.

3.15.1 **General.** The Manual Inspection Station for the Packout area will cover the following items for inspection.

The 40MM Signal case will be inspected for defects while the operator prepares to load the 40MM Signals and fillers into the case. The Hand Held Signal wooden box will be inspected for defects prior to the assembly machine loading the signals. The wooden box will then be inspected again for the proper amount of signals to be in the box and for proper packaging around the signals. The wirebound 40MM boxes will be inspected for proper assembly while the security seal is being applied. The Hand Held Signal wooden box banding will be inspected while the bar code labels are being applied to the box. The pallet of boxes will be inspected for proper placement and banding prior to its removal to the shipping area. Any assemblies and components not meeting the above criteria or any poor workmanship shall be rejected.

3.15.2 **SPC Information Entry.** The manual inspection station located in the packout area shall be capable of reporting a minimum of ten assembly and packout reject categories. The manual entry of the defect shall be done at the main control panel. The operator at the manual inspection station would be able to enter a particular reject fault as it occurs during operation. The station where the defect occurred would then take appropriate action to reject the item in question. An operator shall be able to enter the decision to reject via control entry devices (e.g. push buttons, etc.) located at the main control panel. Manual operations might be used to clear rejects in this area due to the size of the operations. An operator can manually clear some defective items (e.g. defective wooden case, pallet or ammunition box, etc.) easier than automated operations.

3.16 Parachute - Payload Subassembly Machine.

3.16.1 **General.** This machine will assemble the payloads for the Hand Held Signals. The machine will operate at a rate of 15 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded which is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The conveying system will be a walking beam conveyor (Fig. 1 in Appendix A). This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to assemble and inspect the payload subassembly.

A new clasp will be designed for this operation (Fig 7 in Appendix A). The current clasp is manually assembled to the chain and then crimped to keep the chain from coming unhooked. The new clasp will be physically the same size as the existing clasp, the only difference will be that the pocket that captures the chain will be opened up so that the ball chain can just be laid in the pocket and then the clasp formed around the ball chain. The existing clasp requires that the ball chain be snapped into place which is a very difficult operation for an automated assembly machine. The new clasp will serve the same function and be similar to the existing clasp after crimping.

3.16.2 **Crimp Chain Operation.** The first station crimps the chain from the parachute assembly to the payload assembly. The following components are - payload assemblies (9328576, 9295010, 9255113, or 8797998-1, 8797998-2, 9317510, 9255145, or 9243881) and folded parachute (8797991). The payload assembly and the parachute assembly will be hopper fed into holding fixtures. A part presence sensor will be used to locate and position the end of the ball chain. Once located, the end will be held captive for placement into the new clasp. Guides will orient the clasp that is attached to the payload assembly. The clasp will be held captive for the ball chain to be placed in position. The fixture will place the ball chain into the clasp. The clasp will then be formed around the chain by a crimping action. The assembly will then be transfered to the next station.

NOTE ALTERNATE METHOD: Operators will manually place the payload assembly and folded parachute (the parachute will be in a longer cardboard subassembly tube) on the conveyor and align the chain and clip. The assembly will then be transferred to the next station which will assemble the chain and clip together and crimp the assembly. A sensor will verify that the chain was assembled to the clip and that the assembly was crimped.

3.16.3 **Manufacture Payload Washer and Insert into Parachute Tube.** The components that will be assembled at the second station are the washer (8797970 - this component assembly will be manufactured on the machine replacing the current pre-cut units) and the above assembly.

The felt washer will be die cut from felt roll stock. The cutter will have the capacity to hold a minimum of sixty-five feet of felt material, this would require a material change twice an hour. It would also have a take-up roll for the waste material. A second set of feed roll and take-up roll will be installed so that the refilling would not interrupt the automated assembly system. After the washer is cut, a pick and place unit will insert the washer into the parachute tube. Sensors will be located on the felt roll to signal low level and when the roll is empty. These signals will be sent to the controller and alarms will be sounded as needed. A part presence sensor will verify that a completed washer was presented to the parachute tube and that the washer was installed.

NOTE ALTERNATE METHOD: An alternate would be to use the existing washer. An operator would be added to the line and the operator would manually insert the washer.

3.16.4 Insert Payload into Parachute Tube. At the third station a plunger will insert the payload into the parachute tube. Sensors will verify that the operation was completed correctly. The final operation is to stack the completed subassemblies in the interim storage boxes. This will be done manually.

3.16.5 Control Overview. The control overview covers the control description, control panel major components, and machine control devices.

3.16.5.1 Control Description. The control operations are detailed in the following:

Start up procedures are as follows:

1) Make sure all machines are empty and are ready to receive parts for assembly.

2) Manually load assembly components into machines. Jog to index feed components to their proper position for automatic operation.

3) Push "start-up" push button located at the local control panel for that area. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present.

4) Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

Stop sequence procedures are as follows: Pressing the "stop" button in an assembly area lets the machines finish their operations in that area but does not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a part that is jammed, or a station that is misfeeding components). Pressing the "start" button restarts the operation by transferring parts to the next station and continuing operations.

Emergency stop procedures are as follows: Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

Emergency Restart. Push "start-up" to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start up automatic operation.

Shut-down. Press "shut-down" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought back into the staging and magazine loading area. The control system shall sense for all empty and indicate on the display if there are any components present.

Product reject and reinsert procedures are as follows:

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the components assembly (e.g. missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operations. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

Assemblies that were rejected and have been manually repaired may be reinserted into the automated operation. Several station work areas in each room shall have a remote start-stop control station which will allow the stopping of the previous station to allow room for assembly insertion and then its following station that will be performing the needed operation for the previously rejected part. This procedure may be repeated as necessary to reinsert rejected assemblies back into the automated operation.

3.16.5.2 **Control Panel Major Components.** The control panel is located outside room 106. It shall house the following:

480 volt, 3 phase power distribution system. The distribution system shall protect and distribute power to all the 480 volt 3 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide over current protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. A disconnect means shall be used to interrupt power to gain control panel access.

120 volt, 1 phase power distribution system. The distribution system shall protect and distribute power to all the 120 volt 1 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized by applicable codes and standards. A disconnect means shall be used to interrupt power to gain control panel access.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Central Processing Unit. The central processing unit shall control all the machine functions for the room utilizing input/output devices. The central processing unit will use analog and serial interfaces for machine control, communications and display capabilities. It shall be able to be programmed easily at the plant location.

Input/Output Rack. The input/output rack shall control and monitor the field devices and motors located in the room.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations.

Control System Display. The local control panel shall have a display capable of showing all the necessary data for operations.

Motor Starters. The control panel shall contain the necessary motor starters and contactors for all controlled operations in the room. The motor starters shall be sized to conform to applicable codes and standards.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

3.16.5.3 **Machine Control Devices.** The Payload Subassembly Machine has the following machine control devices.

The first station crimps the chain from the parachute assembly to the payload assembly. Both horizontal hoppers have two sensors to detect parts levels; one will be a low alarm to indicate when the hoppers need refilling; the other sensor will signal when the hoppers are out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. Sensors are used to align chain from parachute assembly into fixture. The payload assembly is aligned into the fixture using sensors. The fixture advances and crimps the chain onto the payload assembly. If any assemblies are rejected, a sensor detects placement into the reject containers.

The second station inserts a manufactured washer into the parachute tube. The washer material shall be fed from roll stock. It shall have two feed and take-up systems to permit refilling without shutdown. Each feed roller shall have a low level alarm sensor to indicate refilling is necessary. They shall also have a sensor to signal when the roll is empty and an orderly shutdown would be necessary. A part presence sensor will verify that a washer was presented to the tube and that a washer was installed.

The third station inserts the payload assembly into the parachute tube. A part presence sensor will verify correct placement of the payload assembly for insertion. A part presence sensor will verify correct placement of the parachute tube. Once aligned, the payload assembly will be inserted into the parachute tube by a pusher with positive mechanical stops. The part presence sensors will verify that the operation was completed correctly. An operator then loads the completed subassemblies into storage boxes.

3.16.6 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, and MIL-S-13257H are covered by either a manual inspection prior to or while loading the component into the machine or as detailed below.

The chain from the parachute assembly is crimped onto the payload assembly. A sensor verifies the crimping operation and that it is securely attached. The assembly machine checks for correct placement of components using sensors. The operator will also perform a visual inspection of the operation on occasion to verify its operation. The assembly will be rejected for any other signs of poor workmanship.

3.16.7 **Risk Assessment of the System.** All the devices and concepts that have been chosen for this proposal are low risk. All concepts are currently used in industry packaging and the various food packaging plant. The tooling would be unique to these components, but the concepts have been successfully used for years.

3.17 Staging and Magazine Loading Alarm Center

3.17.1 **General.** The Staging and Magazine Loading Alarm Center shall have the necessary interfaces for the Main Control System to display alarm conditions. See Control System Diagram (Diagram 11). It shall have the annunciator panel to display the necessary alarm conditions for all the components used in the assembly process. It shall have the needed control entry devices for operation to acknowledge alarms and start and stop operation, etc.

3.17.2 **Annunciator Panel.** The annunciator panel shall be located inside the staging and magazine loading area. The main control system will control the annunciator panel and its alarms. The annunciator panel will display low level alarms for components to signal for refilling. It shall display conditions for all components used in the assembly process. The annunciator panel indicators shall be so arranged to permit easy identification of which room, which station, and which component needs attention. It shall also display components for the 40MM assembly machine separately. A "no part present" alarm shall be displayed for all stations indicating a feeder system jam or a level sensor not working properly. The main control panel shall have different states of alarm conditions to allow for start-up and shutdown conditions. For example, this would allow for low level conditions to be present if the operations were in a shutdown cycle. Other conditions would also apply to having various alarm states.

3.17.3 **Control Overview.** The Control Overview for the Staging and Magazine Loading Alarm Center covers the control description, control panel major components, and machine control devices.

3.17.3.1 **Control Description.** The control operations are detailed in the following paragraphs.

Start-up operations shall operate in the following manner. All machines are to be empty and ready to receive parts for assembly. Components are manually loaded into the machines, and are jogged to index feed components to their proper position for automatic operation. Push "start-up" push button located at the 40MM Assembly Machine Control Panel. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present. Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

A stop sequence shall operate in the following manner. By pressing the "stop" button in an assembly area, the machines will finish their operation at each station but will not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a component that is jammed, or a station that is misfeeding components. Pressing the "start" push button restarts the operation by transferring parts to the next station and continuing operations.

The emergency stop procedures shall operate in this manner. Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

An emergency restart will be used to start operation after an emergency stop has occurred. Push "start-up" push button to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start-up automatic operation.

The shutdown procedures shall be used to shut down automatic operation in an orderly manner. Press the "shutdown" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought back into the staging and magazine loading area. The control system shall sense for "all empty" and indicate on the display if there are any components present.

Product reject and reinsert procedures are used to remove rejected assemblies and once repaired, they may be reinserted back into automatic operation.

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the components assembly (e.g. missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operations. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room, shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

Assemblies that were rejected and have been manually repaired may be reinserted into the automated operation. Several station work areas in each room shall have a remote start-stop control station which will allow the stopping of the previous station to allow room for assembly insertion. The following station will perform the needed operation for the previously rejected part. This procedure may be repeated as necessary to reinsert rejected assemblies back into the automated operation.

3.17.3.2 **Control Panel Major Components.** The control panel is located inside Room 105. It shall house the following:

Annunciator Panel. The Annunciator Panel will display low level alarms and "no part present" alarms for all components used in the assembly process. The panel indicators shall be so arranged to permit easy identification of which room, which station, and which component needs attention.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.) Such devices may be paralleled to provide for local and machine mounted control stations.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

3.18 Main Control System - Building 16Y

3.18.1 **General.** The Main Control System shall provide the necessary interfaces and utilities to each machine and the Alarm Center. See Control System Diagram (Diagram 11). In addition, sufficient Input/Output capability to operate the Leak Testing and Packout Machine, Case Palletizer, and the Packout Conveyor must be resident within the Main Control Panel. It is also the interface to the Voice Synthesis Module used for paging alarms throughout the building. The Remote Console accesses the Building Automation to monitor and record alarms and production information.

3.18.2 **Control Features.** The main control system shall monitor each of the assembly rooms for production data and alarm conditions. It will also monitor assembly rejection at the automated stations and at the manual inspection stations. The main control system will monitor and control the Leak Testing and Packout Machine, Case Palletizer, and the Packout Conveyor. The Case Palletizer may be configured as a stand alone machine with its own processor, an industrial robot with its own control, or the main control system may be used to perform the functions necessary to load the pallets. The main control system will control the annunciator panel and provide for low level alarms and "no part present" alarms for all the components at all the work stations. The main control panel shall have different states of alarm conditions to allow for start-up and shutdown conditions. Other possible conditions would also apply to having various alarm states. For example this would allow for low level conditions to be present if the operations were in a shutdown cycle. The main control system shall provide control indications for the

Voice Synthesis Alarm System, which will announce particular alarms through a speaker system. The main control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations. If programmable logic controllers are utilized for the control operation, the use of Allen-Bradley programmable controllers shall be used to facilitate ease of incorporation of this automation with other areas of Longhorn AAP. The main control system shall assemble the following listings and make available for data storage at the remote console via modem:

Active and/or unacknowledged alarms and times.
Any alarms and times since last query.
Alarm reset times.
Any system downtimes.
Update of shift production.
Update of reject rates by type.
Update of reject frequency by type.

3.18.3 **Alarm and Display Features.** The main control system controls the alarm and display operations. The control system will alarm low level conditions for components at all stations. These alarms will be displayed on the annunciator panel located at the staging and magazine loading alarm center. A "no part present" alarm shall be displayed at the alarm center for all stations indicating (e.g. a feeder system jam or a level sensor not working properly, etc.). The main control panel shall have different states of alarm conditions to allow for start-up and shutdown conditions. Other conditions would also apply to having different alarm states. For example this would allow for low level conditions to be present if the operations were in a shutdown cycle. The main control system will be capable of displaying current information on operations in the testing and packout area, (e.g. low levels, production rates and rejection rates of assemblies) at the display located at the main control panel. It shall also display current information on operations in all other work areas. The display shall display all necessary data for automated operations on various screen menus. The display shall report all types of rejects and the frequency of those assemblies rejected for the various work areas. The main control system will display listings of the following:

Active and/or unacknowledged alarms and time.
Alarm reset times.
Any system downtimes.
Shift production.
Rejection rates by type.
Rejection frequency by type.

3.18.4 **Voice Synthesis Alarm System.** The main control system will control voice activation and message selection for the alarm system. The voice synthesis alarm system will help in the process of refilling low component levels and prevent the likelihood of system shutdown due to insufficient component supply. The voice synthesis alarm system will indicate which component has a low level and indicate which station it is at. The alarm system will have speakers in several locations so the alarm can be heard in the Staging and Magazine Loading alarm center, the hallway connecting all the assembly rooms and in the assembly room where the component is low. The alarm system will have an audio amplifier capable of driving all necessary speakers and allow for future expansions.

3.18.5 **Power Distribution.** The main control system shall have a 480 volt, 3 phase distribution system and a 120 volt, 1 phase distribution system. The 480 volt, 3 phase distribution system shall protect and distribute power to all local control panels for their operation along with all the 480 volt, 3 phase motor starters located in the main control panel, and all the field devices located in Leak Testing and Packout area. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide overcurrent protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. The 480 volt, 3 phase distribution system will also provide power to a 480 volt/120 volt power transformer properly sized by all applicable codes and standards for the 120 volt, 1 phase power distribution system. The 120 volt, 1 phase distribution system shall protect and distribute power to all local control panels for their operation along with all the 120 volt, 1 phase motor starters located in the main control panel, and all the field devices located in Leak Testing and Packout area. It shall utilize either breakers or fuses sized with applicable codes and standards. The 480 volt, 3 phase distribution system shall have a disconnect means to interrupt power to gain control panel access.

3.18.6 **Remote Monitoring and Reporting.** The Main Control System shall monitor and report the operations for Hand Held Signal and 40MM Signal manufacturing. All machine operations, component levels, and alarm conditions for all operations shall be monitored and stored in the main control system. The control entry devices at the local control panels, machine control stations, main control panel and all the field input devices shall be monitored for inputs to the main control system. The main control system shall report various operations via several different means. Alarm conditions shall be reported to the annunciator panel, main control system display, and to the voice synthesis module. The component levels for all the assembly components shall be reported to the annunciator panel and the main control system display. The machine operations, shift production data, rejection rates by type and their frequency shall be reported on the main control system display. The Remote Console shall call and store alarm conditions, alarm times, shift production data, rejection rates by type and their frequency by type via telephone lines. This data shall be stored at the Remote Console and made available for report generation.

3.18.7 **Risk Assessment of System.** All the devices and concepts that have been chosen for the control system are low risk. All concepts are currently used in industries such as drug manufacturing and packaging, and the various food packaging plants. The control system design may be unique to these operations and components, but these concepts have been successfully used for years.

4.0 Building 34Y Automation and Quality Control System.

4.1 System Description. The automation in Building 34Y shall apply the first fire and quick match to the Star Assemblies and load them into payload subassembly container tubes. The system also allows for manual inspection of the Stars prior to inserting them into tubes.

All equipment and coating techniques discussed are capable of more than the required production rates. Their implementation can be done within the necessary safety requirements and building restrictions. The product coming from such automation should be of equal quality as the present operation. This will be done without exposing the operators to the present fumes and tedious work.

4.2 Integration. The control system is as detailed in the Control System Diagram (Diagram 11 in Appendix A). The Star Finishing Control Panel provides the utilities and controls the Star Finishing Machine, the Star Finishing Inspection Station, and the Star Loading Machine. The communication between the Remote Console and Building 34Y comes through a telephone modem in the Star Finishing Control Panel.

4.3 Layout. All of the equipment is located in Building 34Y as shown on Layout Drawing No. 2 in Appendix A.

4.4 Special Considerations. The automation system proposed for Building 34Y will demand a high level of system integration as well as critical production operations. It is important that the entire system be thoroughly checked at the vendor's premise prior to shipping. This should include a continuous production of 5000 units of each type of payload assembled and packed as final product at 135% of production rate.

The above checkout will assure that the equipment once installed at Longhorn AAP will operate as required without major startup delays. Because of the magnitude of the equipment proposed, it will be impossible to maintain even limited production within the building. It appears that a minimum of 30 days downtime would be necessary. That would not include the start-up of the equipment which could take another 15 days. Thus, a total of 45 days should be allotted. Even this would require certain pre-installation preparation that should be detailed in the final design and schedule.

During the installation downtime, the equipment vendor should train the operators, maintenance personnel and engineering for a complete understanding of the equipment. This should include levels of troubleshooting and familiarization with the system documentation. Items such as action/decision diagrams should be prepared for each level of personnel. These should be incorporated with the new Standard Operating Procedures.

Complete documentation should precede start-up including programming code and O&M Manuals. The vendor should present all design notes and other information used by their personnel during the start-up.

Technical specialists must be stationed at Building 34Y. They should include one Mechanical Technician to perform necessary setup, maintenance and calibration. An Electronic and Instrumentation

Technician will be stationed at Building 16Y. He can assist in troubleshooting and maintenance of the sophisticated controls systems in Building 34Y. Note that these must be technically competent people. They will be required to interface with robotics as well as the fixed place automation. Special training should begin once the vendor has developed a final design. It should include courses on all major equipment and controls.

As stated in Section 2.3, the production rates can easily be increased without changes in technology. It is suggested that ıch an increase be implemented to guarantee production rates even with extended downtimes. This will be of particular importance when initially operating the system. If this option is to be taken, increased magazine and hopper storage should be specified.

Before furthe design can be done on the Star Finishing Machine, an inert First Fire formulation must be developed. This can be used to test the coating equipment and fine tune the design concepts. None was available at the time of this report. The ideas and concepts proposed have been applied with a wide range of coating materials and should not be any problem.

4.5 Items Considered - Utilized/Rejected.

A one step star finishing system was proposed. This would have been a mold being placed around the star and the first fire would be pumped into the cavity. This was rejected because of the need to clean the mold and the ability to control the operation. Other items that were rejected included:

1. Spray & Mask because it needs ventilation for spraying (a safety problem because of static charges), causes excessive overspray, and excessive loss of product which is undesirable with this energetic material.

2. Brush Applicator because of excessive product buildup on applicator which would result in product on part.

4.6 Star Finishing Machine.

4.6.1 General. This machine will apply the first fire compound and quick match to the colored stars. The machine will operate at a rate of 30 completed assemblies per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed and fabricated to eliminate places to trap dirt and energetic materials. Since this machine is handling energetic materials, all components will be designed to be non-sparking and anti-static. All equipment is to be grounded and bonded that is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer to monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

The first fire shall be pumped continuously in a circulation system to prevent stratification of components in the reservoir. This shall occur at every station in which the first fire is applied.

The conveying system will be a walking beam conveyor (Fig. 1 in

Appendix A). This system will convey the assemblies to various stations that are designed to accommodate the various components and operations needed to produce the finished stars.

4.6.2 **Orientation Marking of Star.** At the pressing of the stars, an ink marking system will be added and place a mark on the stars that will indicate the orientation of the quick match groove. The presses will also have to be modified so that the grooves are always in the same relative position to each other.

4.6.3 **Load Stars into Machine.** The first station loads the stars into the assembly machine. An operator will manually clean, inspect, and place the star subassemblies into the first nest type fixture. The star will then be transferred to the next station.

4.6.4 **Apply First Fire to Star Side 1.** (Step 2 on Fig. 8 in Appendix A.) The second station applies first fire to the first side of the star. A silk screen will pass through a cleaning wiper as it is presented to the top face of the star. The silk screen will apply the first fire. The silk screen will be a metal mesh (i.e. stainless steel) which will allow the first fire to be applied evenly and accurately. The silk screen operation will be able to apply first fire without any excess or misapplication. This will eliminate the necessity of cleaning and scraping of the stars manually. A pumping system will deliver the first fire to the silk screen as needed per the sensing units. The cleaning wiper will be automatically cleaned between cycles. The screen will also be cleaned periodically during operation. At that time, a different screen will be manually installed. The dirty screen will be cleaned and made ready for the next change. The star will be transferred to the next station.

4.6.5 **Apply First Fire and Quick Match to Star Side 1 Groove.** (Steps 3 & 4 in Fig. 8 in Appendix A.) The third and fourth stations apply first fire and the quick match to the groove on side 1 of the star. A sensor will read the orientation mark on the cardboard tube. A rotary actuator unit will then rotate the star to align the quick match groove with the machine. A pick and place unit will present a pump type applicator to the groove and dispense a measured quantity of the first fire to the groove. Another pick and place unit will take a quick match from the cutting unit (the cutter will cut the matches from the sticks they are received in into short pieces) and place the quick match in the groove. As the cutter cuts the quick match, the pick and place unit will receive the cut quick match. Any quick match that is not long enough will be discharged into a waste container. Sensors will verify these operations. If a prolonged time period elapses before placement of the quick match, the controller shall alarm and reject the assembly. This will prevent the application of the quick match on dry first fire. The star will be transferred to the next station.

4.6.6 **Rotate Star.** (Step 5 on Fig. 8 in Appendix A.) The fifth station rotates the star for operation on the second side. A rotary actuator unit will pick up the star and rotate the star top to bottom. The star will then be transferred to the next station.

4.6.7 **Apply First Fire to Star Side 2.** (Step 2 on Fig. 8 in Appendix A.) The sixth station applies first fire to the second side of the star. A silk screen will pass through a cleaning wiper as it is presented to the top face of the star. The silk screen will apply the first fire. The silk screen will be a metal mesh (i.e. stainless steel) which will allow the first fire to be applied evenly and accurately. The silk screen operation will be able to apply first fire without any excess or misapplication. This will eliminate the necessity of cleaning and scraping of the stars manually. A pumping system will deliver the first fire to the silk screen as needed per the sensing units. The cleaning wiper will be automatically cleaned between cycles. The screen will also be cleaned periodically during operation. At that time, a different screen will be manually installed. The dirty screen will be cleaned and made ready for the next change. The star will be transferred to the next station.

4.6.8 **Apply First Fire and Quick Match to Star Side 2 Groove.** (Steps 3 & 4 on Fig. 8 in Appendix A.) The seventh and eighth stations apply first fire and the quick match to the groove on side 2 of the star. A sensor will verify the correct location of the star relative to the groove. A pick and place unit will present a pump type applicator to the groove and dispense a measured quantity of the first fire to the groove. Another pick and place unit will take a quick match from the cutting unit (the cutter will cut the matches from the sticks they are received in into short pieces) and place the quick match in the groove. As the cutter cuts the quick match, the pick and place unit will receive the cut quick match. Any quick match that is not long enough will be discharged into a waste container. Sensors will verify these operations. If a prolonged time period elapses before placement of the quick match, the controller shall alarm and reject the assembly. This will prevent the application of the quick match on dry first fire. The star will be transferred to the next station.

4.6.9 **Control Overview.** The Control Overview for the Star Finishing Machine covers the control description, control panel major components, and machine control devices.

4.6.9.1 **Control Description.** The control operations are detailed in the following paragraphs.

Start-up operations shall operate in the following manner. All machines are to be empty and ready to receive parts for assembly. The Star Finishing control panel shall have a selector switch which will allow for applying the first fire and quick match to one side only. This is for the manufacturing of the 40MM Signal assembly (White Star, Cluster #9212688). This selection shall be made before loading in component parts. Components are manually loaded into the machines, and are jogged to index feed components to their proper position for automatic operation. Push "start-up" push button located at the 40MM Assembly Machine Control Panel. An alarm shall sound if a part is not present or in proper position. The display screen shall show which component needs attention in that area. After correcting any component presence or position, push "start-up" push button to again check component positions and to start automatic operation. A "ready" light or indication shall show all components are present. Push "start" push button once ready indication has occurred. The assembly machine shall then start automatic operation.

A stop sequence shall operate in the following manner. By pressing the "stop" button in an assembly area, the machines will finish their operation at each station but will not transfer the assembly into the next station. This is done to provide a momentary stop to solve any problems that might arise (e.g. a component that is jammed, or a station that is misfeeding components. Pressing the "start" push button restarts the operation by transferring parts to the next station and continuing operations.

The emergency stop procedures shall operate in this manner. Pressing the "emergency stop" push button immediately stops all operations on the assembly. All assemblies will be rejected after an emergency stop. The assemblies rejected shall be logged separately on the SPC due to the nature of their rejection.

An emergency restart will be used to start operation after an emergency stop has occurred. Push "start-up" push button to advance conveyors and move all assemblies into rejection bins. Check for removal of all assemblies from work stations. Push "start" push button once ready indication has occurred. The assembly machine shall then start-up automatic operation.

The shutdown procedures shall be used to shut down automatic operation in an orderly manner. Press the "shutdown" push button to stop feeding components at the first station in that area. As the last assembly moves down the line, the previous stations will stop operations. The components shall then be removed as the assemblies are completed in that area and brought back into the staging and magazine loading area. The control system shall sense for "all empty" and indicate on the display if there are any components present.

Product reject and reinsert procedures are used to remove rejected assemblies and once repaired, they may be reinserted back into automatic operation.

Assemblies shall be rejected automatically at each different station if the machine senses a problem with the components assembly (e.g. missing component, improper alignment, and incomplete operation etc.). Assemblies that are rejected are reported to a data recorder that will be used in conjunction with a SPC monitoring system. If assembly rejection occurs with any frequency, an alarm will be given to correct assembly operations. The main control panel will count rejected assemblies at all the assembly stations. When a reject container reaches a quantity of 25 assemblies, the main controller will alarm in the magazine loading room alerting an operator to empty the reject container. The alarm shall be cleared by a reset pushbutton located at the local control panels. The operator will remove the assemblies from the reject containers, and when leaving the assembly room, shall press the reset pushbutton. This operation would prevent an accumulation of assemblies in any area along the line. Assemblies that are rejected after an emergency stop shall be logged separately on the SPC due to the nature of their rejection. Manual inspection stations shall have a minimum of ten reject containers which will automatically record into the SPC when an item is rejected and the reason it was rejected.

4.6.9.2 Control Panel Major Components. The control panel is located in Building 34Y. It shall house the following:

480 volt, 3 phase Power Distribution System. The distribution

system shall protect and distribute power to all the 480 volt 3 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide overcurrent protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. A disconnect means shall be used to interrupt power to gain control panel access. The 480 volt, 3 phase distribution system will also provide power to a 480 volt/120 volt power transformer properly sized by all applicable codes and standards for the 120 volt, 1 phase power distribution system.

120 volt, 1 phase Power Distribution System. The distribution system shall protect and distribute power to all the 120 volt 1 phase motor starters located in this local panel and all the field devices located in the room. It shall utilize either breakers or fuses sized by applicable codes and standards. A disconnect means shall be used to interrupt power to gain control panel access.

Power Conditioner. The power conditioner shall provide stable clean power to the Central Processing Unit and the display to prevent any hardware/software damage due to brown outs and surges.

Central Processing Unit. The central processing unit shall control all the machine functions for the room utilizing input/output devices. The central processing unit will use analog and serial interfaces for machine control, communications and display capabilities. It shall be able to be programmed easily at the plant location.

Input/Output Rack. The input/output rack shall control and monitor the field devices and motors located in the room.

Control Entry. The local control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations.

Control System Display. The local control panel shall have a display capable of showing all the necessary data for operations.

Motor Starters. The control panel shall contain the necessary motor starters and contactors for all controlled operations in the room. The motor starters shall be sized to conform to applicable codes and standards.

Control Panel Enclosure. The enclosure shall be rated for Class 1 Division 1 Group D area. The enclosure shall be sized to house and protect all major control system components for the room.

4.6.9.3 **Machine Control Devices.** The Star Finishing Machine has the following machine control devices.

The first station loads the stars into the assembly machine. An operator will manually clean, inspect, and place the star subassemblies into the first nest type fixture. The star will then be transferred to the next station.

The second station applies first fire to the first side of the star. The tank for the first fire will have two sensors detecting tank levels; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is empty, and will send a signal to the main controller to shut down the operation in an orderly manner.

A part presence sensor will verify the star's position to apply first fire. A sensor will sense that the operation has been performed. If any assemblies are rejected, a sensor detects placement into the reject container.

The third station applies first fire to the groove on the first side of the star. The tank for the first fire will have two sensors detecting tank levels; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is empty and will send a signal to the main controller to shut down the operation in an orderly manner. A sensor will read the orientation mark on the star. A rotary actuator unit will then rotate the star to align the quick match groove with the machine. A pick and place unit will present a pump type applicator to the groove and dispense a measured quantity of first fire to the groove. A sensor will verify the operation. If any assemblies are rejected, a sensor detects placement into the reject container.

The fourth station cuts the quick match to length and applies it to the groove. Two sensors will be used to detect quick match material levels. One will be a low alarm to indicate when the machine needs refilling; the other sensor will signal when the machine is empty and will send a signal to the main controller to shut down the operation in an orderly manner. Sensors will be used to position the quick match in the groove and verify the operation. If any assemblies are rejected, a sensor detects placement into the reject container.

The fifth station rotates the star. Sensors will be used for the rotary actuator unit to pick up the star and rotate the star top to bottom.

The sixth station applies first fire to the second side of the star. The tank for the first fire will have two sensors detecting tank levels; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is empty, and will send a signal to the main controller to shut down the operation in an orderly manner. A part presence sensor will verify the star's position to apply first fire. A sensor will sense that the operation has been performed. If any assemblies are rejected, a sensor detects placement into the reject container.

The seventh station applies first fire to the groove on the second side of the star. The tank for the first fire will have two sensors detecting tank levels; one will be a low alarm to indicate when the tank needs refilling; the other sensor will signal when the tank is empty and will send a signal to the main controller to shut down the operation in an orderly manner. A sensor will read the orientation mark on the star. A rotary actuator unit will then rotate the star to align the quick match groove with the machine. A pick and place unit will present a pump type applicator to the groove and dispense a measured quantity of first fire to the groove. A sensor will verify the operation. If any assemblies are rejected, a sensor detects placement into the reject container.

The eighth station cuts the quick match to length and applies it to the groove. Two sensors will be used to detect quick match material levels. One will be a low alarm to indicate when the machine needs refilling; the other sensor will signal when the machine is empty and will send a signal to the main controller to shut down the operation in an orderly manner. Sensors will be used to position the quick match in the groove and verify the operation. If any assemblies are rejected, a sensor detects placement into the reject container.

4.6.10 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, MIL-S-13257H, and MIL-C-63092 are covered by either a manual inspection prior to or while loading the component into the machine or as detailed below:

The Star Finishing Machine will utilize sensors to detect correct placement of the quick match in the groove of the star. A sensor will detect its presence after the operation. The star will be rejected for any other signs of poor workmanship.

4.6.11 **Risk Assessment of System.** The risk assigned to this machine would be moderate. The technology proposed has been used in the ammunition, printing, and coating industries, but it has not specifically been used on items like these in an application like this.

4.7 Manual Inspection Station - Star Finishing Examination.

4.7.1 **General.** The Manual Inspection Station for the Star Finishing area will cover the following items for inspection.

The star assembly will be inspected for correct manufacture prior to being inserted into the assembly operation. The star will be inspected for correct placement of the index mark in relation to the groove in the star. The operator shall insert the star using this index mark on the star. The star assembly will then be inspected for correct assembly of components. The operator will inspect the star for first fire to be applied to each side of the star, to each side groove on the star and that the quick match is present and positioned correctly in each side groove of the star assembly. Any assemblies not meeting the above criteria or any poor workmanship is seen, it shall be rejected.

4.7.2 **Automatic SPC Reporting System.** The automatic SPC reporting system shall report rejected assemblies back to the main control panel automatically from the manual inspection station. Manual inspection stations shall have a minimum of ten reject containers which categorize the rejected assemblies as to their defect. The reject containers shall have sensors that automatically report an assembly has been inserted. The main control panel will utilize this information for its SPC report generation. The number of particular rejected assemblies along with their frequency will be sent back from each manual inspection station with automatic SPC reporting system to the main control panel.

4.8 Star Loading Machine.

4.8.1 **General.** This machine will assemble the individual stars into the subassembly tubes. The major components are the stars and the subassembly tubes. This machine will operate at the same rate as the star finishing machine, 30 stars per minute, 6 filled tubes per minute. Sanitary construction will be used throughout the machine. All welds will be ground and polished. The equipment will be easy to clean and designed to be non-sparking and anti-static. All equipment is to be grounded and bonded that is in the hazardous environment. Electrical components will be rated for the hazardous environment. The control system will be an industrial computer and will monitor all sensors and control all machine actions. All rejects will be reported to a data recorder that will be used in conjunction with a SPC monitoring system.

4.8.2 **Load Stars into Tubes.** The first station loads the star payload into subassembly tubes. The components used in this assembly are star payloads (8797956, 8839489-X, 8839489-Y) and the subassembly tube. After the stars are inspected, the operator will place the stars into the star stacking unit. The finished stars would be stacked in subassembly tubes (the same tube as the parachute subassembly tubes). The tubes would be hopper fed into a nest type fixture. When five stars are present a pusher would insert the stars into the tube. The filled tube would then be transferred to the tube stacking station. Sensors would verify that all components were present and installed correctly.

4.8.3 **Pack Tubes for Storage.** The second station loads the subassemblies into a storage bin. The filled subassembly tube would be stacked into a bin that would be used to store the subassemblies before they are used on the signal motor assembly line. The bins will hold 100 subassembly tubes. The bins will be a wire frame construction and will hold the tubes horizontally ten per row, ten columns high.

4.8.4 **Control Overview.** The Control Overview for the Star Loading Machine utilizes the same control description as detailed in Section 4.6.9.1 and the same control panel major components as detailed in Section 4.6.9.2 since the Star Loading Machine uses the same control panel as the Star Finishing Machine. The machine control devices are described in the following section.

4.8.4.1 **Machine Control Devices.** The Star Loading Machine has the following machine control devices.

The first station loads the star payload into the subassembly tubes. The tubes are hopper fed to the assembly machine. The hopper will have two sensors detecting parts levels. One will be a low alarm to indicate the hopper needs refilling, and the other sensor will signal when the hopper is out of parts and will send a signal to the main controller to shut down the operation in an orderly manner. An operator will place stars into the star stacking unit. A sensor will verify when five star payloads are present for insertion into the tube. Sensors will be used for the positioning of the tube for star insertion. Sensors would verify that all components were present and installed correctly.

The second station loads the subassemblies into a storage bin. Sensors are used for the placement of the subassemblies into the bin. Sensors will also be used to determine when the storage bin is full.

4.8.5 **Quality Conformance Inspection Points.** All the various inspections required by MIL-S-13303G, MIL-S-13261G, MIL-S-13257H, and MIL-C-63092 are covered by a manual inspection prior to and while loading machine and while in operation. The assemblies shall be inspected and rejected for any signs of poor workmanship.

4.8.6 **Risk Assessment of System.** This would be a low risk unit since stacking equipment is used throughout the packaging industry.

4.9 Main Control System - Building 34Y.

4.9.1 **General.** The Main Control System shall provide the necessary interfaces and utilities to each machine. See Control System Diagram (Diagram 11). Sufficient Input/Output capability to operate the

Star Finishing Machine must be resident within the Main Control Panel. The Remote Console accesses the Building Automation to monitor and record alarms and production information.

4.9.2 **Control Features.** The main control system shall monitor the assembly room for production data and alarm conditions. It will also monitor assembly rejections at the automated stations and at the manual inspection stations. The main control system will monitor and control the Star Finishing Machine. The main control system will control the display and provide for low level alarms and "no part present" alarms for all the components at all the work stations. The main control panel shall have different states of alarm conditions to allow for start-up and shutdown conditions. Other possible conditions would also apply to having various alarm states. For example this would allow for low level conditions to be present if the operations were in a shutdown cycle. The main control panel shall have any necessary control entry devices (e.g. push buttons, analog control devices, etc.). Such devices may be paralleled to provide for local and machine mounted control stations. If programmable logic controllers are utilized for the control operation, the use of Allen-Bradley programmable controllers shall be used to facilitate ease of incorporation of this automation with other areas of Longhorn AAP. The main control system shall assemble the following listings and make available for data storage at the remote console via modem:

Active and/or unacknowledged alarms and times.
Any alarms and times since last query.
Alarm reset times.
Any system downtimes.
Update of shift production.
Update of reject rates by type.
Update of reject frequency by type.

4.9.3 **Alarm and Display Features.** The main control system controls the alarm and display operations. The control system will alarm low level conditions for components at all stations. These alarms will be displayed on the display located at the main control panel. A "no part present" alarm shall be displayed for all stations indicating (e.g. a feeder system jam or a level sensor not working properly, etc.). The main control panel shall have different states of alarm conditions to allow for start-up and shutdown conditions. Other conditions would also apply to having different alarm states. For example this would allow for low level conditions to be present if the operations were in a shutdown cycle. The main control system will be capable of displaying current information on operations on the Star Finishing Machine (e.g. low levels, production rates and rejection rates of assemblies) at the display located at the main control panel. The display shall display all necessary data for automated operations on various screen menus. The display shall report the types of rejects and the frequency of those assemblies rejected for the various work areas. The main control system will display listings of the following:

Active and/or unacknowledged alarms and time.
Alarm reset times.
Any system downtimes.

Shift production.
Rejection rates by type.
Rejection frequency by type.

4.9.4 **Power Distribution.** The Main Control System shall have a 480 volt 3 phase distribution system and a 120 volt, 1 phase distribution system. The 480 volt, 3 phase distribution system shall protect and distribute power to all the 480 volt, 3 phase motor starters located in the main control panel and all the field devices. It shall utilize either breakers or fuses sized with applicable codes and standards. It shall provide overcurrent protection for conductors and equipment by opening the circuit if the current reaches a value that will cause an excessive or dangerous temperature in the conductors or electrical devices. The 480 volt, 3 phase distribution system will also provide power to a 480 volt/120 volt power transformer properly sized by all applicable codes and standards for the 120 volt, 1 phase power distribution system. The 120 volt, 1 phase distribution system shall protect and distribute power to all the 120 volt, 1 phase motor starters located in the main control panel and all the field devices. It shall utilize either breakers or fuses sized with applicable codes and standards. The 480 volt, 3 phase distribution system shall have a disconnect means to interrupt power to gain control panel access.

4.9.5 **Remote Monitoring and Reporting.** The Main Control System shall monitor and report the operations for manufacturing. All machine operations, component levels, and alarm conditions for all operations shall be monitored and stored in the main control system. The control entry devices at the machine control stations, main control panel and all the field input devices shall be monitored for inputs to the main control system. The main control system shall report various operations via several different means. The machine operations, shift production data, alarm conditions, component levels, rejection rates by type and their frequency shall be reported on the main control system display. The Remote Console shall call and store alarm conditions, alarm times, shift production data, rejection rates by type and their frequency by type via telephone lines. This data shall be stored at the Remote Console and made available for report generation.

4.9.6 **Risk Assessment of System.** All the devices and concepts that have been chosen for the control system are low risk. All concepts are currently used in industries such as drug manufacturing and packaging, and the various food packaging plants. The control system design may be unique to these operations and components, but these concepts have been successfully used for years.

5.0 **Remote Console.**

5.1 **General.** The Remote Console shall be a computer work station. It shall be an MS-DOS compatible microprocessor. It shall be capable of communicating via telephone modem with the main control panels in 16Y and 34Y. The remote console shall communicate at a rate which will not slow down or inhibit data collection from the main control panels. The console shall have memory storage capable of storing a minimum of 60 days trend cycle of operation. The console shall have a means of making a tape "back-up" copy of prior operation trends. It shall have a means in which to visually monitor trends as they update every thirty minutes. The console shall be able to print a report efficiently and expediently at the end of each shift. The console shall have a means of transporting data via floppy diskette drives to other personal computers for report generation. The remote console shall also have data entry capabilities via a keyboard. The remote console shall come complete with software to perform the system features described below.

5.2 **Alarm and Display Features.** Periodically, but not less than every thirty minutes, the Remote Console shall automatically contact the Main Control Panel (located in Building 16Y) and the Star Finishing Control Panel (located in Building 34Y). The Remote Console shall obtain a listing of the following:

Active and/or unacknowledged alarms and time
Any alarms and time since last query.
Alarm reset times.
Any system downtimes.
Update of shift production.
Update of reject rates by type.
Update of reject frequency by type.

Note that since some alarms occur during the normal operation of the system (e.g. low magazine levels) there should be a method to lockout such alarms. Any alarm or control signal which would result in machine shutdown should not be capable of being locked out.

All such information shall be displayed on the screen and simultaneously stored into the system fixed memory.

At the end of each shift, the Remote Console shall automatically print a report detailing the above activities.

5.3 **Historical Trending.** The Remote Console shall contain software to provide a minimum 60 day trend of the following areas:

Shift production rates by date.
Reject rates by date.
Reject frequency by date.
System downtimes by date.

It shall also be capable of entering supply batch numbers to component records via the Keyboard. This information shall be shown on particular component reject trends.

The entire activity shall be put on tape backup on a monthly basis for storage. A minimum of two months backup tapes shall be loaded into the operating Remote Console at anytime. The Remote Console shall continue to perform all its other functions and process the down loaded information into historical trends using the same operator interfaces.

NOTE ALTERNATE METHOD: The incoming data could be recorded directly on a WORM drive such as a CD ROM. This would mean that tape backup would be unnecessary since all data would be on optical diskettes. It would require additional hardware and software to coordinate disk change-over at specific times. Those would occur infrequently, perhaps no more often than once a year. If such a system is used, it limits the number of machines on which such data can be read. The information is not on magnetic media and therefore is less likely to be damaged.

5.4 **Risk Assessment of System.** All the devices and concepts that have been chosen for the remote console and its interface with the main control system are low risk. All concepts are currently used in production and manufacturing management. The design may be unique to these operations, but these concepts have been successfully used for years.

6.0 Implementation Concerns.

6.1 **General.** The type and complexity of the automation presents no particular implementation concerns. The most difficult portion of the entire project is its schedule. In order to complete installation within fiscal year 1992, all aspects of the project must be accelerated. An Overall Project Schedule is shown on Figure 9 in Appendix A.

There are ten major phases remaining in this project. They are detailed as follows:

PHASE I - PREPARATION OF DESIGN PROPOSAL (60 days)

This will include detail review of the final draft of this report. Portions of it must be combined with standard contractural material to provide a detailed proposal for the final design of the project.

PHASE II - AWARD DESIGN CONTRACT (60 days)

The time to have potential design firms bid and to evaluate the bids is included in this phase. The award should be immediately notified to winner so initial administrative delays do not occur.

PHASE III - FINAL DESIGN (240 days)

This will produce the detailed design, drawings, and specifications for both the automation equipment and the installation. It will need to detail specific evaluation procedures to minimize evaluation time. It also must outline the information that will be required of the equipment vendor to allow detail installation proposal development. At least one major review by AMCCOM staff should occur during this phase. The necessary changes in component design will require <u>fast</u> approval from AMCCOM staff. These should actually be started with the review of this report. All such changes will not alter the mechanical operation of the product, but allow for reasonable automation development.

PHASE IV - PREPARATION OF EQUIPMENT PROPOSAL (45 days)

The blending of the final design drawings and specifications with the normal contractural information.

PHASE V - AWARD EQUIPMENT CONTRACT (75 days)

This is the time to have equipment companies detail their proposals as outlined in the final design documents. That should include a comprehensive project schedule and listing of major material suppliers. Again, the award should be immediately notified to minimize start-up time.

PHASE VI - EQUIPMENT FABRICATION AND CHECKOUT (480 days)

The time to engineer fabrication drawings, write detail control software, order material, fabricate equipment, check out operation, train Longhorn AAP personnel, and provide installation coordination. Maintaining schedule will be among the most critical items. Certain information will be required to allow an installation contract to be awarded. Control development must be coordinated with safety and quality representatives from AMCCOM.

PHASE VII - PREPARATION OF INSTALLATION PROPOSAL (60 days)

This will require merging information from the equipment vendor with the final design documents. The necessary contractural requirements must be detailed.

PHASE VIII - AWARD INSTALLATION CONTRACT (60 days)

This is the time necessary for contractors to bid the installation and the evaluation of such bids.

PHASE IX - INSTALLATION (120 days)

This includes all work to install the automation equipment at Longhorn AAP. It includes initial routing of utilities and control wiring while the buildings are still operating, removing the existing equipment once the new equipment has been checked out at the vendors, receive and install the new equipment. Various components of the equipment shall be started to assure alignment and mechanical adjustments. Only 60 days shutdown is anticipated.

PHASE X - START-UP AND REDUCED PRODUCTION (30 days)

After the equipment is installed and adjusted, the equipment vendor shall provide start-up assistance. Since all equipment will be previously operated at the vendors, the actual start-up will be minimal. This time will be used to finish the training of Longhorn AAP personnel. Reduced operating rates should be anticipated.

Other implementation concerns revolve around coordination and safety as detailed below. The installation in Buildings 16Y and 34Y must occur simultaneously to complete project in fiscal year 1992.

6.2 **Building 16Y.** The majority of the work will be performed in this building. The efforts will include:

6.2.1 **Work Done Prior to Shutdown.** There are some items which should be performed while the building is still operating the old system.

1. Route all conduit. Terminate with unions.
2. Route all piping. Terminate with unions.
3. Install wiring in control runs and tag each end.
4. Fabricate new metal plates separating room 105, room 106, room 107, room 108, room 109, room 110 and room 111 to accommodate the new conveyors and material handling systems.
5. Work within guidelines for safety by decontaminating areas, etc. This may require work to be performed during shifts other than production shifts.

6.2.2 **Work Done During Shutdown.** The remainder of th work will be performed after the building production activities have been shut down (60 days):

1. Decontamination of the building.
2. Removal of old equipment.
3. Installation of new equipment.
4. Connection of control wiring.
5. Alignment of equipment.
6. Anchoring equipment.
7. Patching holes, etc. from old equipment.

6.3 Building 34Y.

6.3.1 **Work Done Prior to Shutdown.** There are some items which should be ˌ ːrformed while the building is still operating the old system.

1. Route all conduit. Terminate with unions.
2. Route all piping. Terminate with unions.
3. Install wiring in control runs and tag each end.
4. Work within guidelines for safety by decontaminating areas, etc.

This may require work to be performed during shifts other than production shifts.

6.3.2 **Work Done During Shutdown.** The remainder of the work will be performed after the building production activities have been shut down (45 days):

1. Decontamination of the building.
2. Removal of old equipment.
3. Installation of new equipment.
4. Connection of control wiring.
5. Alignment of equipment.
6. Anchoring equipment.
7. Patching holes, etc. from old equipment.

6.4 Building 18Y.

The old equipment can be removed and any holes patched once the shutdown in Building 16Y occurs.

6.5 **Remote Console in Administrative Area.** The Remote Console can be installed anytime after its delivery.

7.0 Equipment Selection and Evaluation Matrix

7.1 General.

This section is to give the vendors and the contractor a method of evaluation of the bids. The bidder will be aware of the criterion that will be used to judge his proposal. The contractor will have a consistent method of evaluating the bidders.

7.2 Evaluation Factors.

Five categories will be used to evaluate the equipment proposals:

1. Technical - The construction of the equipment will be evaluated in this category. The features evaluated will include but not be limited to construction of equipment, sanitary construction, safety in handling energetic materials, and the ease of set-up and maintenance of the equipment.

2. Performance - The performance will be evaluated on the guaranteed production rate, number of operating and support personnel needed to maintain the equipment and the conformity to environmental standards for operating personnel.

3. Project Management - The project management will be evaluated on the understanding of the project requirements, the project plan and schedule, the vendor site proveout plan, the training program for operating personnel, and the installation and start-up plan.

4. Risk - The risk consideration will evaluate the bidder's demonstration of sufficient technical and managerial competence to inspire the confidence in the bidder's ability to satisfactorily complete the contract. The bidder must also demonstrate a thorough understanding of the problems and needs to meet schedules and to budget.

5. Cost - The cost will be factored against the above factors to calculate the best valued piece of equipment.

7.3 Scoring Standards.

The following scoring system should be used when reviewing proposals:

Zero — The score should be 0 under these conditions:

a. The proposal does not address the requirement or does not include sufficient detail to permit thorough evaluation.
b. The proposer grossly misunderstands the nature or scope of the requirement.
c. The proposer's technical approach is incompetent and/or will not fulfill the requirement.
d. The proposer's bid is the most expensive.

One — The score should be 1 under these conditions:

a. The proposal does not meet the intent of the requirement or lacks significant detail.
b. The proposer misunderstands the nature or scope of the requirement.
c. The proposer's technical approach is risky or only

marginally competent.

d. The proposer's bid is in the 75 to 99% of the most costly range.

Two — The score should be 2 under these conditions:

a. The proposal just barely or only partially meets the requirements.
b. The proposer's understanding of the requirement is marred by some misinterpretation or flaws.
c. The technical approach appears acceptable but lacks convincing evidence.
d. The proposer's bid is in the 50 to 75% of the most costly range.

Three — The score should be 3 under these conditions:

a. The proposal meets the intent of the requirement and includes sufficient detail for a thorough evaluation.
b. The proposer demonstrates an understanding of the nature and scope of the requirement.
c. The technical approach is sound and has sufficient supporting evidence.
d. The proposer's bid is in the 15 to 50% of the most costly range.

Four — The score should be 4 under these conditions:

a. The proposal fully complies with or surpasses the requirements and proves its superiority with the right amount of convincing detail.
b. The proposer demonstrates a superior understanding of the needs and problems and offers sound, realistic solutions.
c. The technical approach is clearly superior, offering advantages in scope, feasibility, or design without adding complications or increasing cost.
d. The proposer's bid is lowest or not more than 15% of the low bid.

7.4 General Evaluation Score Sheet.

See following score sheet.

7.5 Summary Score Sheet.

See following summary sheet.

GENERAL EVALUATION SCORE SHEET

The following is a weighed evaluation criteria to be used when evaluating proposals:

1. Technical

Dimensions/Specifications		____ x1 =	____	
Sanitary Construction		____ x1 =	____	
Safety in Handling Energetic Materials		____ x1 =	____	
Ease of Set-up		____ x1 =	____	
Ease of Maintenance		____ x1 =	____	
Total			____	
Average	Total/5			____

2. Performance

Production Rate		____ x2 =	____	
Number of Operating Personnel		____ x1 =	____	
Conformity to Safety Standards		____ x2 =	____	
Conformity to Environmental Standards		____ x2 =	____	
Total			____	
Average	Total/7			____

3. Project Management

Project Plan		____ x2 =	____	
Schedule		____ x2 =	____	
Vendor Prove-out Plan		____ x2 =	____	
Training		____ x1 =	____	
Installation Plan		____ x1 =	____	
Start-up Plan		____ x1 =	____	
Documentation		____ x1 =	____	
Total			____	
Average	Total/10			____

4. R

Sufficient Technical Staff		____ x2 =	____	
Sufficient Managerial Staff		____ x1 =	____	
Understanding of Budget Needs		____ x1 =	____	
Understanding of Schedule Needs		____ x1 =	____	
Total			____	
Average	Total/5			____

5. Cost

Cost (Based on the Points System) ____

Combined Average Score (Average Total/5) ____

SUMMARY SCORE SHEET

The following is a weighed evaluation criteria to be used when comparing proposals:

Criterion	Bid 1	Bid 2	Bid 3
Technical Average Score	____x3=____	____x3=____	____x3=____
Performance Average Score	____x2=____	____x2=____	____x2=____
Project Management Avg. Score	____x2=____	____x2=____	____x2=____
Risk Average Score	____x1=____	____x1=____	____x1=____
Cost Average Score	____x1=____	____x1=____	____x1=____
Totals	________	________	________
Maximum Possible	36 pts.	36 pts.	36 pts.
Highest Average Score	________	________	________
Combined Average Score	________	________	________
Lowest Average Score	________	________	________

8.0 Cost Estimate.

8.1 Overview.

8.1.1 General. The completed automation system as detailed in this report would cost $2,929,200.00 if purchased at the date of this report. This includes all necessary proveout at the vendor's facilities as well as final installation at Longhorn AAP. It also is within the currently approved budget (1989) of $3,130,000.00 even though the scope of the project was expanded to include the complete automation of the assembly, test and packout of the 40MM Signals.

The breakdown of the project is as follows:

Building 16Y Automation		
Hand Held Signal Motor Assembly Machine		$ 419,750.
Manual Inspection Station - HHS Motor Examination		20,700.
Rocket Barrel Assembly Machine		503,600.
Manual Inspection Station - HHS Rocket Examination		20,700.
Hand Held Signal Containerization Machine		201,050.
40MM Assembly Machine		257,950.
Manual Inspection Station - 40MM Assembly Examination		20,700.
Leak Testing and Packout Machine		287,700.
Case Palletizer		281,900.
Manual Inspection Station - Packout Area Examination		12,000.
Payload Subassembly Machine		130,450.
Staging and Magazine Loading Alarm Center		33,700.
Main Control System		187,800.
	Subtotal	$2,378,000.
Building 16Y Equipment Removal		18,300.
	Total	$2,396,300.
Building 34Y Automation		
Star Finishing Machine		$ 161,700.
Manual Inspection Station - Star Finishing Examination		20,700.
Star Loading Machine		52,450.
Main Control System		239,750.
	Subtotal	$ 474,600.
Building 34Y Equipment Removal		4,000.
	Total	$ 478,600.
Remote Console		
Remote Monitoring Hardware and Software		$ 49,500.
Building 18Y Equipment Removal		
Obsoleted Equipment Removal		$ 4,800.
TOTAL AUTOMATED SYSTEM (1990)		$2,929,200.

When the above 1990 prices are increased by three (3%) percent for 1991 and five (5%) percent for 1992, the project budget is still positive.

Approved Project Funding (1992)	$3,440,000.
System Cost (1992)	3,167,930.
Reserve Funding Available	$ 272,070.

Thus there remains approximately 7.9% reserve contingency in the approved budget. This could be used if scope changes were necessary during the design phase.

8.1.2 **Methods, Assumptions, and Procedures.** Every effort has been made to detail all major equipment necessary and the engineering required to integrate it. (Refer to Appendix C and Appendix D for a detailed equipment list.) Also included were the manhours necessary to check out the completed system at the vendor's premises and its final installation at Longhorn AAP.

Whenever possible, vendors of the various types of equipment were contacted for budgetary cost estimates. Those prices along with a fifteen (15%) percent contingency amount are listed in the material costs. Specialty machine manufacturers were used to develop the intra-structure pricing. A control systems house assisted in the control pricing. Thus the cost estimate as detailed is an actual representation of the system cost today.

The only assumption which was used is that further engineering will be done prior to contracting for the system. This will be used to further refine the ideas that are contained herein. It would also assure that all vendors respond initially to the same concepts but permit innovation for better value. This engineering shall provide the following engineering deliverables for this project.

Engineering Deliverables:

Detail Design of Hand Held Signal Motor Assembly Machine
- Manual Inspection Station - HHS Motor Examination
- Rocket Barrel Assembly Machine
- Manual Inspection Station - HHS Rocket Examination
- Hand Held Signal Containerization Machine
- 40MM Assembly Machine
- Manual Inspection Station - 40MM Assembly Examination
- Leak Testing and Packout Machine
- Case Palletizer
- Manual Inspection Station - Packout Area Examination
- Payload Subassembly Machine
- Staging and Magazine Loading Alarm Center
- Main Control System - 16Y Building
- Star Finishing Machine
- Manual Inspection Station - Star Finishing Examination
- Star Loading Machine
- Main Control System - 34Y Building
- Remote Monitoring Hardware and Software

Such Detail Design shall include but not be limited to:
- Equipment Layout Drawings
- Machine Assembly Drawings
- Detail Parts and Assembly Drawings
- Subassembly Drawings

- Wiring Diagrams
- Schematic Diagrams
- Utility Connection Drawings
- Detailed Operating Descriptions
  - Normal Start-up
  - Normal Shutdown
  - Emergency Shutdown
  - Restart After Emergency Shutdown
  - Rejection Criteria at Various Stations
- Standard Operating Procedure Outlines
- Layaway Procedures
- Detailed Hazard Analysis
- Pre-Operational Proveout Plan - Prior to Shipment
- Detailed Installation Plan
- Proveout Plan - After Installation
- Specifications for Each Machine, etc.
- Detailed Spare Parts List
- Outline for Final O&M Manuals
- Preparation of Bid Packages

8.2 Building 16Y Automation.

8.2.1 **General.** The automation proposed for Building 16Y would cost $2,396,300 if purchased in 1990. That would include all equipment, checkout at the vendor's premise and installation at Longhorn AAP.

It is estimated that the following minimum operating personnel would be required to service this new equipment:

1 Receiving Personnel - used to receive components and component stock.

3 Material Handlers - used to load magazines and hoppers on equipment.

4 QC Inspectors - used to manually inspect assemblies at stations Note: This number would need to be increased to 8 if the machines were to operate at 25 Units/Minute.)

2 Packout Personnel - used to perform some manual operations and ship product.

2 Mechanical Technicians - used to set up, adjust and maintain equipment.

1 Electronic and Instrument Technician - used to maintain the control system.

1 Crew Leader - Supervision and fill-in.

1 Building Foreman - Overall supervision.

No monetary figure has been given for such operating personnel. Likewise, no figure has been given for the necessary downtime of the production when the installation occurs.

8.2.2 **Hand Held Signal Motor Assembly Machine.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	10,000	25	80	15	160
Intra System - Framework	2,500	15	80	0	0
Intra System - Utility Distr.	3,000	10	40	20	10
Control System	60,000	300	100	100	100
Item 3.6.2	5,500	50	100	50	15
Item 3.6.3	5,000	75	100	50	10
Item 3.6.4	1,000	20	30	10	5
Item 3.6.5	4,000	20	80	20	5
Item 3.6.6	35,000	80	30	60	5
Item 3.6.7	26,000	80	40	40	5
Item 3.6.8	100,000	120	40	60	20
Item 3.6.9	10,000	100	60	50	5
Item 3.6.10	1,000	20	30	10	5
Item 3.6.11	7,000	20	30	10	5
Item 3.6.12	3,000	20	20	10	5
General Installation	5,000	0	0	0	40
MACHINE TOTAL	278,000	955	860	505	395
MANHOUR RATES		60	40	60	50
MANHOUR COST		57,300	34,400	30,300	19,750
TOTAL	419,750				

8.2.3 **Manual Inspection Station - Hand Held Signal Motor Examination.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Framework	1,000	20	20	5	5
Item 3.7.2	3,000	100	30	45	45
General Install.	1,000	0	0	0	20
STATION TOTAL	5,000	120	50	50	70
MANHOUR RATES		60	40	60	50
MANHOUR COST		7,200	2,000	3,000	3,500
TOTAL	20,700				

8.2.4 **Rocket Barrel Assembly Machine.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	10,000	25	80	15	160
Intra System - Framework	2,500	15	80	0	0
Intra System - Utility Distr.	3,000	10	40	20	10
Control System	60,000	300	100	100	100
Item 3.8.2	13,000	50	100	50	15
Item 3.8.3	4,000	50	30	10	5
Item 3.8.4	100,000	120	40	60	20
Item 3.8.5	8,000	100	60	50	5
Item 3.8.6	10,000	100	60	50	5
Item 3.8.7	7,000	20	30	10	5
Item 3.8.8	8,000	100	60	50	5
Item 3.8.9	18,000	60	80	30	5
Item 3.8.10	8,000	40	30	20	5
Item 3.8.11	80,000	10	20	5	5
Item 3.8.12	10,000	100	100	20	10
Item 3.8.13	3,000	20	20	5	5
General Installation	5,000	0	0	0	40
MACHINE TOTAL	349,500	1,120	930	495	400
MANHOUR RATES		60	40	60	50
MANHOUR COST		67,200	37,200	29,700	20,000
TOTAL	503,600				

8.2.5 **Manual Inspection Station - Hand Held Signal Rocket Examination.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Framework	1,000	20	20	5	5
Item 3.9.2	3,000	100	30	45	45
General Installation	1,000	0	0	0	20
STATION TOTAL	5,000	120	50	50	70
MANHOUR RATES		60	40	60	50
MANHOUR COST		7,200	2,000	3,000	3,500
TOTAL	20,700				

8.2.6 **Hand Held Signal Containerization Machine.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	5,000	15	40	10	80
Intra System - Framework	1,000	10	40	0	0
Intra System - Utility Distr.	1,000	10	20	10	5
Control System	25,000	100	50	50	50
Item 3.10.2	8,000	30	30	10	5
Item 3.10.3	7,000	20	30	10	5
Item 3.10.4	11,000	40	80	10	5
Item 3.10.5	9,500	60	80	20	10
Item 3.10.6	80,000	10	20	5	5
General Installation	3,000	0	0	0	30
MACHINE TOTAL	150,500	295	390	125	195
MANHOUR RATES		60	40	60	50
MANHOUR COST		17,700	15,600	7,500	9,750
TOTAL	201,050				

8.2.7 40MM Assembly Machine.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	10,000	25	80	15	160
Intra System - Framework	2,500	15	80	0	0
Intra System - Utility Distr.	3,000	10	40	20	10
Control System	60,000	300	100	100	100
Item 3.11.2	6,000	20	30	10	5
Item 3.11.3	12,000	80	80	20	5
Item 3.11.4	8,000	100	60	50	5
Item 3.11.5	7,000	20	30	10	5
Item 3.11.6	6,000	20	30	10	5
Item 3.11.7	11,000	40	80	10	5
Item 3.11.8	6,000	20	30	10	5
Item 3.11.9	12,000	100	100	30	10
General Installation	5,000	0	0	0	40
MACHINE TOTAL	148,500	750	740	285	355
MANHOUR RATES		60	40	60	50
MANHOUR COST		45,000	29,600	17,100	17,750
TOTAL	257,950				

8.2.8 Manual Inspection Station - 40MM Assembly Examination.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Framework	1,000	20	20	5	5
Item 3.12.2	3,000	100	30	45	45
General Installation	1,000	0	0	0	20
STATION TOTAL	5,000	120	50	50	70
MANHOUR RATES		60	40	60	50
MANHOUR COST		7,200	2,000	3,000	3,500
TOTAL	20,700				

8.2.9 Leak Testing and Packout Machine.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	15,000	100	150	50	300
Intra System - Framework	3,000	20	50	0	20
Intra System - Utility Distr.	3,000	10	40	20	35
Item 3.13.2	115,000	200	200	100	60
Item 3.13.3	8,000	80	30	20	40
Item 3.13.4	8,000	80	30	20	40
Item 3.13.5	1,000	10	20	5	5
Item 3.13.6	1,000	10	20	5	5
Item 3.13.7	4,000	60	30	5	20
Item 3.13.8	3,000	40	20	5	20
Item 3.13.9	1,000	10	20	5	5
General Install.	10,000	0	0	0	250
MACHINE TOTAL	172,000	620	610	235	800
MANHOUR RATES		60	40	60	50
MANHOUR COST		37,200	24,400	14,100	40,000
TOTAL	287,700				

8.2.10 Case Palletizer.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	8,000	20	40	10	20
Intra System - Framework	1,000	5	5	0	0
Intra System - Utility Distr.	1,000	5	10	10	10
Item 3.14.2	200,000	100	50	100	100
Item 3.14.3	25,000	50	50	20	50
General Install.	5,000	0	0	0	150
MACHINE TOTAL	240,000	180	155	140	330
MANHOUR RATES		60	40	60	50
MANHOUR COSTS		10,800	6,200	8,400	16,500
TOTAL	281,900				

8.2.11 **Manual Inspection Station - Packout Area Examination.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Item 3.15.2	3,000	100	20	20	10
General Installation	0	0	0	0	10
STATION TOTAL	3,000	100	20	20	20
MANHOUR RATES		60	40	60	50
MANHOUR COST		6,000	800	1,200	1,000
TOTAL	12,000				

8.2.12 **Payload Subassembly Machine.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	5,000	20	40	5	120
Intra System - Framework	1,500	10	40	0	0
Intra System - Utility Distr.	1,500	5	20	10	10
Control System	45,000	200	50	50	50
Item 3.16.2	5,000	120	80	30	5
Item 3.16.3	7,000	20	30	10	5
Item 3.16.4	1,000	20	30	10	5
General Installation	5,000	0	0	0	150
MACHINE TOTAL	71,000	395	290	115	345
MANHOUR RATES		60	40	60	50
MANHOUR COST		23,700	11,600	6,900	17,250
TOTAL	130,450				

8.2.13 **Staging and Magazine Loading Alarm Center.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Item 3.17.2	12,000	80	120	60	60
General Installation	3,000	0	0	0	50
CENTER TOTAL	15,000	80	120	60	110
MANHOUR RATES		60	40	60	50
MANHOUR COST		4,800	4,800	3,600	5,500
TOTAL	33,700				

8.2.14 **Main Control System - Building 16Y.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
System Integration	25,000	150	60	80	50
Item 3.18.2	10,000	75	40	40	50
Item 3.18.3	7,500	100	50	60	10
Item 3.18.4	25,000	125	30	60	120
Item 3.18.5	15,000	75	40	40	100
Item 3.18.6	1,500	200	10	80	10
General Installation	5,000	0	0	0	150
SYSTEM TOTAL	89,000	725	230	360	490
MANHOUR RATES		60	40	60	50
MANHOUR COST		43,500	9,200	21,600	24,500
TOTAL	187,800				

8.2.15 **Building 16Y Equipment Removal.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Room 105	0	15	0	0	30
Room 106	0	15	0	0	30
Room 107	0	15	0	0	30
Room 108	0	15	0	0	30
Room 109	0	15	0	0	30
Room 110	0	15	0	0	30
Room 111	0	15	0	0	60
REMOVAL TOTAL	0	105	0	0	240
MANHOUR RATES		60	40	60	50
MANHOUR COST		6,300	0	0	12,000
TOTAL	18,300				

8.3 Building 34Y Automation.

8.3.1 General. The automation proposed for Building 34Y would cost $478,600 if purchased in 1990. That would include all equipment, checkout at the vendor's premise and installation at Longhorn AAP.

It is estimated that the following minimum operating personnel would be required to service this new equipment:

1 Material Handler - used to load the stars into the Star Finishing Machine.

2 QC Inspectors - used to manually inspect assemblies at station. (Note: This number would need to be increased to 4 if the machine were to operate at 45 Units/Minute.)

1/4 Packout Personnel - used to ship Stars for storage.

1 Mechanical Technician - used to set-up, adjust and maintain the equipment.

The Electronic and Instrumentation Technician could be borrowed from

Building 16Y and would not need to be duplicated. No monetary figure has been given for such operating personnel. Likewise, no figure has been given for the necessary downtime of the production when the installation occurs.

8.3.2 Star Finishing Machine.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	10,000	25	80	15	160
Intra System - Framework	2,500	15	80	0	0
Intra System - Utility Distr.	3,000	10	40	20	10
Item 4.6.2	10,000	100	200	50	60
Item 4.6.3	6,000	20	30	10	5
Item 4.6.4	6,000	90	60	20	20
Item 4.6.5	5,500	90	100	50	40
Item 4.6.6	1,000	20	20	5	5
Item 4.6.7	6,000	90	60	20	20
Item 4.6.9	5,500	90	100	50	40
General Installation	5,000	0	0	0	100
MACHINE TOTAL	60,500	550	770	240	460
MANHOUR RATES		60	40	60	50
MANHOUR COST		33,000	30,800	14,400	23,000
TOTAL	161,700				

8.3.3 Manual Inspection Station - Star Finishing Examination.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Framework	1,000	20	20	5	5
Item 4.7.2	3,000	100	30	45	45
General Installation	1,000	0	0	0	20
STATION TOTAL	5,000	120	50	50	70
MANHOUR RATES		60	40	60	50
MANHOUR COST		7,200	2,000	3,000	3,500
TOTAL	20,700				

8.3.4 **Star Loading Machine.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Intra System - Transfer	5,000	10	20	5	50
Intra System - Framework	1,000	10	20	0	0
Intra System - Utility Distr.	1,000	10	10	10	10
Item 4.8.2	7,000	20	30	10	5
Item 4.8.3	10,000	60	100	40	60
General Installation	2,000	0	0	0	50
MACHINE TOTAL	26,000	110	180	65	175
MANHOUR RATES		60	40	60	50
MANHOUR COSTS		6,600	7,200	3,900	8,750
TOTAL	52,450				

8.3.5 **Main Control System - Building 34Y.**

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
System Integration	25,000	150	60	80	50
Item 4.9.2	60,000	250	100	100	100
Item 4.9.3	7,500	100	50	60	10
Item 4.9.4	25,000	100	50	50	125
Item 4.9.5	1,500	200	10	80	10
General Installation	10,000	0	0	0	300
SYSTEM TOTAL	129,000	800	270	370	595
MANHOUR RATES		60	40	60	50
MANHOUR COSTS		48,000	10,800	22,200	29,750
TOTAL	239,750				

8.3.6 Building 34Y Equipment Removal.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Star Finishing Equipment	0	25	0	0	50
REMOVAL TOTAL	0	25	0	0	50
MANHOUR RATES		60	40	60	50
MANHOUR COSTS		1,500	0	0	2,500
TOTAL	4,000				

8.4 Remote Console.

8.4.1 General. The Remote Console proposed for the Administration area would cost $49,500 if purchased in 1990. That would include all equipment, checkout at the vendor's premise and installation at Longhorn AAP.

There would be no full time personnel required for its operation. Only a few hours each week to enter lot numbers and perform storage functions would be required. No monetary figure has been given for such personnel.

8.4.2 Cost Breakdown.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
System Integration	8,000	100	20	50	0
Item 5.2	0	150	0	100	0
Item 5.3	0	150	0	100	0
General Installation	500	0	0	0	24
SYSTEM TOTAL	8,500	400	20	250	24
MANHOUR RATE		60	40	60	50
MANHOUR COST		24,000	800	15,000	1,200
TOTAL	49,500				

8.5 Building 18Y Equipment Removal.

8.5.1 General. The only work occurring at Building 18Y is to remove the old Hand Held Signal Packout equipment and the bolt taping machines.

This will result in two rooms being available for other activities.

8.5.2 Cost Breakdown.

	Material Cost	Engineering M.H.	Fabrication M.H.	Checkout M.H.	Install M.H.
Room 112	0	15	0	0	30
Room 113	0	15	0	0	30
REMOVAL TOTAL	0	30	0	0	60
MANHOUR RATES		60	40	60	50
MANHOUR TOTAL		1,800	0	0	3,000
TOTAL	4,800				

9.0 Conclusions.

It can be concluded from the previous details that viable automation systems can be implemented for the assembly of Hand Held Signals, 40MM Signals, and the finishing of Star Illuminant. Such improvements in the manufacturing can be obtained without major risk or budgetary problems. It can show betterment in safety, quality of products, and productivity.

9.1 Safety Improvements. The major safety objectives have all been met. Manufacturing personnel nave been removed from the production line. The only time that Longhorn workers will be exposed to hazardous (energetic) materials will be when loading the various machines. This is very low risk compared to actually performing work on those materials. Since only loading and inspection of completed assemblies will be manually executed, the vast majority of pinch and cut injuries should be eliminated. Likewise, exposure to certain solvents and their fumes will be nearly eradicated.

This overall improvement in operator safety should be enough reason to implement the program. The goal of any responsible employer is to prevent the occurrence of injuries and illnesses which may result from exposure to hazardous work place conditions. It is even more essential when technology can easily provide such improvements.

The operation of the automated equipment should represent no particular safety problems. The design will eliminate potential explosive practices by being non-sparking, anti-static, non-trapping of dirt and energetic materials, rated for hazardous environments, and controlled for fail-safe operation eliminating excessive temperatures or pressures.

9.2 Technological Risks in Implementation. All pieces of equipment proposed are commercially available from multiple sources. Their implementation is all considered low risk except the use of silk screening in the Star Finishing Machine. It is considered moderate since the First Fire material has never been used with silk screening equipment. Such equipment has been used with materials having the same physical properties (viscosity and density). Therefore, no particular problems should be anticipated.

The Appendix provides a list of some typical manufacturers of equipment. All equipment described within the report is supplied by American manufacturers although they may use off shore production facilities. None should require the payment of royalties nor should any licensing fees be necessary.

Another way to reduce the risk in implementing this program is to have all the work be done by a single systems integrator. This would include producing detailed fabrication drawings, wiring diagrams, computer programs, selecting individual equipment and devices, purchasing and expediting the items, and fabricating the various machines. At this point, a complete checkout and production run (using inert components) should be done at the vendor's premises. This assures that the machines operate properly and communicate with one another before production is stopped at Longhorn AAP. The installation can then proceed. The downtime should be limited to actual installation efforts and a small time to restart the machines. Thus, there is minimal interruption risk to Longhorn AAP production.

9.3 **Improved Quality.** While there has never been a problem with quality in the existing operations, the implementation of automation guarantees that all parts are identically made. No steps are ever overlooked. No parts are ever left out. All tests are performed. Too many times, an operator's attention can be diverted from the task at hand. The machine's attention is always what the program demands. If the controls and integration are properly done, it is possible to have zero manufacturing defects leave as finished products.

Another area of improvement is better quality records. Each event can be automatically logged for analysis. That means better insight on equipment, components, and operating personnel. As the program evolves, additional software can be added to provide trending information prior to material ordering.

9.4 **Increased Productivity.** The technology proposed in this report can produce parts at a much greater rate than required. Both the Hand Held Signals and the 40MM Signals could be produced at 24 units/minute without any changes in design or equipment. The Star Finishing could produce finished product up to 48 units/minute. The only limiting factor is the ability of the operators to manually inspect the parts and keep the machines loaded with components.

Manufacturing rates in industry have forced equipment suppliers to increase the production rates on even their lowest price models. It is not uncommon for the low end products to have capabilities of up to 60 units/minute. The equipment proposed utilizes these low end devices. That means that there are no savings by trying to reduce production rates.

What this increased productivity achieves is production guarantees. If the system is operated at an increased rate, any downtime can be larger and still not create problems. This could be particularly important when initially operating the equipment. As the technical maintenance personnel become more familiar with the equipment, average downtimes will decrease. It also allows for increased mobilization rates if needed.

9.5 **Maintain Budget.** The overall cost of the proposed equipment is within the funded budget including installation. This also includes automating the 40MM Assembly Line which was not in the original scope of work. When the project is implemented, several areas in Building 18Y and Room 109 in Building 16Y will be freed for other activities. This could prevent the need for future enlargements and provide the opportunity to do other work without building modification costs.

There also could be cost savings on the manufacture of certain components as detailed below.

9.6 **Component Modification.** Several components should be manufactured by the various machines. These included the light weight flimsy components (e.g. felt washers) and components with orientation problems (e.g. paper or rubber sided parts). This will assure proper handling and orientation. Such changes will result in no end product changes.

There are three component changes which are needed to assist in the automation process. None will affect the performance of the product. The bolt for the Hand Held Signals needs a different head to provide for more assembly torque without the chance of closing the fire hole. The teflon tape should also be replaced on the bolt with a liquid lubricant/sealant to be machine applied before insertion into assembly. These bolt changes should create no operational changes in the final product. The clip used to attach the payload to the parachute should be formed at the machine. This may result in a slight design change from the manual clip. However, the manual clip was compressed and became basically a compression fitting. The new clip would act in the same way. The final component change would be to substitute a hot melt colored plastic seal for the present lacquer seal on the Hand Held Signals. This reduces the noxious vapors, produces a better seal, and eliminates the need to dry the Hand Held Signal before being placed into its container. This is a substantial cost and space savings.

None of these component changes need occur for the automation to still be practical. There exist alternate automation methods in lieu of each component change proposed, but the best system would be to change the component. This is particularly true since no operational changes in the final products occur.

10.0 Recommendations.

The fact that all major objectives were achieved in the proposed system dictates that it be recommended for implementation at Longhorn AAP. The conclusion is based on the increased safety for plant personnel, the low risk in implementing the proposed technology, the improved quality of the final products, the ability to increase production rates if required, and the fact that sufficient money is already authorized for the project.

The authors do feel that the expenditure required for a Case Palletizer is not warranted. There is not enough production (based on 15 units/minute) to justify spending $225,000 (1989) or $243,340 (1992). That money represents approximately 7.1% of the money that will be spent in 1992. There will be no reduction in personnel for the area by purchasing a case palletizer. The only real justification would be increased safety in the Packout area. The safety record at Longhorn AAP Building 16Y was stated as needing no improvement. It is therefore recommended that the Case Palletizer not be purchased and those funds be held for other contingencies. The remaining costs in the Case Palletizer section will be required for conveying and banding equipment.

APPENDIX A - REPORT DRAWINGS

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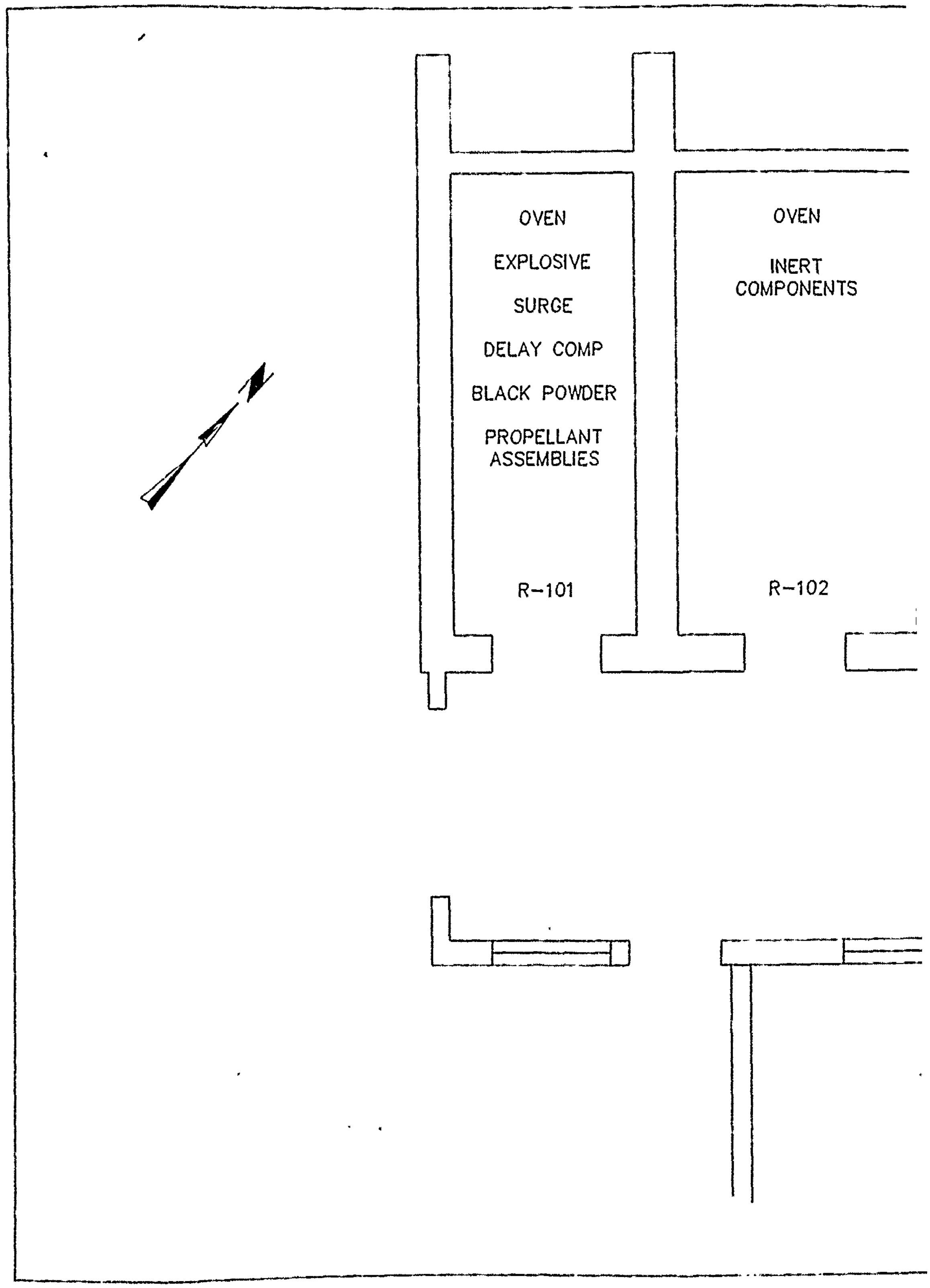
DATE: 12/08/89



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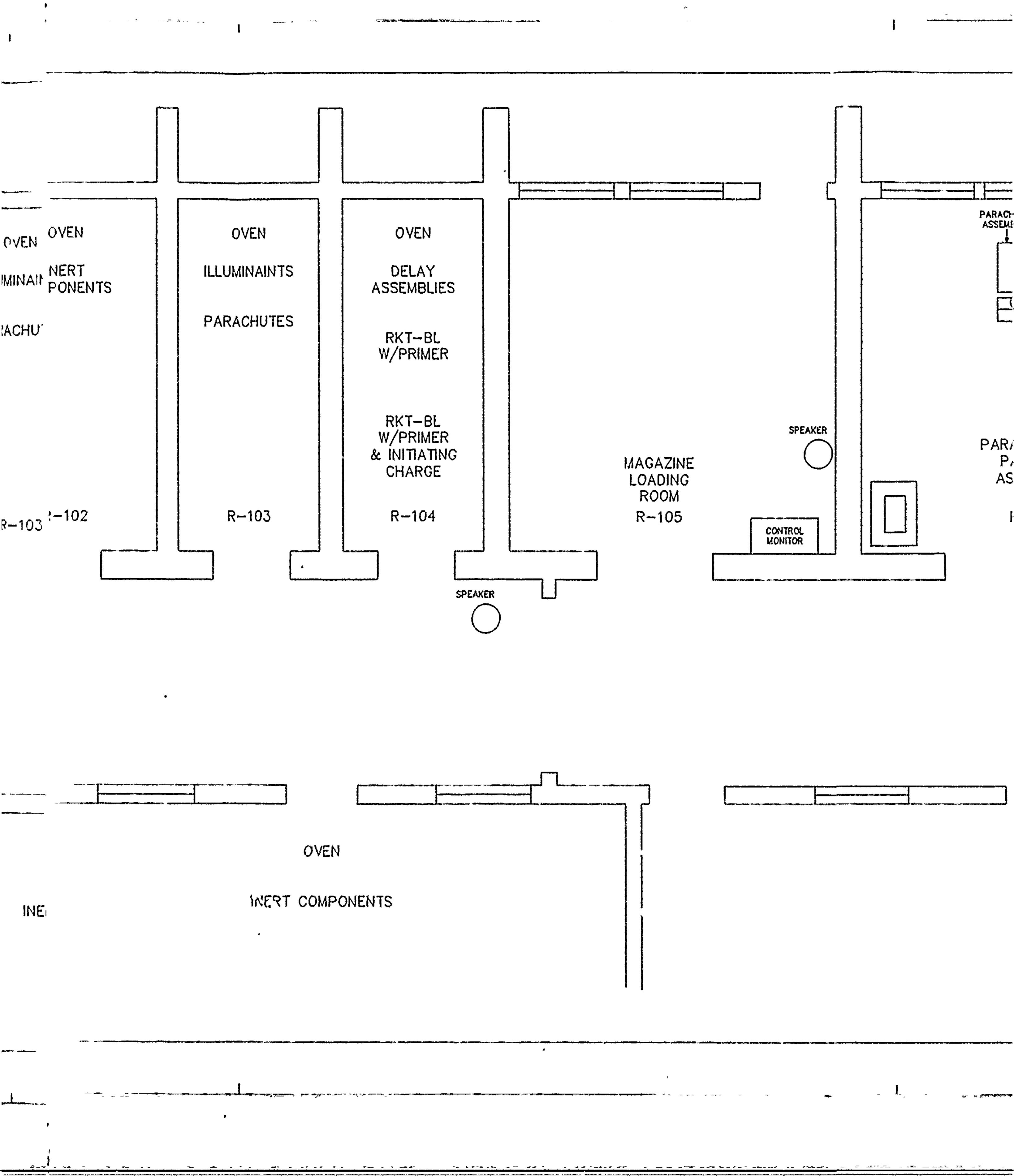
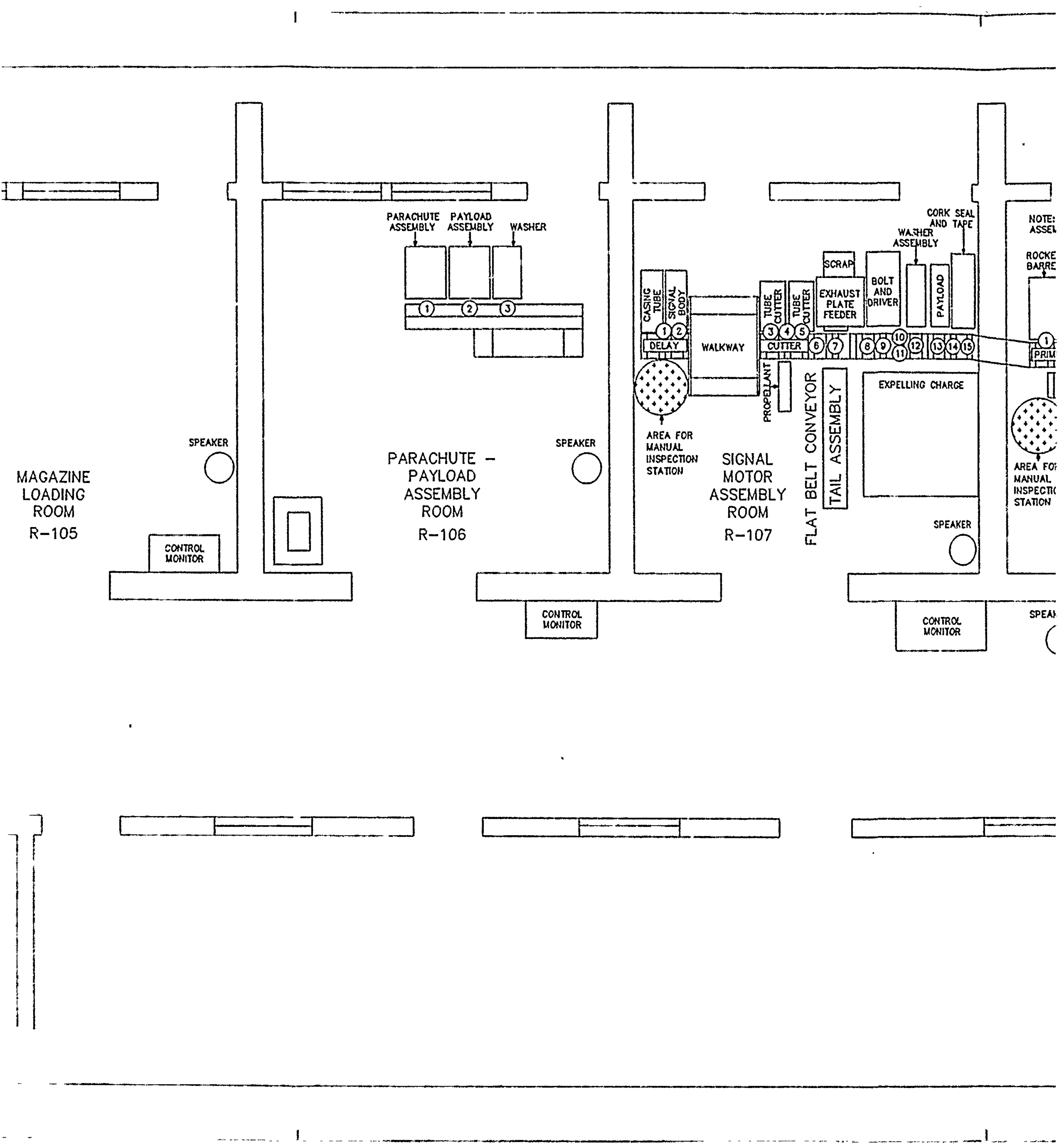
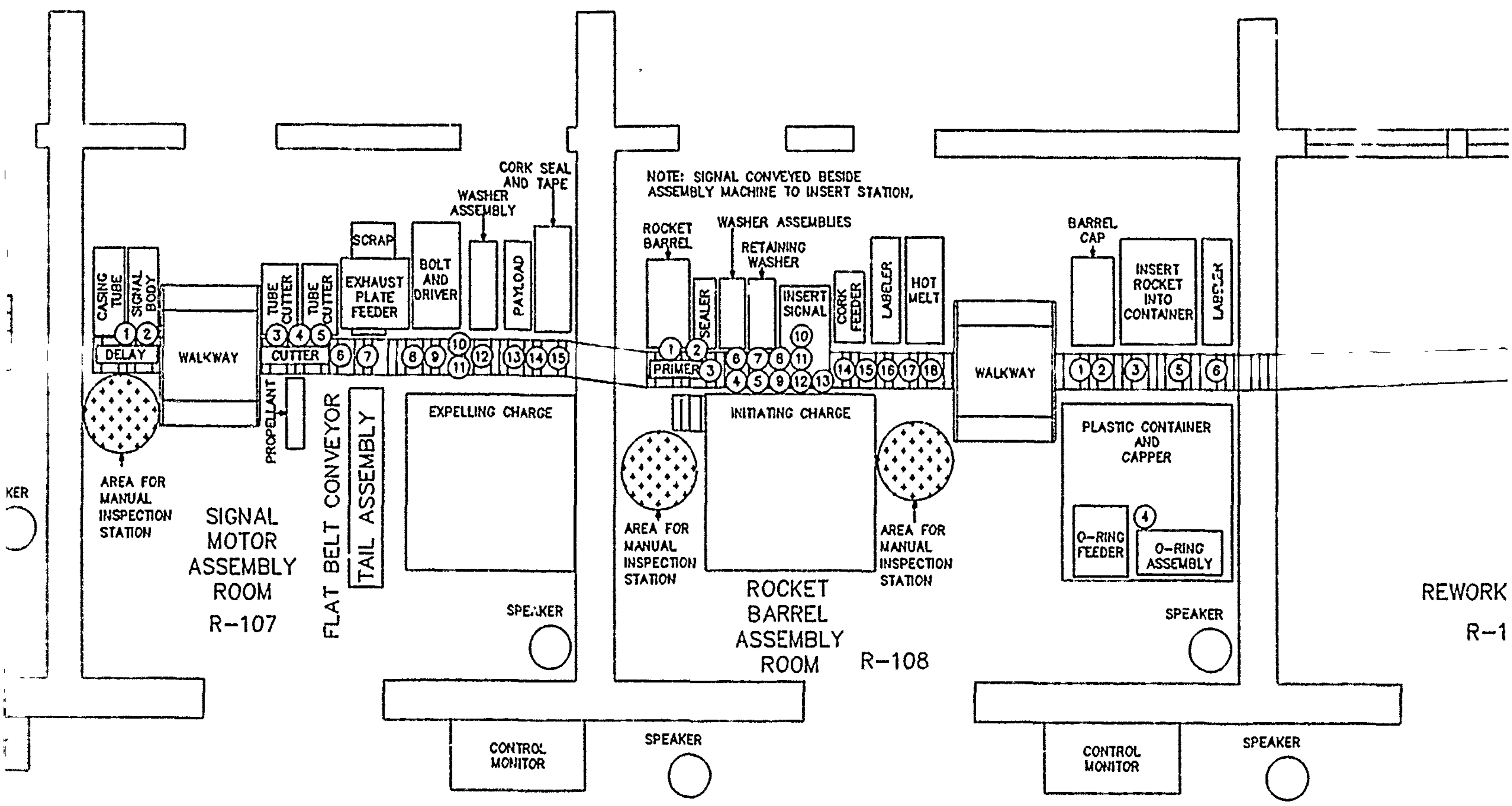
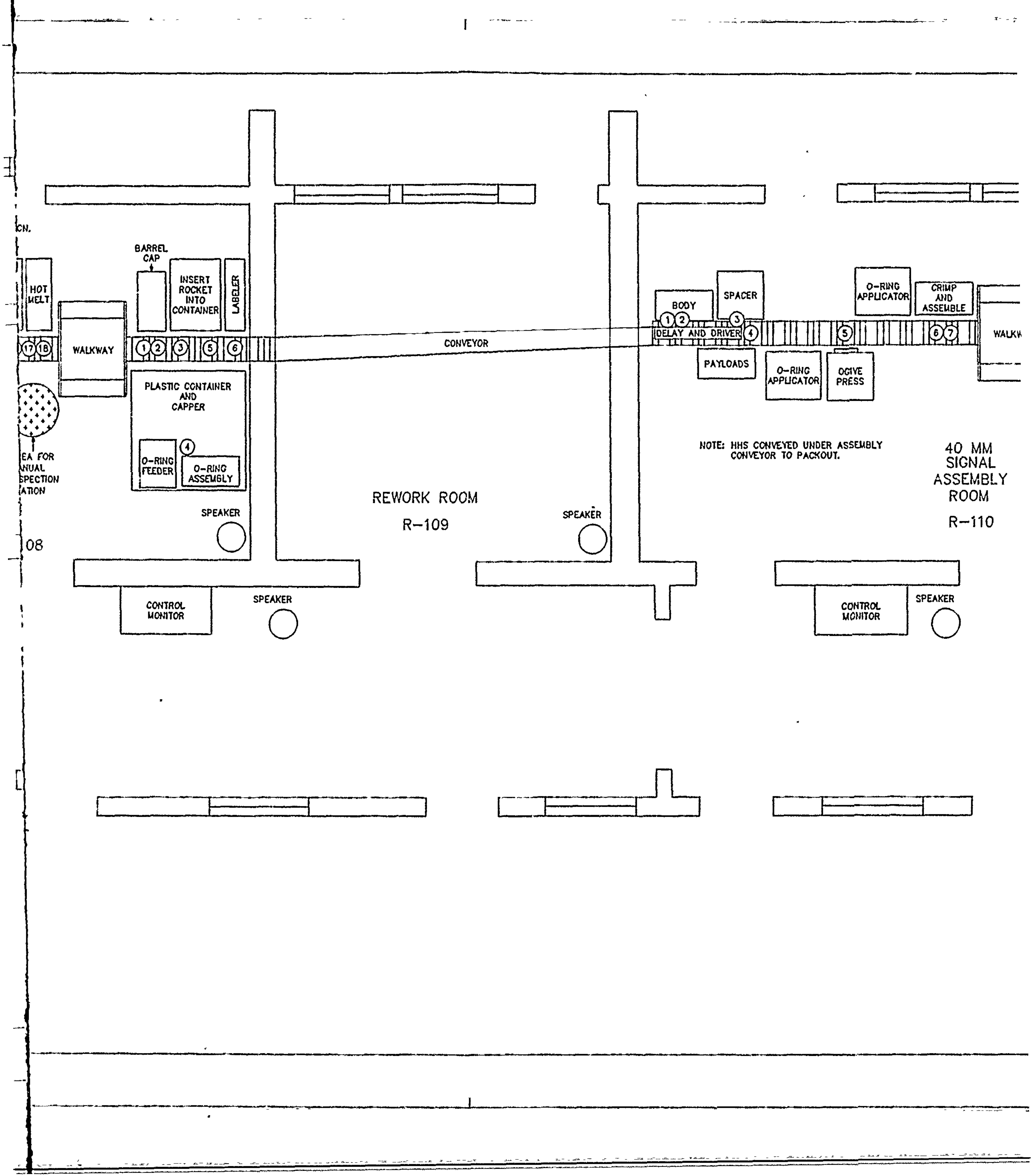

OVEN
OVEN
NERT
PONENTS
R-103
-102
OVEN
ILLUMINAINTS
PARACHUTES
R-103
OVEN
DELAY ASSEMBLIES
RKT-BL W/PRIMER
RKT-BL W/PRIMER & INITIATING CHARGE
R-104
SPEAKER
MAGAZINE LOADING ROOM
R-105
SPEAKER
CONTROL MONITOR
OVEN
INERT COMPONENTS



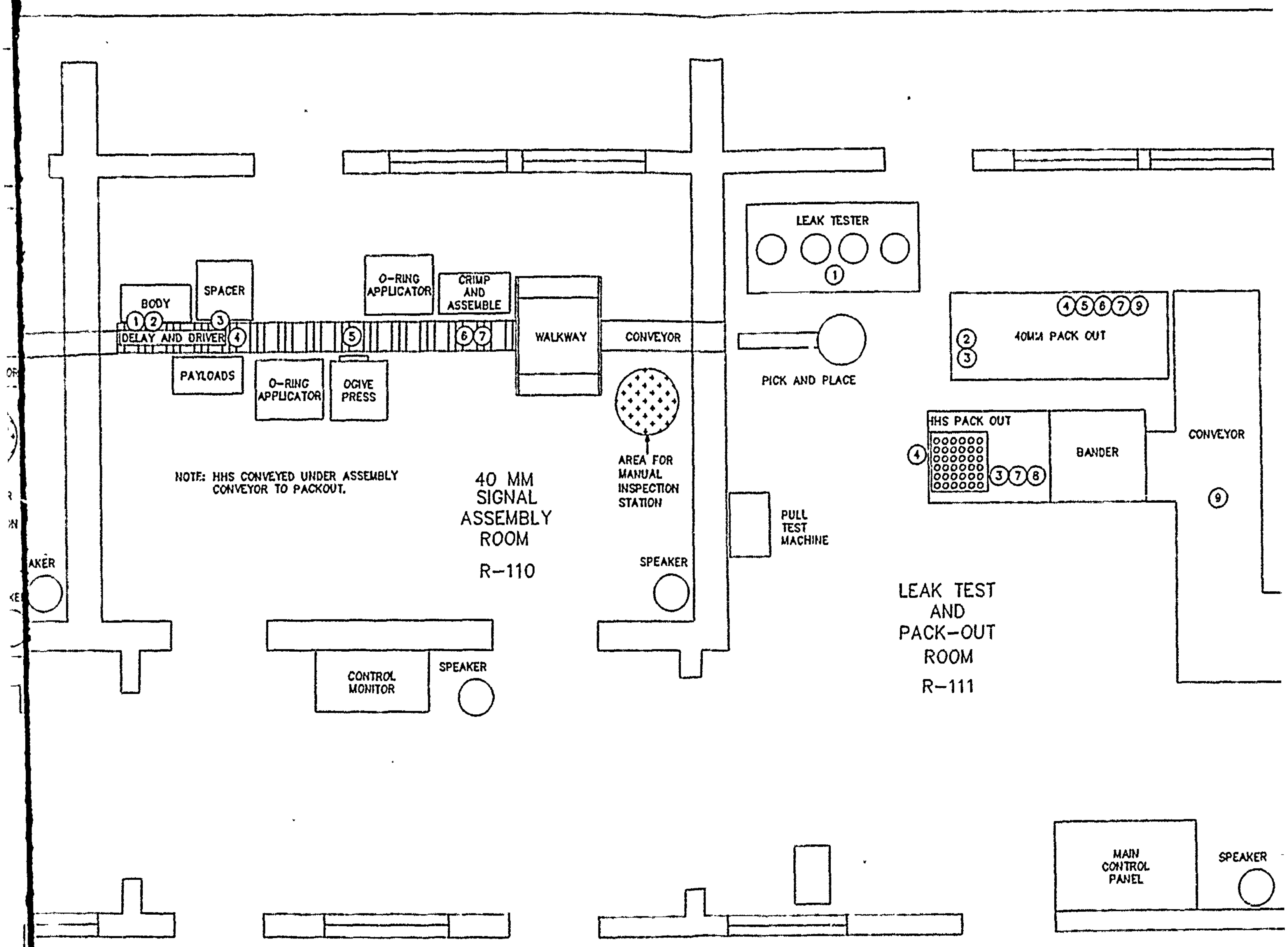
PARACHUTE ASSEMBLY
PAYLOAD ASSEMBLY
WASHER
SPEAKER
MAGAZINE LOADING ROOM R-105
CONTROL MONITOR
PARACHUTE - PAYLOAD ASSEMBLY ROOM R-106
SPEAKER
CONTROL MONITOR
CASING TUBE
SIGNAL BODY
DELAY
WALKWAY
AREA FOR MANUAL INSPECTION STATION
SIGNAL MOTOR ASSEMBLY ROOM R-107
TUBE CUTTER
TUBE CUTTER
CUTTER
PROPELLANT
FLAT BELT CONVEYOR
TAIL ASSEMBLY
SCRAP
EXHAUST PLATE FEEDER
BOLT AND DRIVER
WASHER ASSEMBLY
PAYLOAD
CORK SEAL AND TAPE
EXPELLING CHARGE
SPEAKER
CONTROL MONITOR
NOTE: ASSEM
ROCKE BARRE
PRIM
AREA FOR MANUAL INSPECTIO STATION
SPEAK



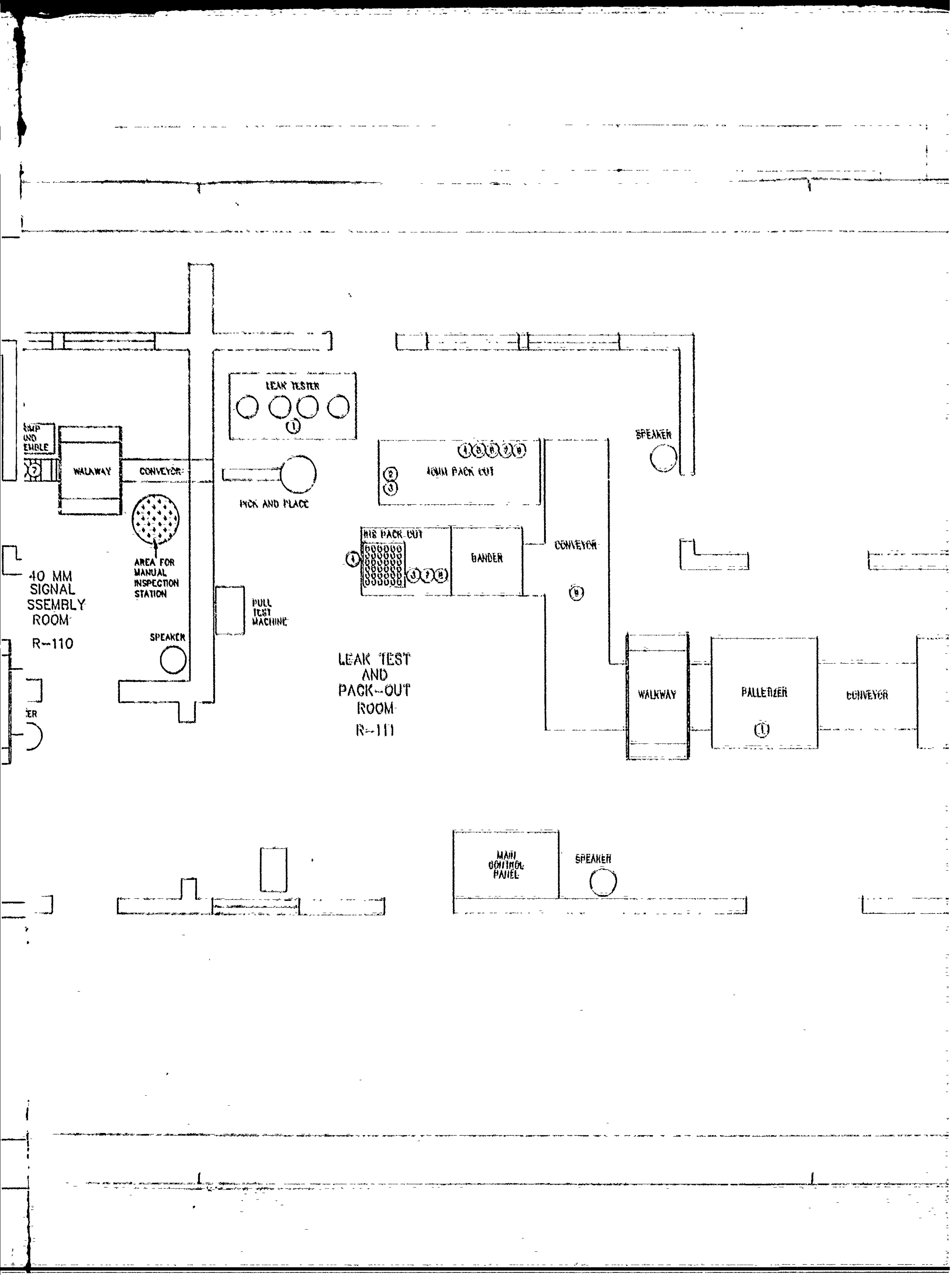
NOTE: SIGNAL CONVEYED BESIDE ASSEMBLY MACHINE TO INSERT STATION.
CASING TUBE
SIGNAL BODY
DELAY
WALKWAY
TUBE CUTTER
TUBE CUTTER
CUTTER
SCRAP
EXHAUST PLATE FEEDER
BOLT AND DRIVER
WASHER ASSEMBLY
PAYLOAD
CORK SEAL AND TAPE
PROPELLANT
FLAT BELT CONVEYOR
TAIL ASSEMBLY
EXPELLING CHARGE
AREA FOR MANUAL INSPECTION STATION
SIGNAL MOTOR ASSEMBLY ROOM
R-107
SPEAKER
CONTROL MONITOR
SPEAKER
ROCKET BARREL
WASHER ASSEMBLIES
RETAINING WASHER
SEALER
INSERT SIGNAL
CORK FEEDER
LABELER
HOT MELT
PRIMER
INITIATING CHARGE
AREA FOR MANUAL INSPECTION STATION
AREA FOR MANUAL INSPECTION STATION
ROCKET BARREL ASSEMBLY ROOM
R-108
WALKWAY
BARREL CAP
INSERT ROCKET INTO CONTAINER
LABELER
PLASTIC CONTAINER AND CAPPER
O-RING FEEDER
O-RING ASSEMBLY
SPEAKER
CONTROL MONITOR
SPEAKER
REWORK
R-1



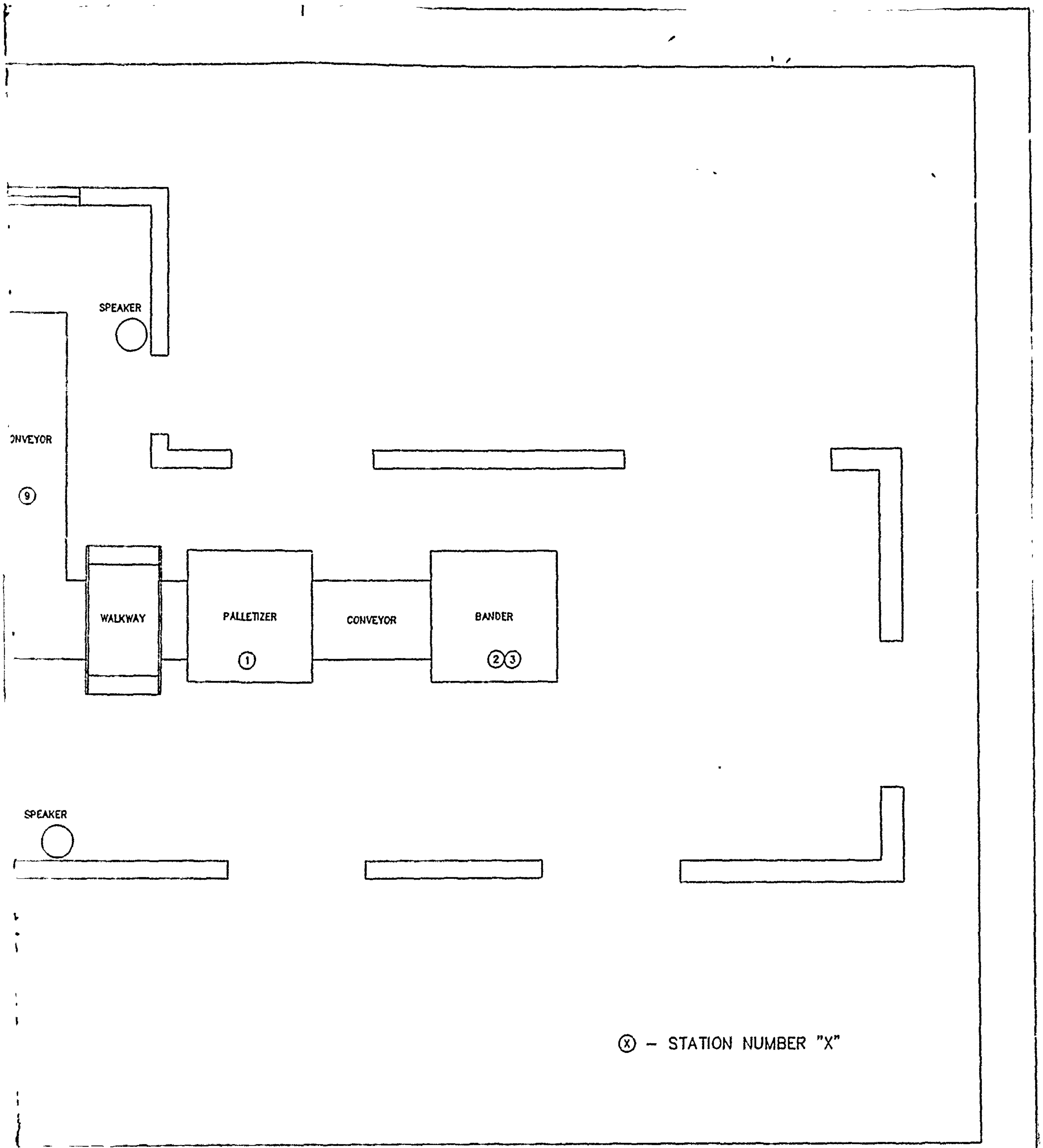
CN.
HOT MELT
WALKWAY
17 18
BARREL CAP
INSERT ROCKET INTO CONTAINER
LABELER
1 2 3 5 6
CONVEYOR
PLASTIC CONTAINER AND CAPPER
4
O-RING FEEDER
O-RING ASSEMBLY
EA FOR
NUAL
SPECTION
ATION
08
SPEAKER
CONTROL MONITOR
SPEAKER
REWORK ROOM
R-109
SPEAKER
BODY
SPACER
1 2 3
DELAY AND DRIVER
4
PAYLOADS
O-RING APPLICATOR
5
OGIVE PRESS
O-RING APPLICATOR
CRIMP AND ASSEMBLE
6 7
WALKW
NOTE: HHS CONVEYED UNDER ASSEMBLY CONVEYOR TO PACKOUT.
40 MM SIGNAL ASSEMBLY ROOM
R-110
CONTROL MONITOR
SPEAKER



LEAK TESTER
BODY
SPACER
O-RING APPLICATOR
CRIMP AND ASSEMBLE
DELAY AND DRIVER
WALKWAY
CONVEYOR
PAYLOADS
O-RING APPLICATOR
OGIVE PRESS
PICK AND PLACE
40MM PACK OUT
HHS PACK OUT
BANDER
CONVEYOR
AREA FOR MANUAL INSPECTION STATION
NOTE: HHS CONVEYED UNDER ASSEMBLY CONVEYOR TO PACKOUT.
40 MM SIGNAL ASSEMBLY ROOM
R-110
PULL TEST MACHINE
SPEAKER
SPEAKER
LEAK TEST AND PACK-OUT ROOM
R-111
CONTROL MONITOR
SPEAKER
MAIN CONTROL PANEL
SPEAKER



LEAK TESTER
WALKWAY
CONVEYOR
PICK AND PLACE
AREA FOR MANUAL INSPECTION STATION
40 MM SIGNAL SSEMBLY ROOM
R-110
SPEAKER
PULL TEST MACHINE
BANDER
CONVEYOR
SPEAKER
LEAK TEST AND PACK-OUT ROOM
R-111
WALKWAY
PALLETIZER
CONVEYOR
MAIN CONTROL PANEL
SPEAKER



BUILDING 16Y EQUIPMENT LAYOUT DRAWING

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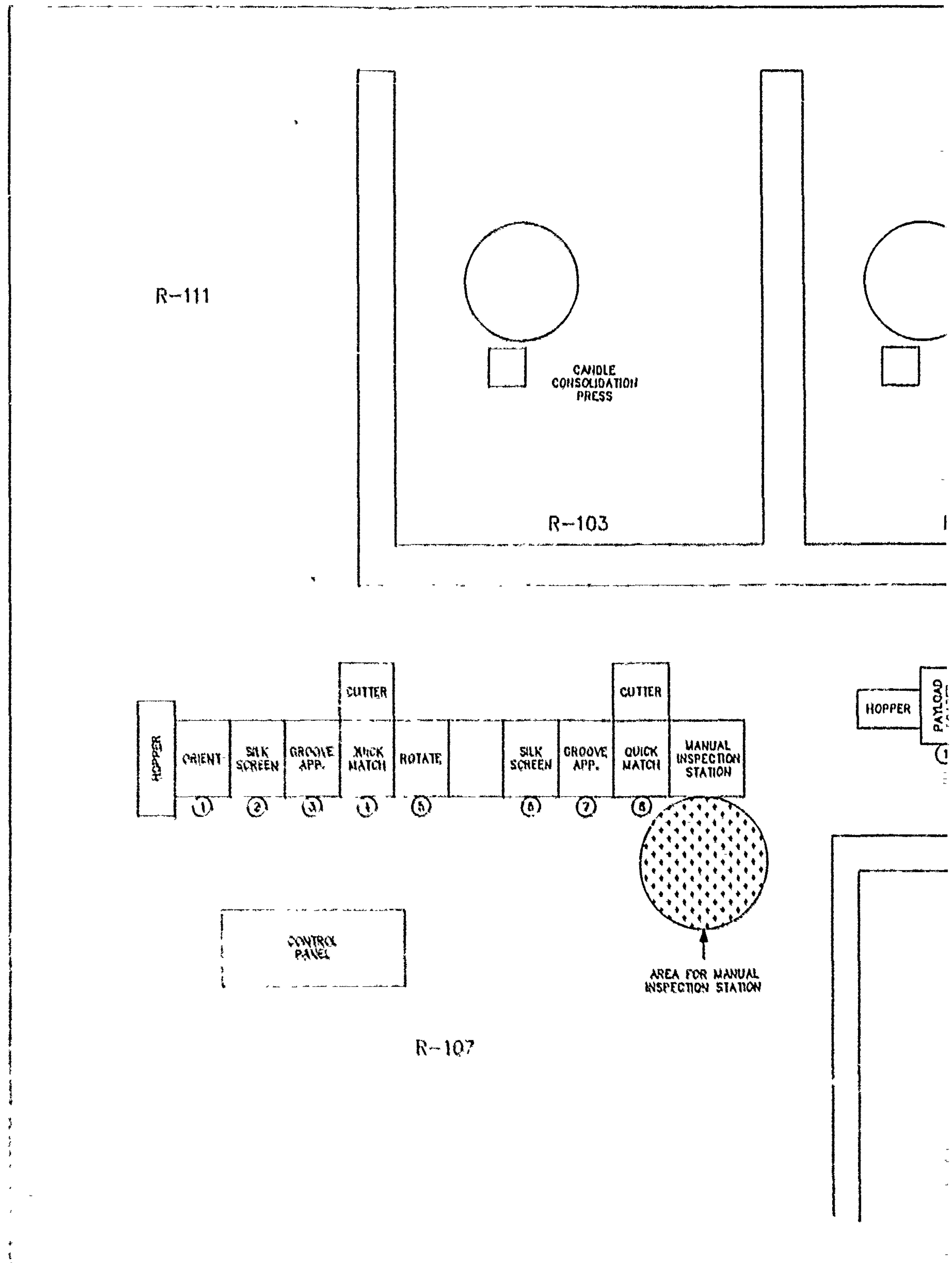

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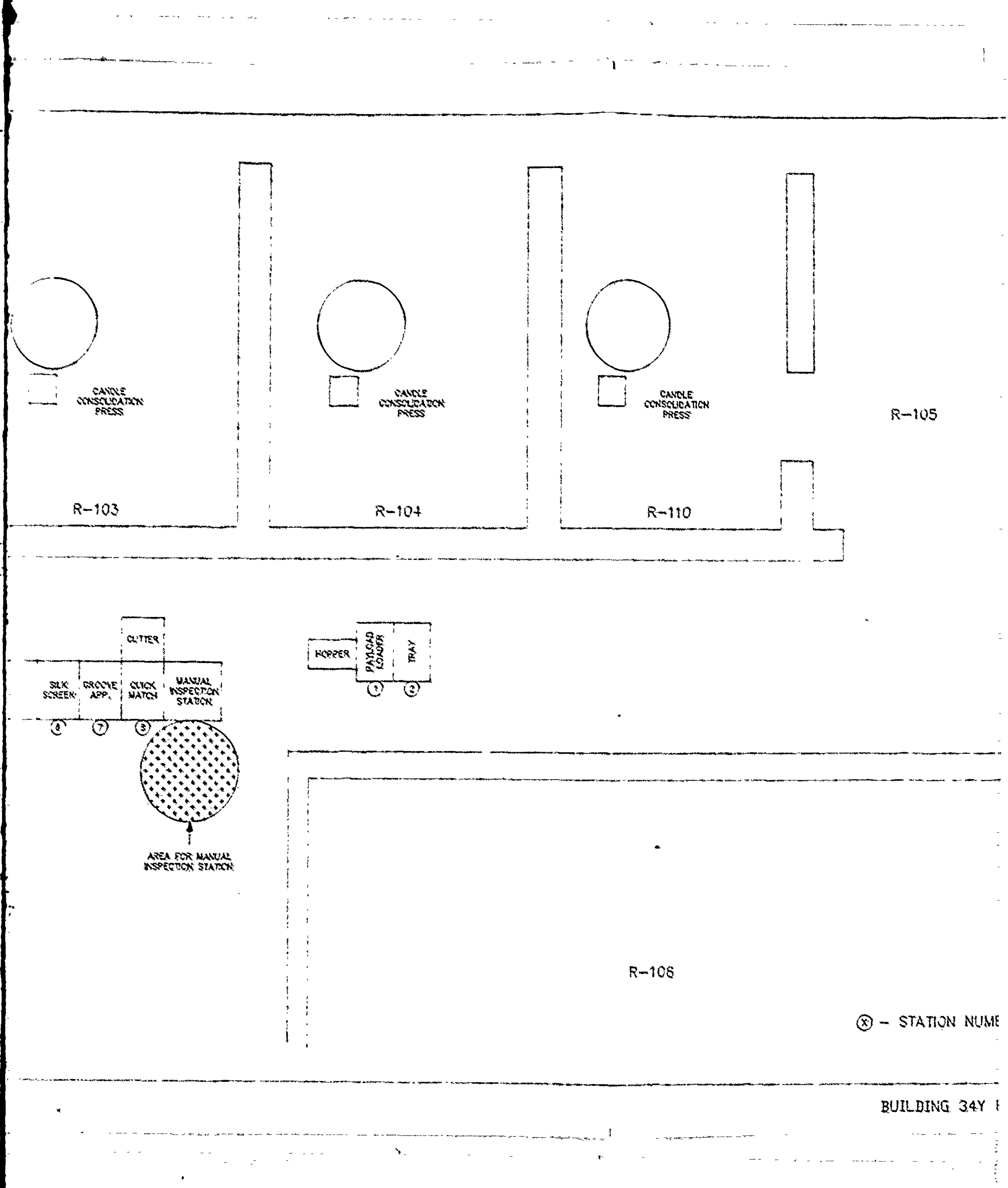
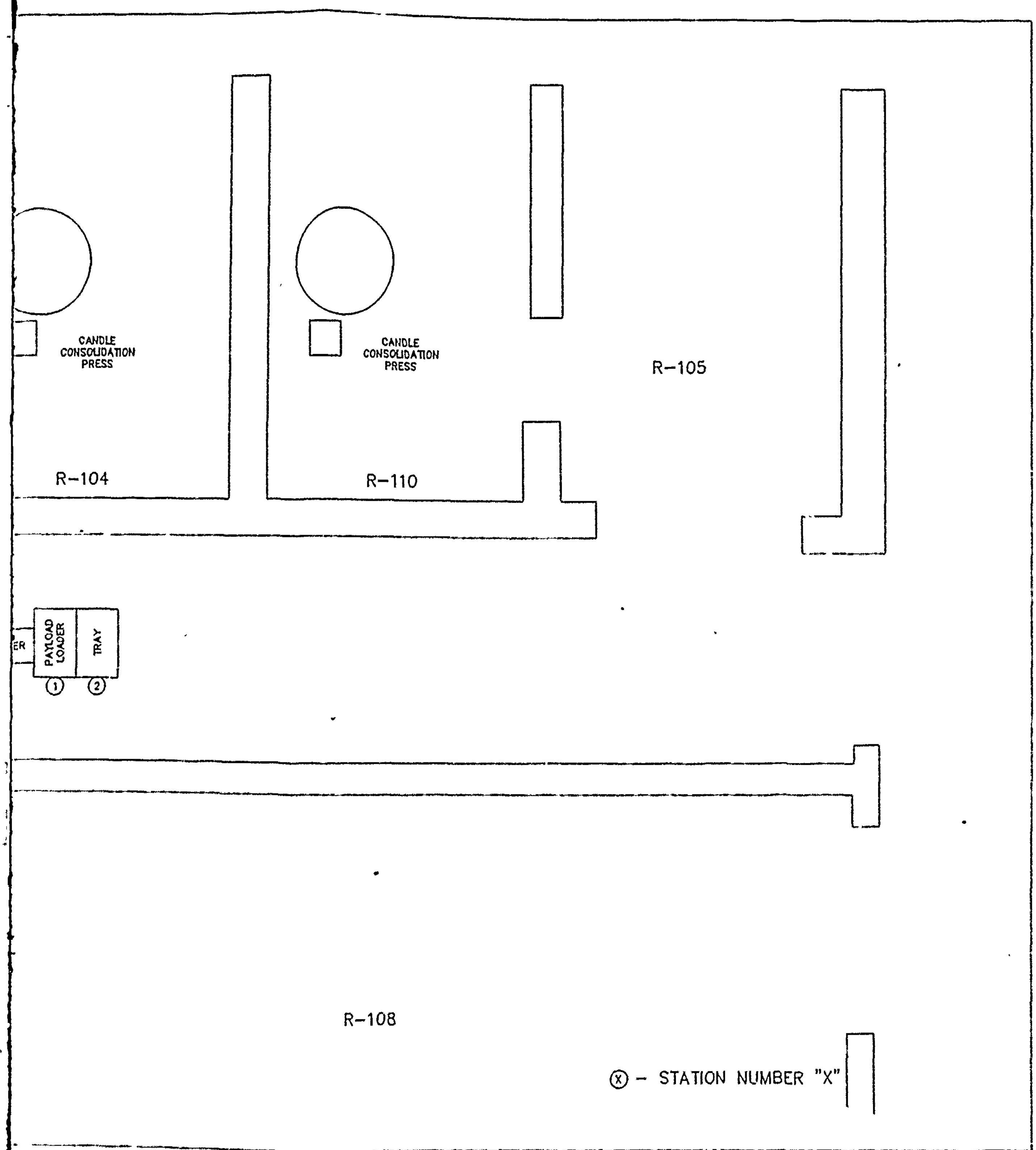


BUILDING 34Y



BUILDING 34Y EQUIPMENT LAYOUT DRAWING

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DATE: 12/08/89

WALKING BEAM CONVEYOR

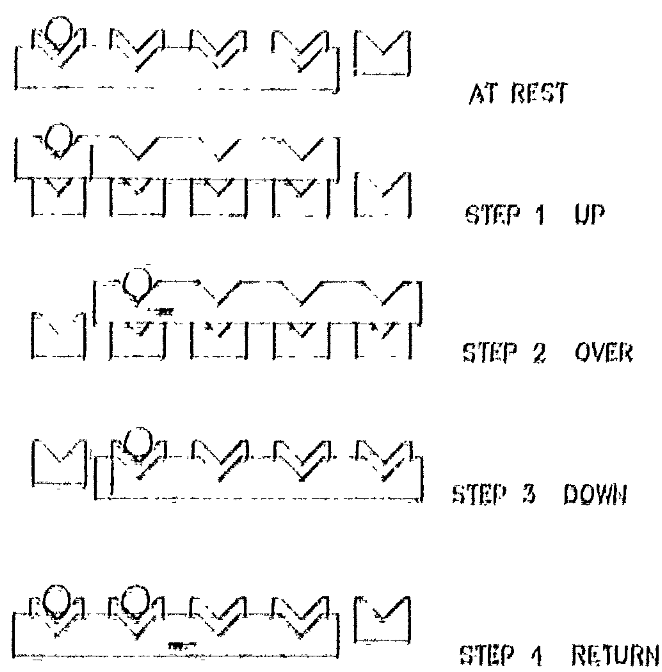

FIG. 1

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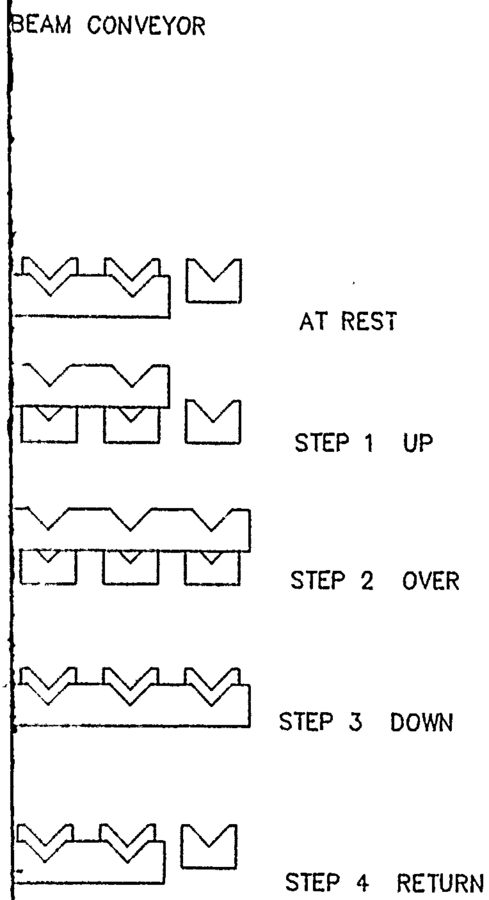

BEAM CONVEYOR
AT REST
STEP 1 UP
STEP 2 OVER
STEP 3 DOWN
STEP 4 RETURN

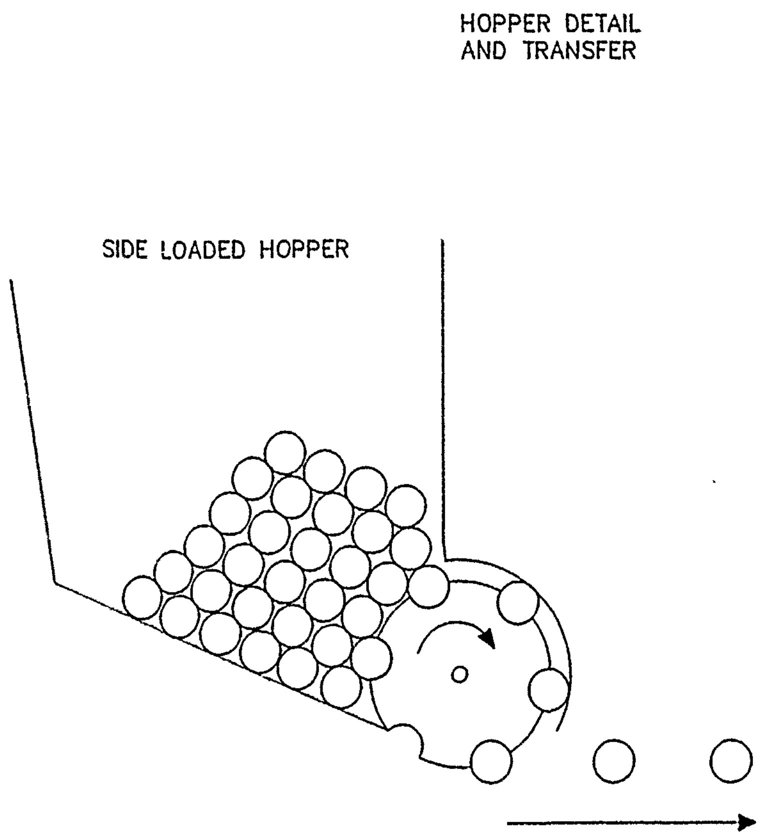
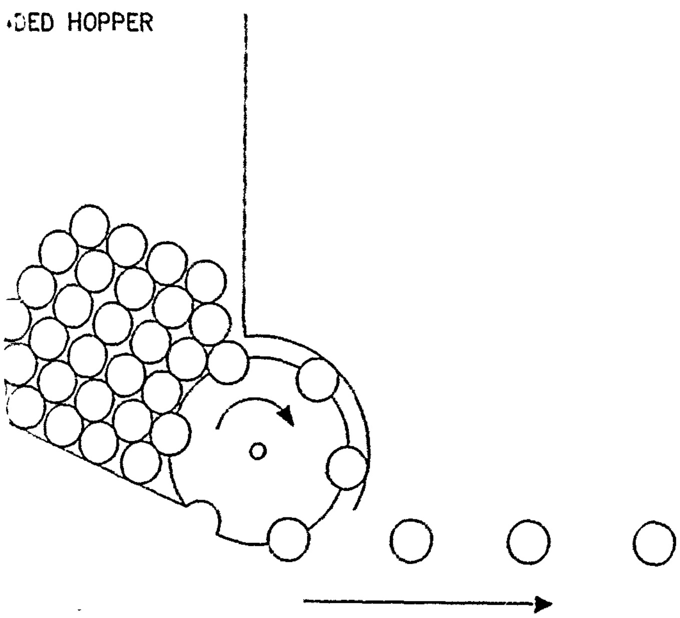

HOPPER DETAIL
AND TRANSFER
SIDE LOADED HOPPER

FIG. 2

HOPPER DETAIL
AND TRANSFER



DELAY MAGAZINE
STORAGE AND TRANSF

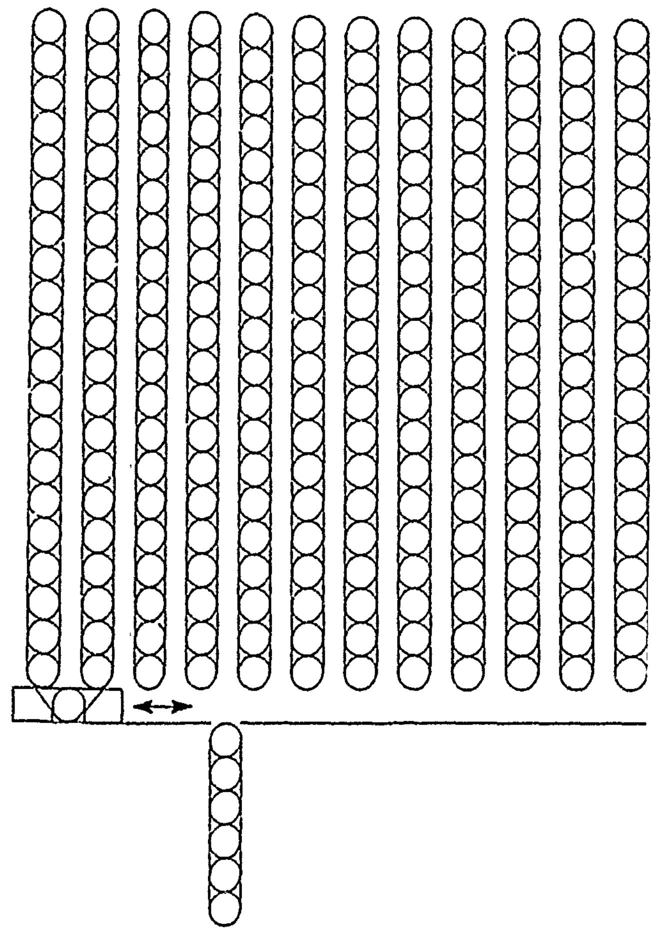


FIG. 3

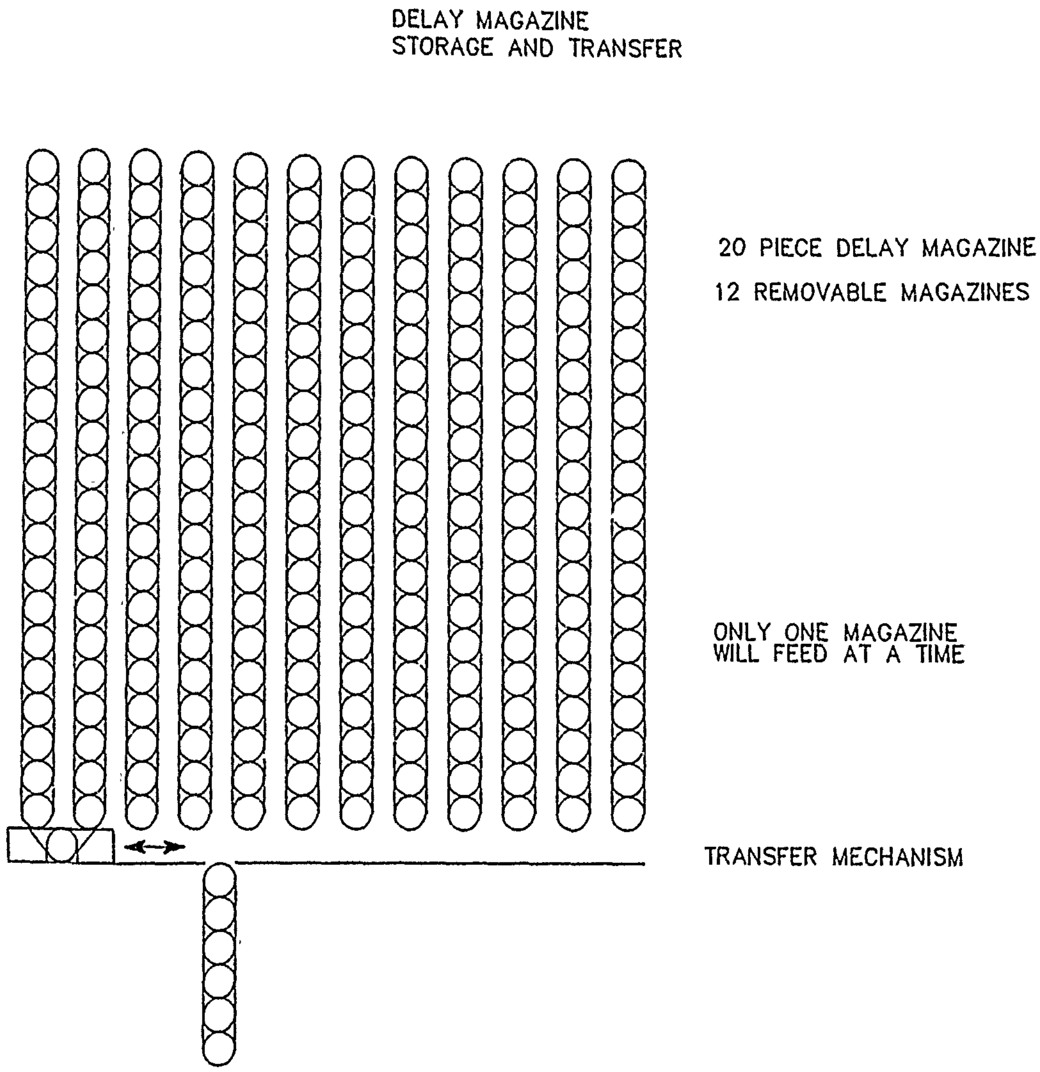


FIG. 3

FIGURE DRAWING NO. 1

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DATE: 12/08/89

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SIGNAL BODY ASSEMBLY MANDREL

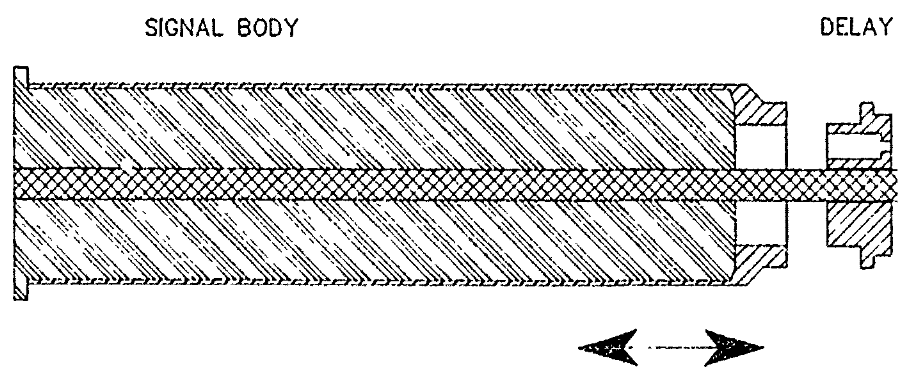
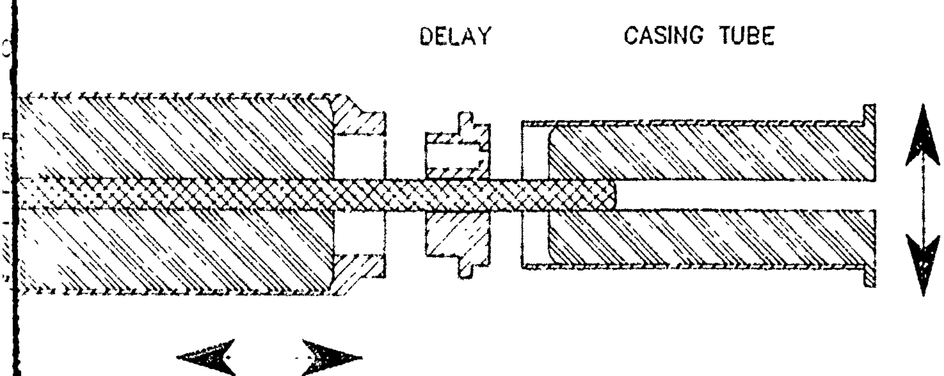


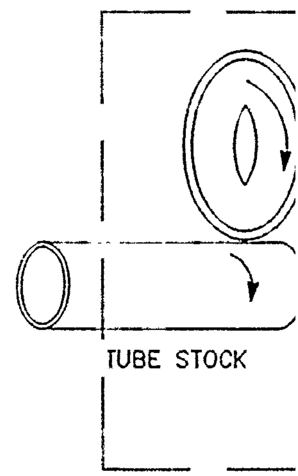
FIG. 4

DRAWING FILE: C:\ACAD10\LONGHORN\FDWG2
DATE: 12/08/89

ASSEMBLY MANDREL



TUBE SPACER MAN



OPTIONAL TUBE

FIG. 5

TUBE SPACER MANUFACTURING

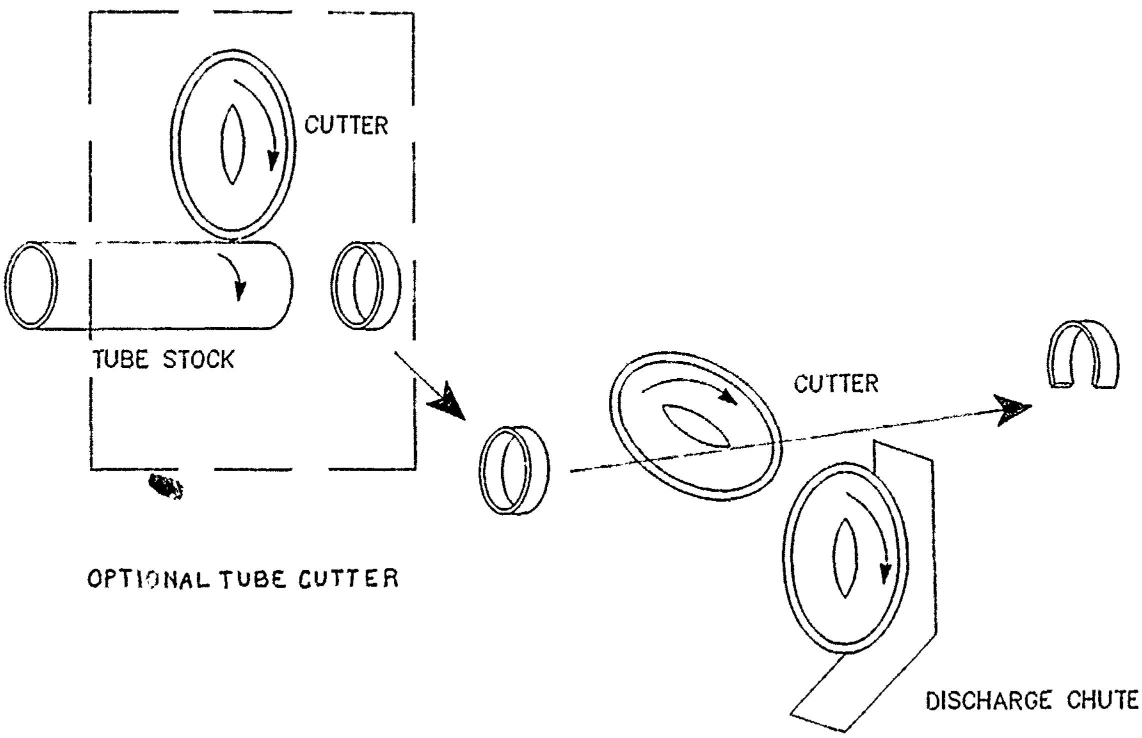
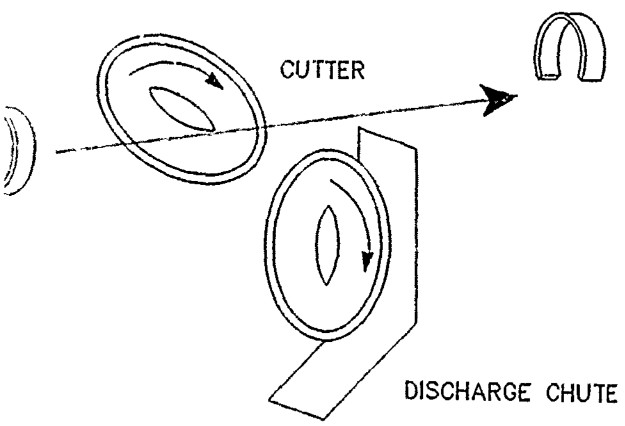


FIG. 5


CUTTER
DISCHARGE CHUTE

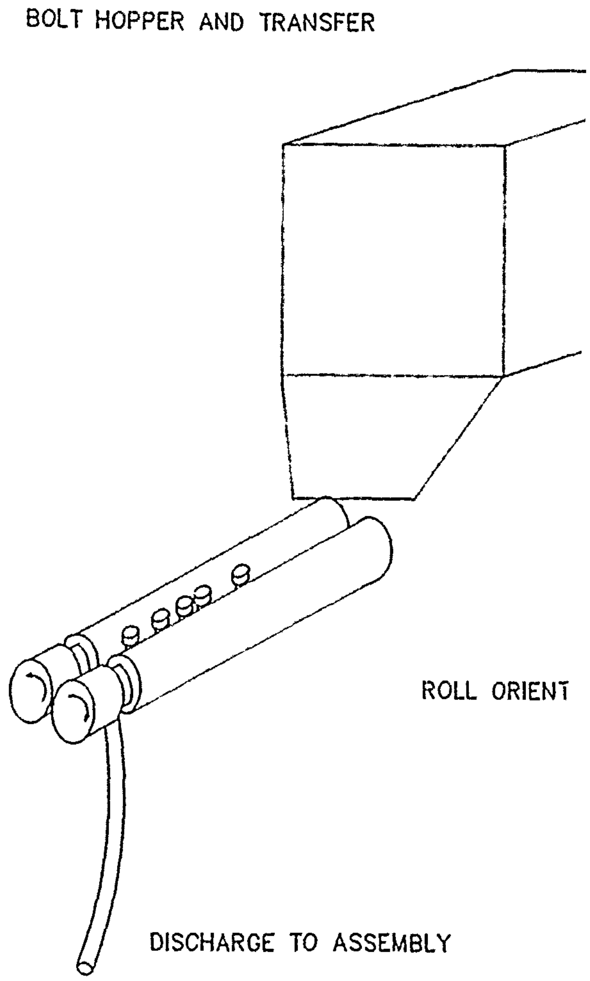
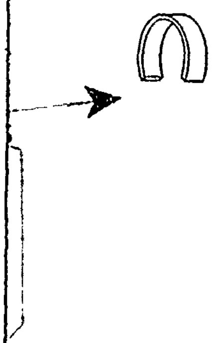

BOLT HOPPER AND TRANSFER
ROLL ORIENT
DISCHARGE TO ASSEMBLY

FIG. 6



DISCHARGE CHUTE

BOLT HOPPER AND TRANSFER

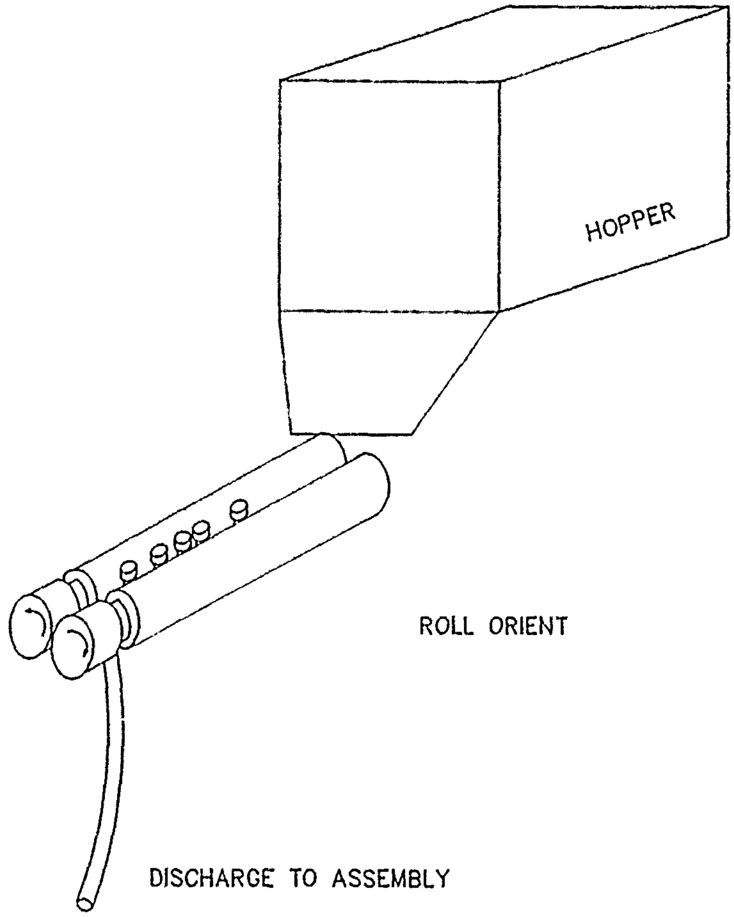


FIG. 6

FIGURE DRAWING NO. 2

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DATE: 12/08/89

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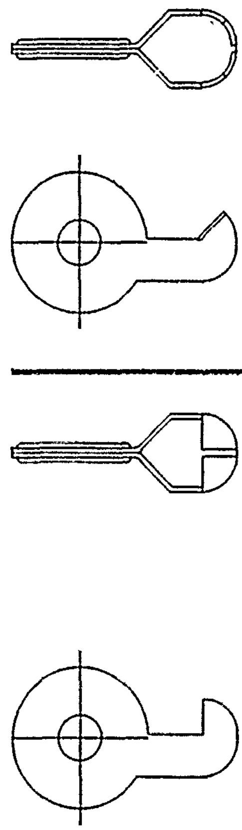


FIGURE 7 PROPOSED CHAIN CLIP DESIGN

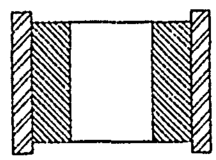
DRAWING FILE: C:\ACAD10\LONGHORN\FDWG3
DATE: 12/08/93

NEW COUPLING
OPEN

NEW COUPLING
CLOSED

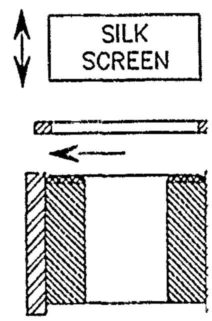
FIGURE 7 PROPOSED CHAIN CLIP DESIGN

STEP 1

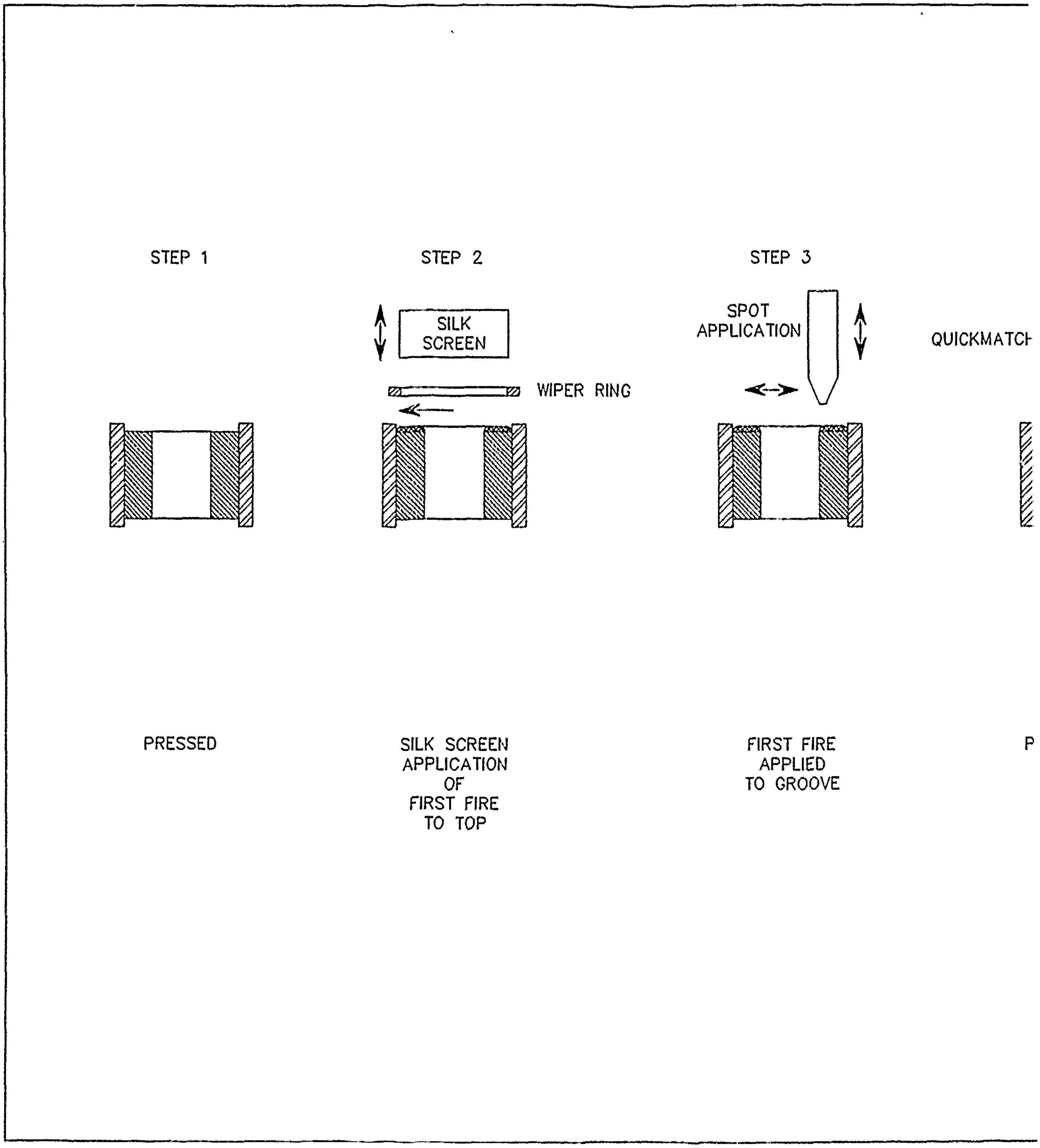


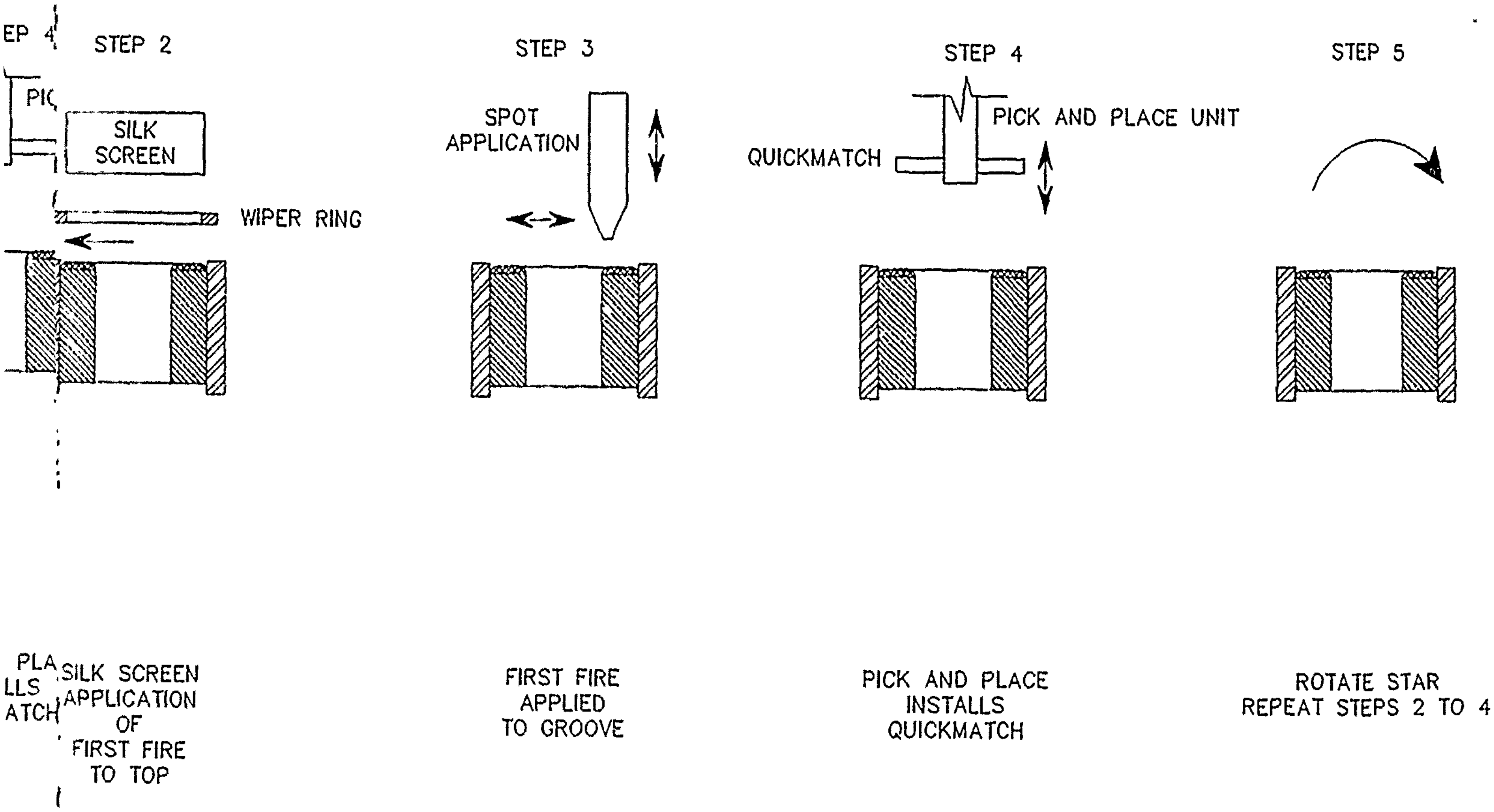
PRESSED

STEP 2



SILK SCREEN
APPLICATION
OF
FIRST FIRE
TO TOP


STEP 1
STEP 2
STEP 3
SILK
SCREEN
WIPER RING
SPOT
APPLICATION
QUICKMATCH
PRESSED
SILK SCREEN
APPLICATION
OF
FIRST FIRE
TO TOP
FIRST FIRE
APPLIED
TO GROOVE



STEP 2
SILK SCREEN
WIPER RING
SILK SCREEN APPLICATION OF FIRST FIRE TO TOP
STEP 3
SPOT APPLICATION
FIRST FIRE APPLIED TO GROOVE
STEP 4
PICK AND PLACE UNIT
QUICKMATCH
PICK AND PLACE INSTALLS QUICKMATCH
STEP 5
ROTATE STAR REPEAT STEPS 2 TO 4

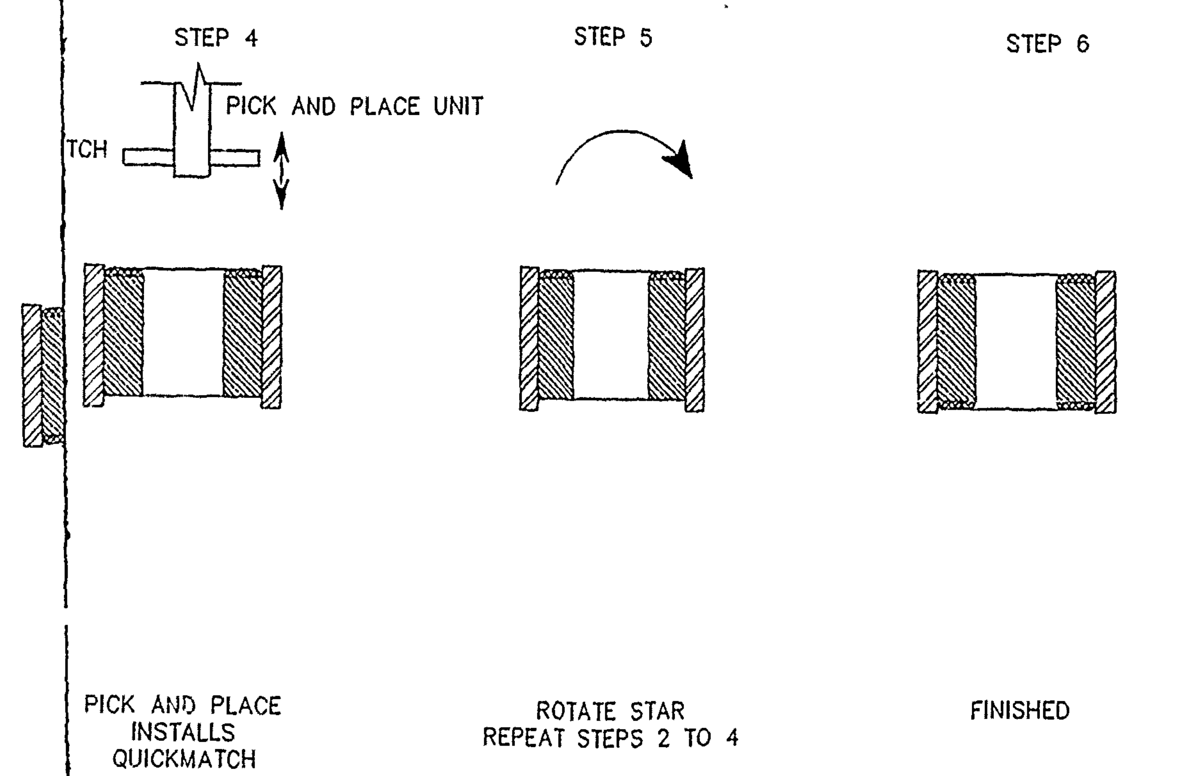


FIGURE 8 FIRST FIRE APPLICATION

FIGURE DRAWING NO. 3

OVERALL PROJECT SCHEDULE

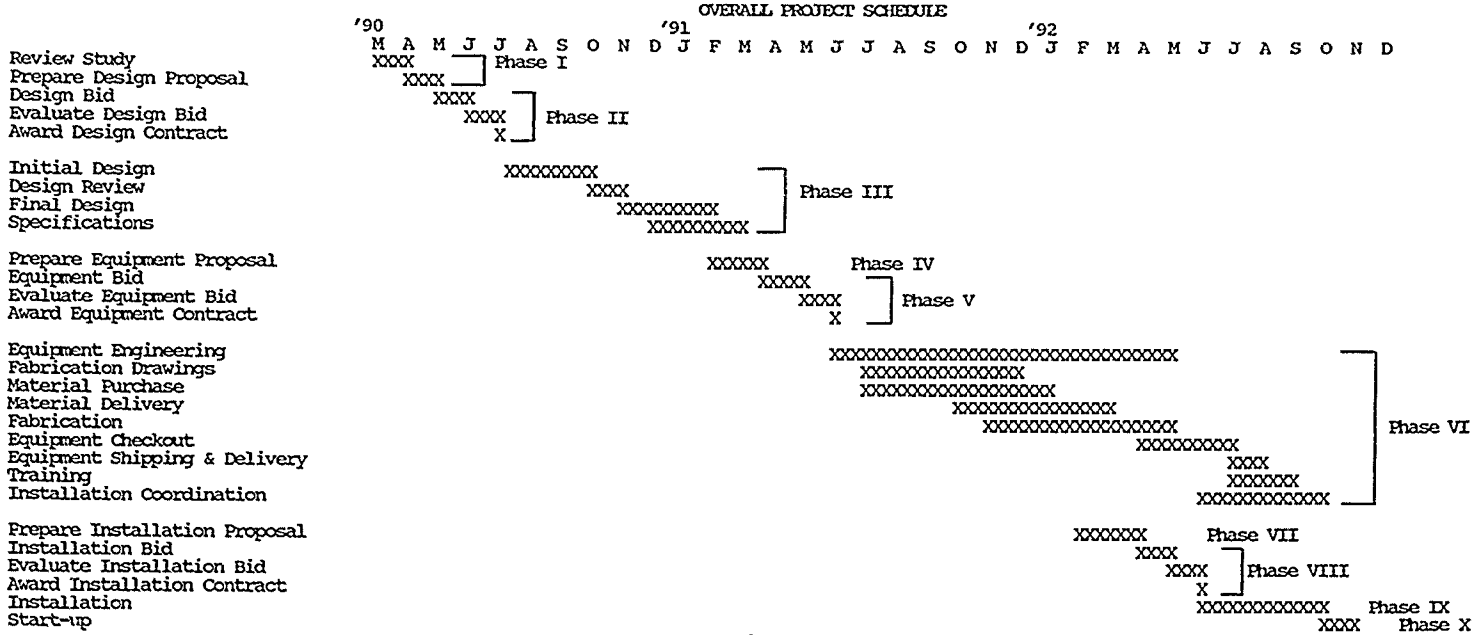


Figure 9

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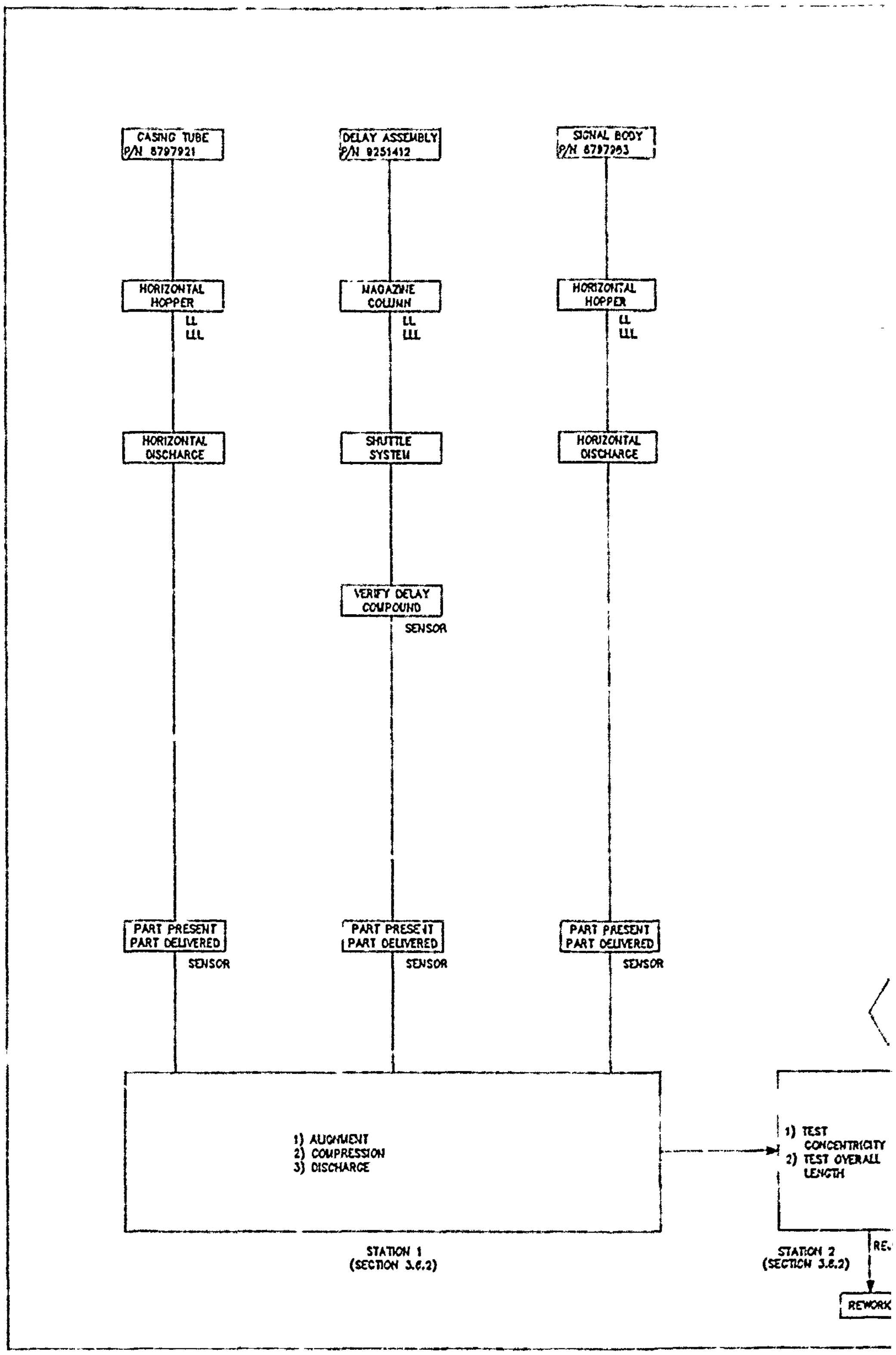
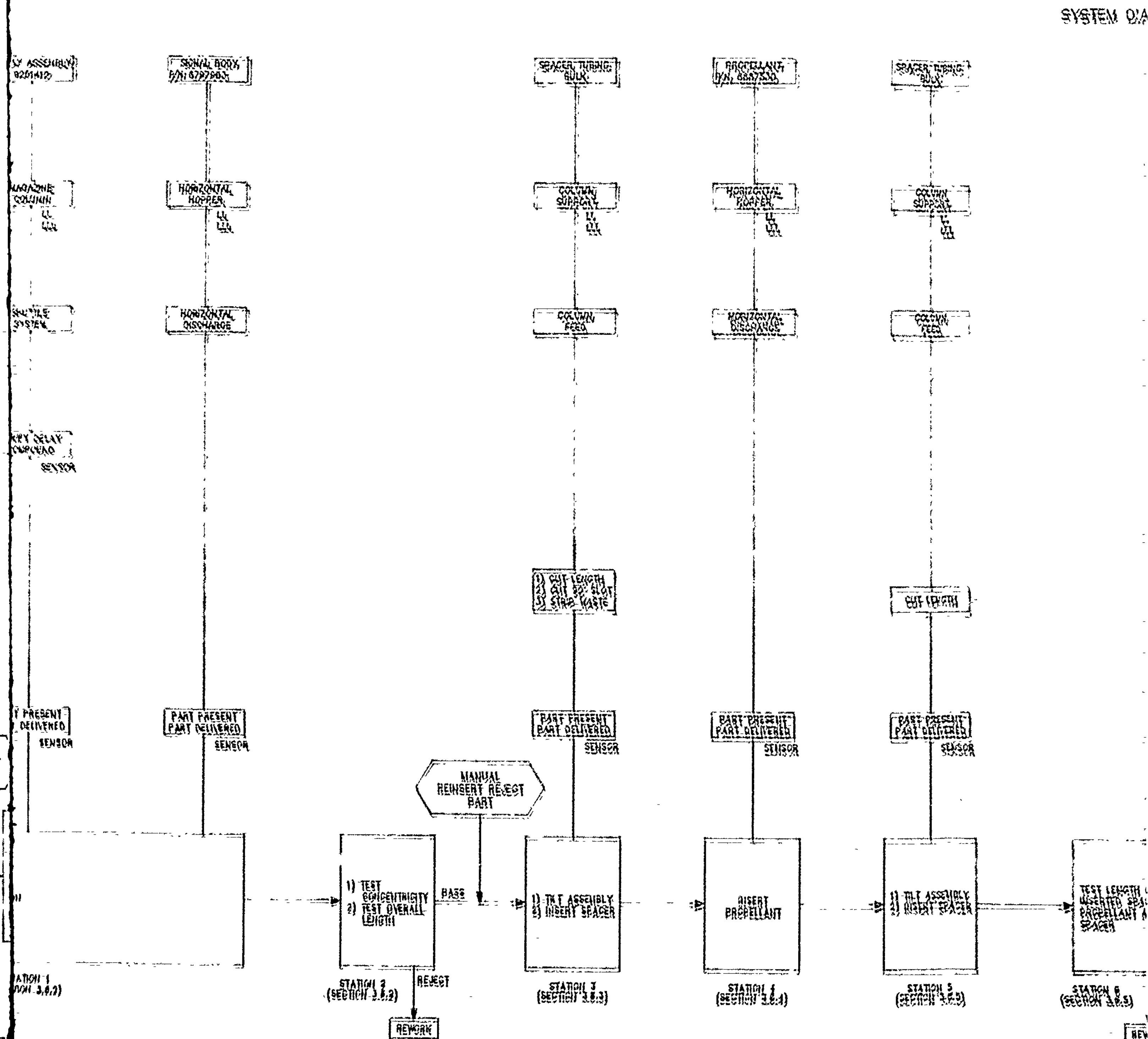
DATE: 12/08/89

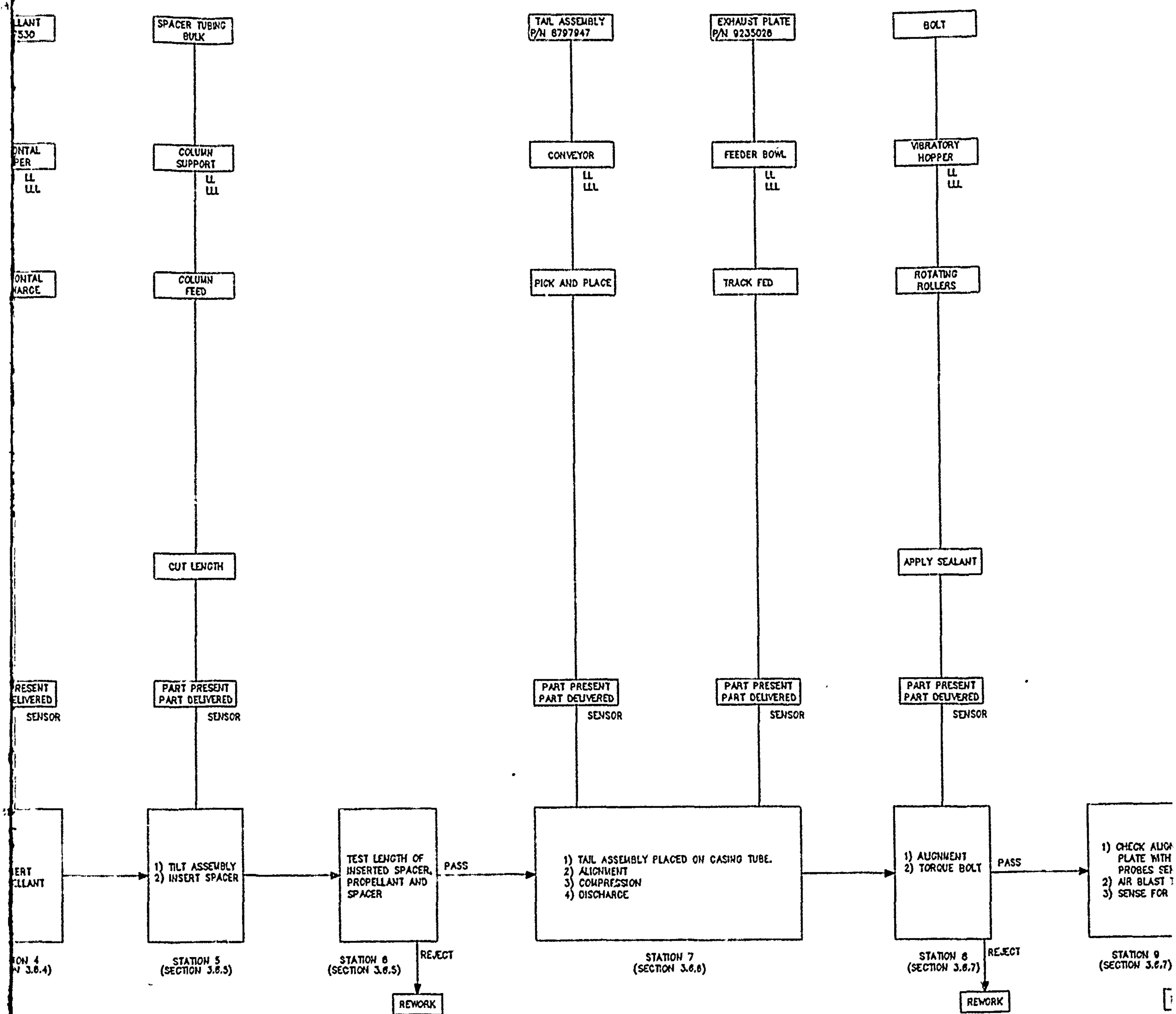
LEFT BLANK



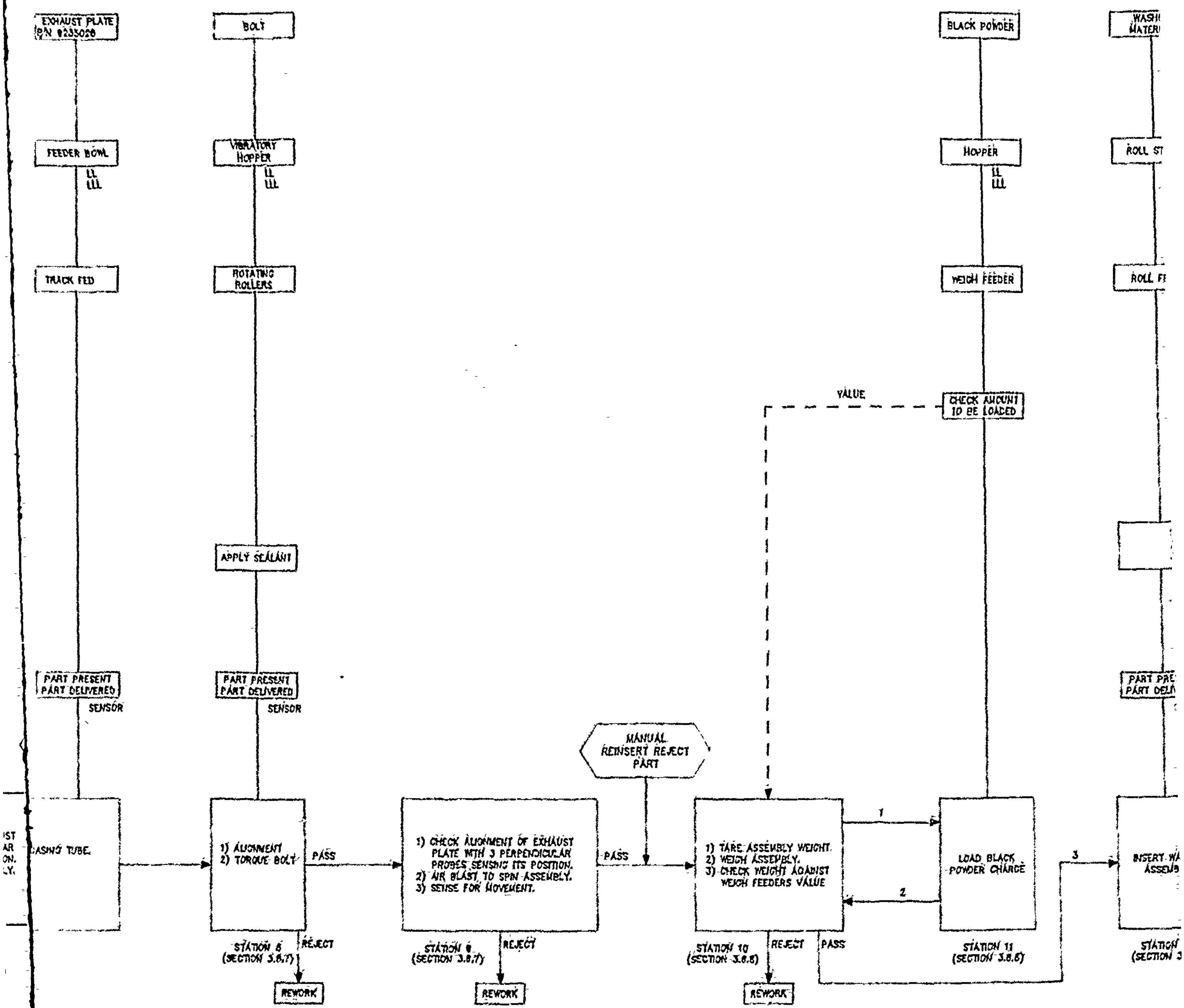
DRAWING FILE: C:\ACAD9\LONGHORN\DIA1
DATE: 12/08/89

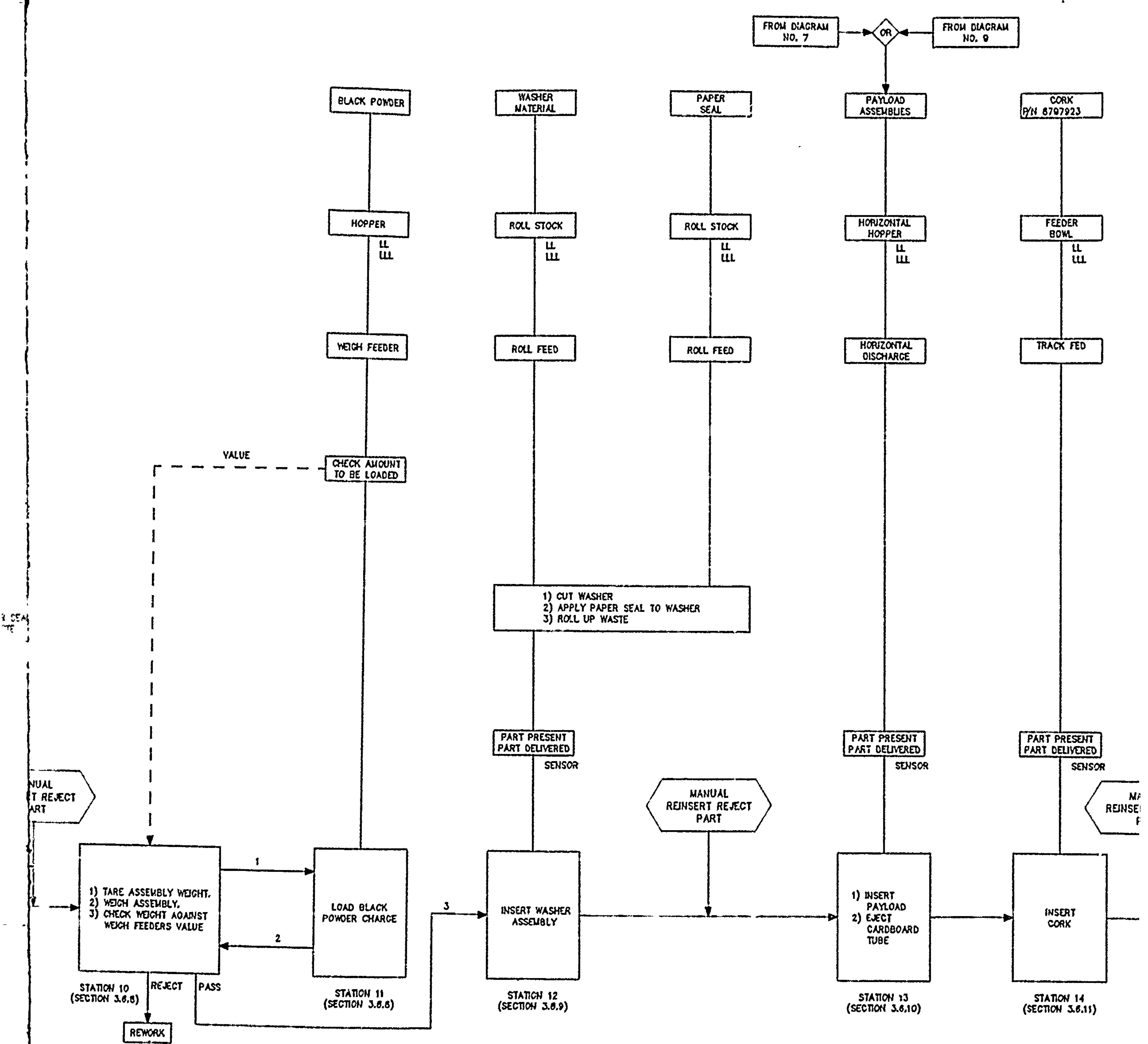

SYSTEM DIA
SIGNAL BODY P/N 6797903
HORIZONTAL HOPPER
HORIZONTAL DISCHARGE
PART PRESENT PART DELIVERED
SENSOR
SPACER TUBING BULK
COLUMN SUPPORT
COLUMN FEED
1) CUT LENGTH
2) CUT 90° SLOT
3) STRIP WASTE
PROPELLANT
HORIZONTAL HOPPER
HORIZONTAL DISCHARGE
CUT LENGTH
MAGAZINE COLUMN
SHUTTLE SYSTEM
SENSOR
MANUAL REINSERT REJECT PART
1) TEST CONCENTRICITY
2) TEST OVERALL LENGTH
PASS
REJECT
REWORK
1) TILT ASSEMBLY
2) INSERT SPACER
INSERT PROPELLANT
STATION 2 (SECTION 3.6.2)
STATION 3 (SECTION 3.6.3)
STATION 4 (SECTION 3.6.4)
STATION 5 (SECTION 3.6.5)
STATION 6 (SECTION 3.6.5)

SYSTEM DIAGRAM OF HAND HELD SIGNAL MOTOR ASSEMBLY MACHINE



OR ASSEMBLY MACHINE





FROM DIAGRAM NO. 7
OR
FROM DIAGRAM NO. 9
BLACK POWDER
WASHER MATERIAL
PAPER SEAL
PAYLOAD ASSEMBLIES
CORK P/N 8797923
HOPPER
ROLL STOCK
ROLL STOCK
HORIZONTAL HOPPER
FEEDER BOWL
WEIGH FEEDER
ROLL FEED
ROLL FEED
HORIZONTAL DISCHARGE
TRACK FED
VALUE
CHECK AMOUNT TO BE LOADED
1) CUT WASHER
2) APPLY PAPER SEAL TO WASHER
3) ROLL UP WASTE
PART PRESENT PART DELIVERED
SENSOR
PART PRESENT PART DELIVERED
SENSOR
PART PRESENT PART DELIVERED
SENSOR
MANUAL REINSERT REJECT PART
1) TARE ASSEMBLY WEIGHT.
2) WEIGH ASSEMBLY.
3) CHECK WEIGHT AGAINST WEIGH FEEDERS VALUE
LOAD BLACK POWDER CHARGE
INSERT WASHER ASSEMBLY
1) INSERT PAYLOAD
2) EJECT CARDBOARD TUBE
INSERT CORK
1
2
3
REJECT
PASS
REWORK
STATION 10 (SECTION 3.6.8)
STATION 11 (SECTION 3.6.8)
STATION 12 (SECTION 3.6.9)
STATION 13 (SECTION 3.6.10)
STATION 14 (SECTION 3.6.11)

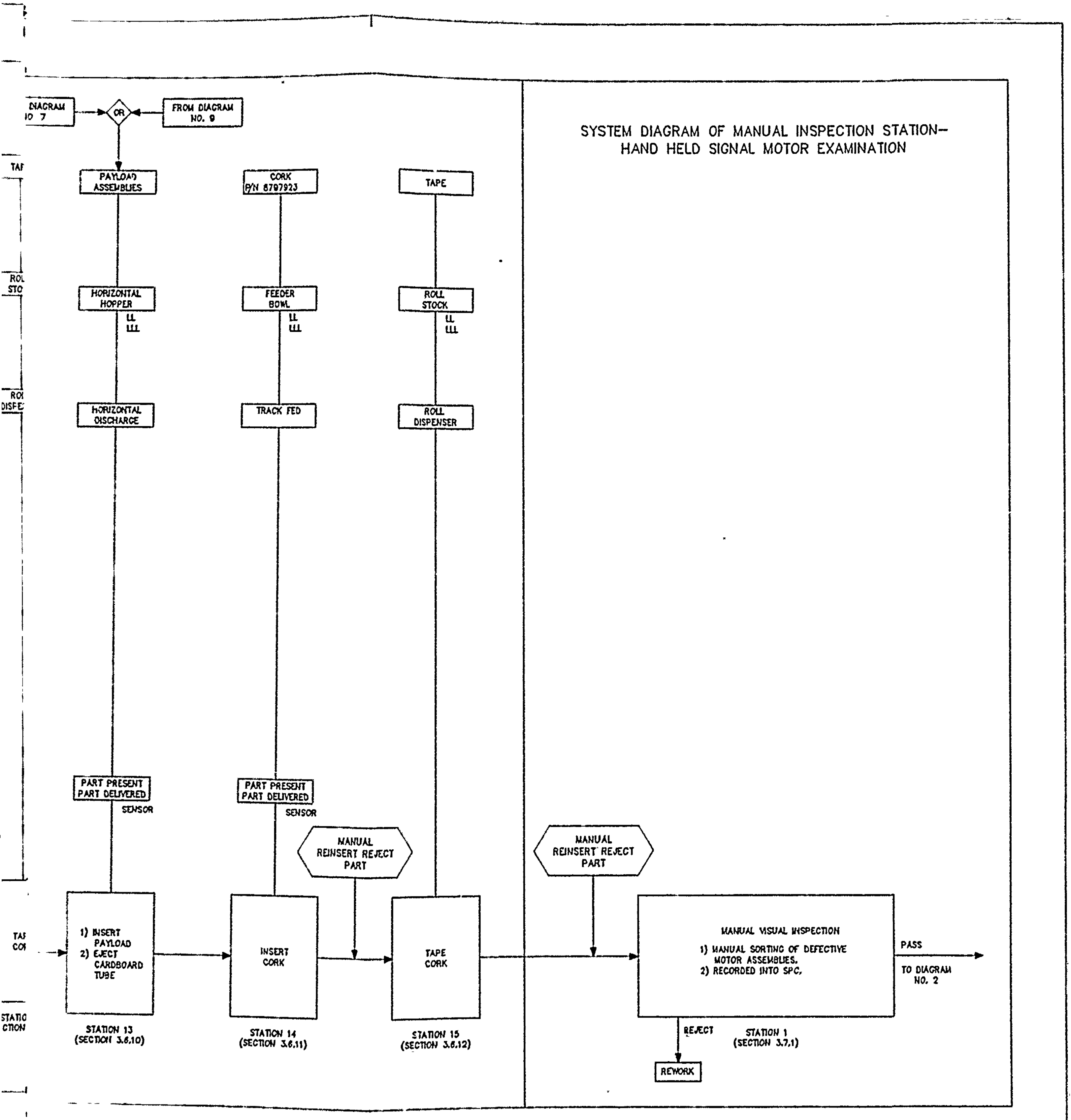

SYSTEM DIAGRAM OF MANUAL INSPECTION STATION—
HAND HELD SIGNAL MOTOR EXAMINATION
DIAGRAM
NO 7
OR
FROM DIAGRAM
NO. 9
PAYLOAD
ASSEMBLIES
CORK
P/N 8797923
TAPE
HORIZONTAL
HOPPER
FEEDER
BOWL
ROLL
STOCK
HORIZONTAL
DISCHARGE
TRACK FED
ROLL
DISPENSER
PART PRESENT
PART DELIVERED
SENSOR
PART PRESENT
PART DELIVERED
SENSOR
MANUAL
REINSERT REJECT
PART
MANUAL
REINSERT REJECT
PART
1) INSERT
PAYLOAD
2) EJECT
CARDBOARD
TUBE
INSERT
CORK
TAPE
CORK
MANUAL VISUAL INSPECTION
1) MANUAL SORTING OF DEFECTIVE
MOTOR ASSEMBLIES.
2) RECORDED INTO SPC.
PASS
TO DIAGRAM
NO. 2
STATION 13
(SECTION 3.6.10)
STATION 14
(SECTION 3.6.11)
STATION 15
(SECTION 3.6.12)
REJECT
STATION 1
(SECTION 3.7.1)
REWORK

DIAGRAM NO. 1

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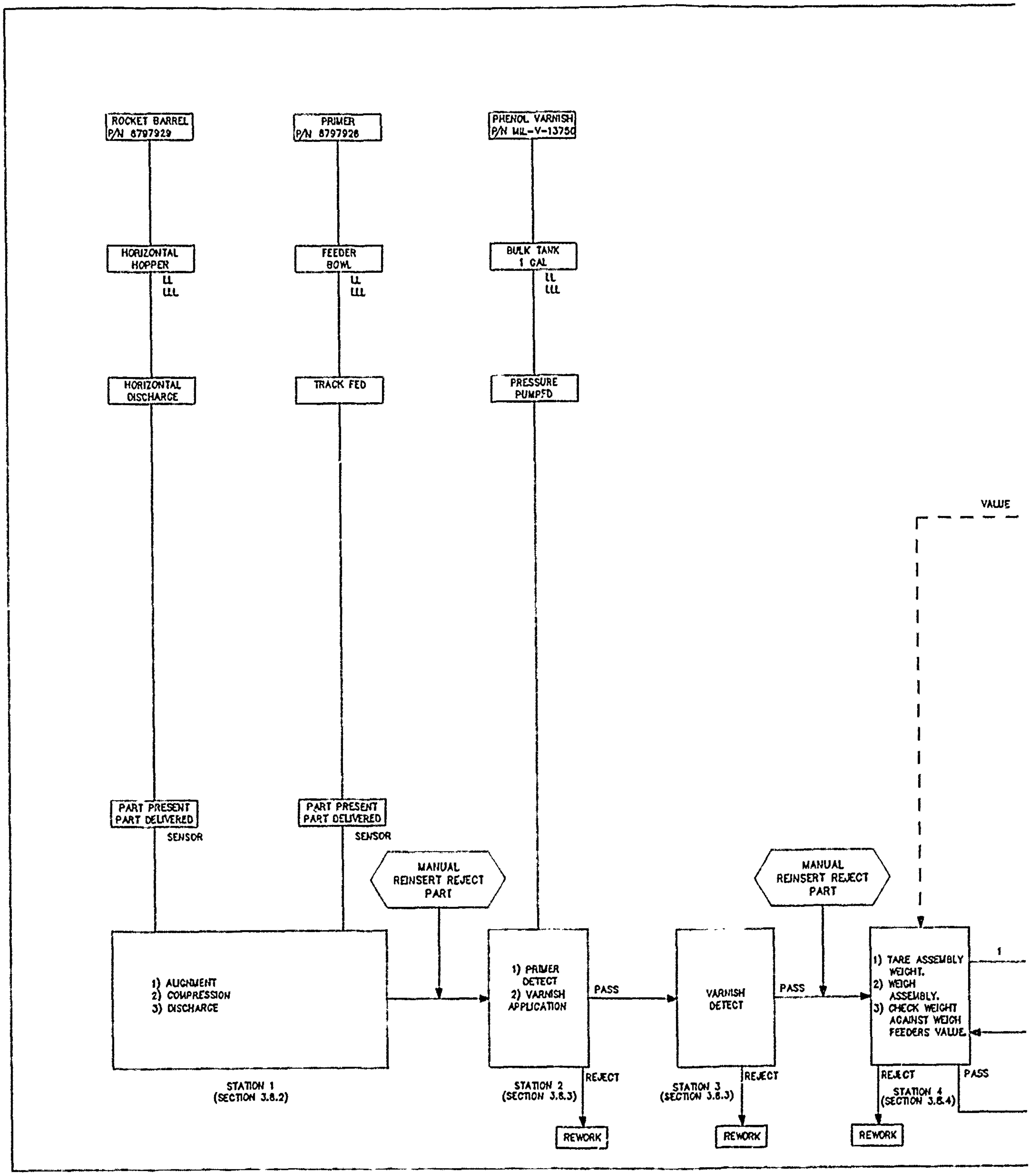
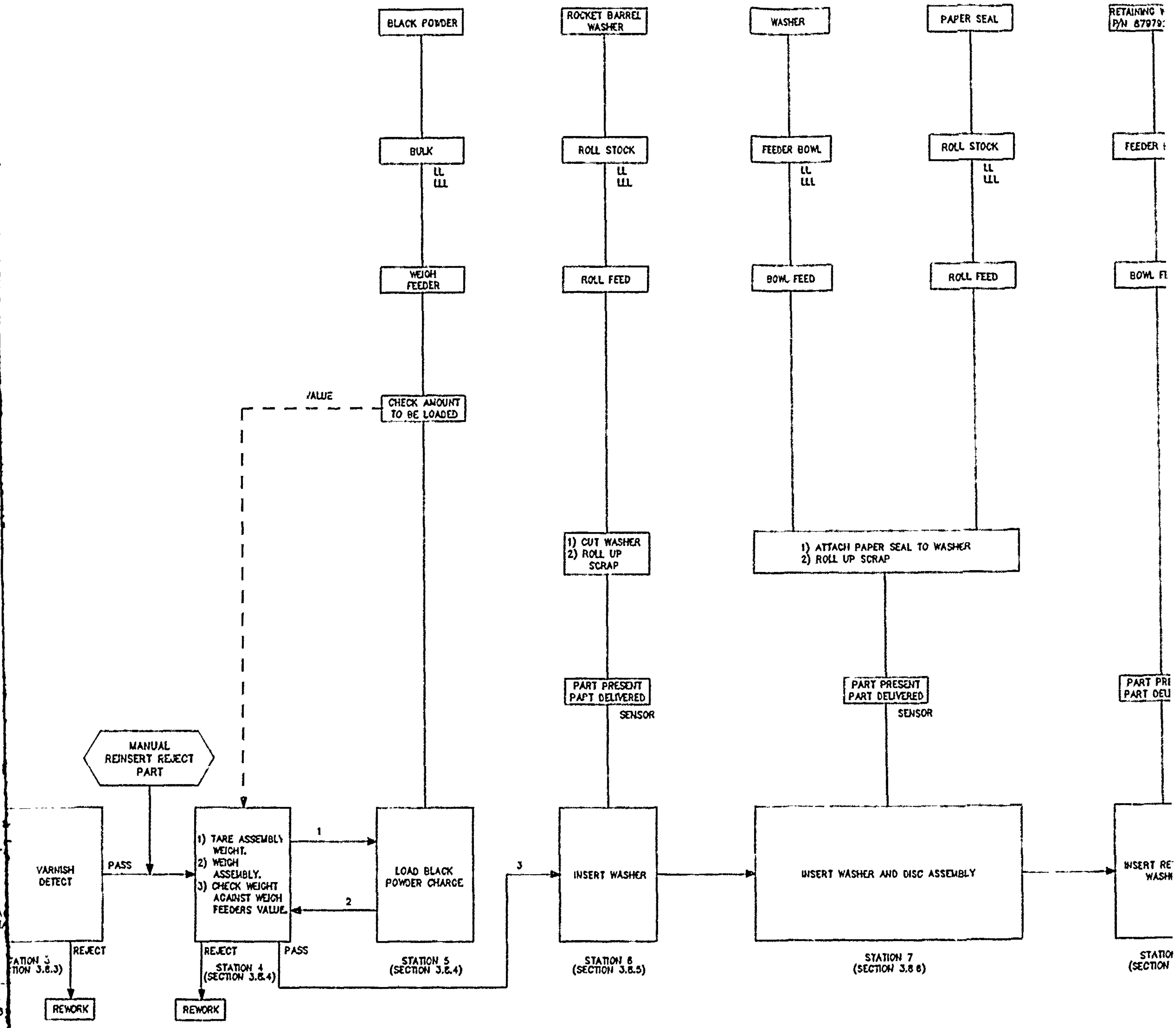
DATE: 12/08/89

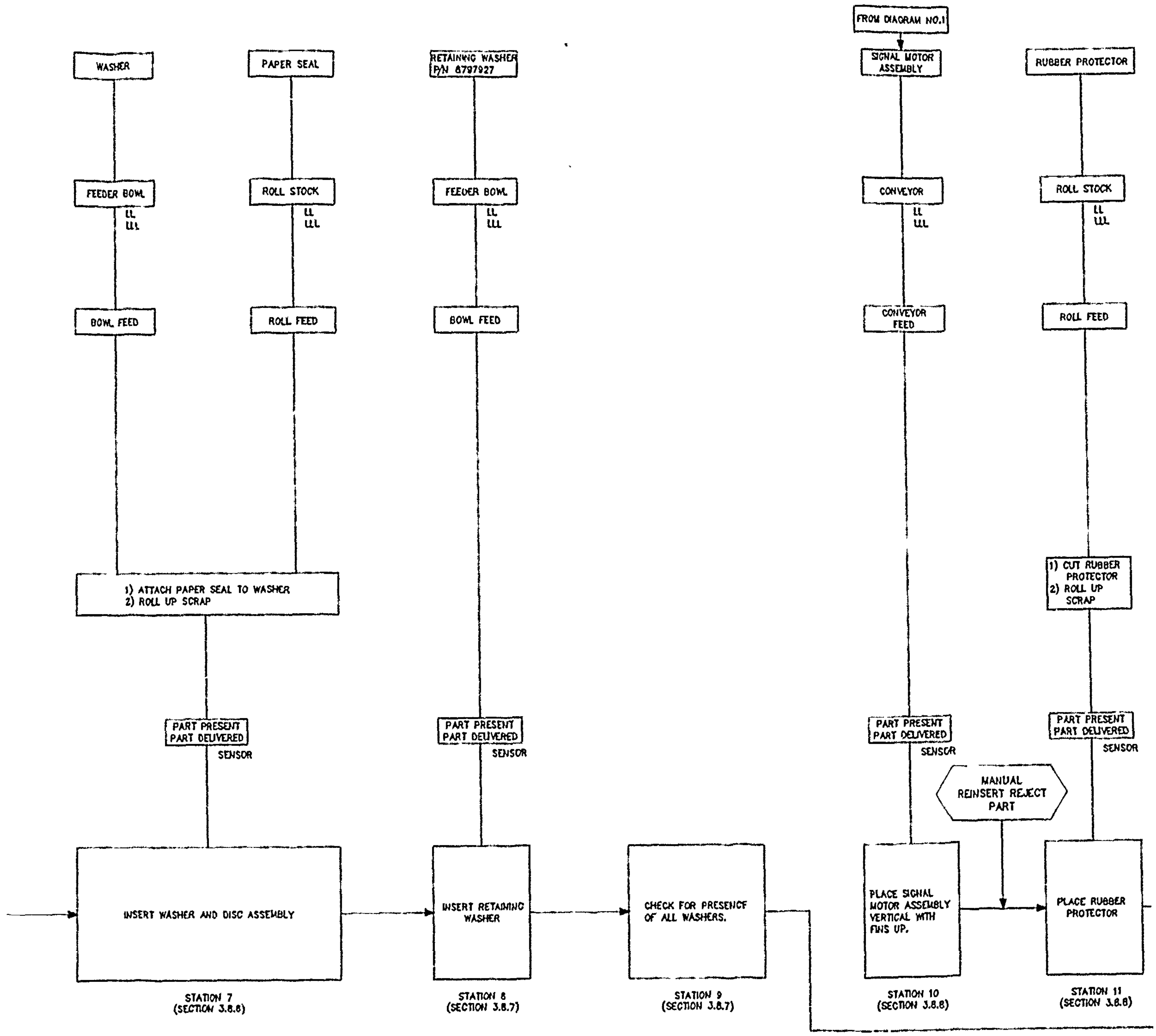


9\LONGHORN\DIA2

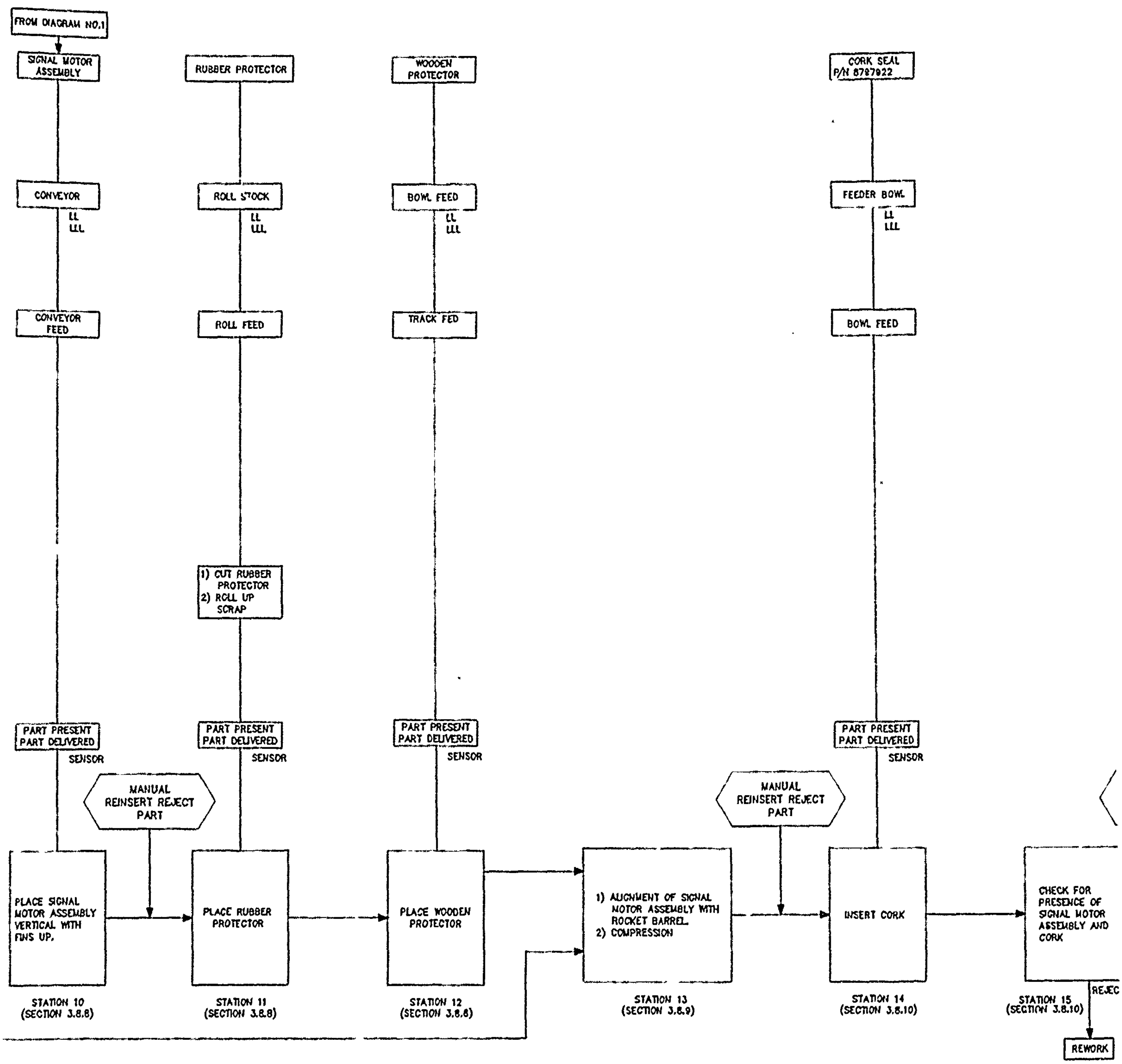
SYSTEM DIAGRAM OF

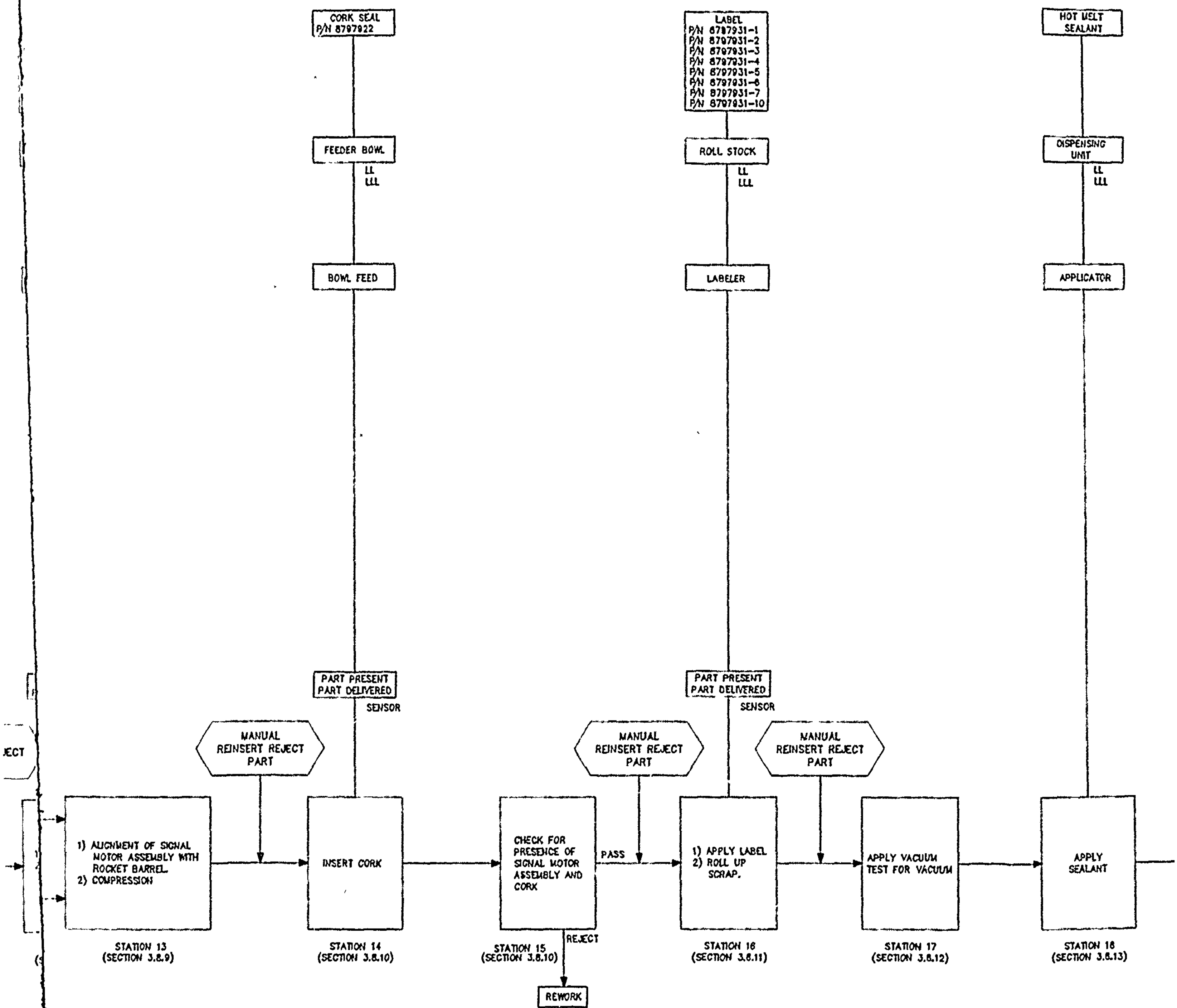


SYSTEM DIAGRAM OF HAND HELD SIGNAL ROCKET BARREL ASSEMBLY MACHINE



SSEMBLY MACHINE





CORK SEAL P/N 8797922
LABEL
P/N 8797931-1
P/N 8797931-2
P/N 8797931-3
P/N 8797931-4
P/N 8797931-5
P/N 8797931-6
P/N 8797931-7
P/N 8797931-10
HOT MELT SEALANT
FEEDER BOWL
ROLL STOCK
DISPENSING UNIT
BOWL FEED
LABELER
APPLICATOR
PART PRESENT PART DELIVERED
SENSOR
PART PRESENT PART DELIVERED
SENSOR
MANUAL REINSERT REJECT PART
MANUAL REINSERT REJECT PART
MANUAL REINSERT REJECT PART
1) ALIGNMENT OF SIGNAL MOTOR ASSEMBLY WITH ROCKET BARREL
2) COMPRESSION
INSERT CORK
CHECK FOR PRESENCE OF SIGNAL MOTOR ASSEMBLY AND CORK
PASS
REJECT
REWORK
1) APPLY LABEL
2) ROLL UP SCRAP.
APPLY VACUUM TEST FOR VACUUM
APPLY SEALANT
STATION 13 (SECTION 3.8.9)
STATION 14 (SECTION 3.8.10)
STATION 15 (SECTION 3.8.10)
STATION 16 (SECTION 3.8.11)
STATION 17 (SECTION 3.8.12)
STATION 18 (SECTION 3.8.13)

SYSTEM DIAGRAM OF MANUAL INSPECTION STATION– HAND HELD SIGNAL ROCKET EXAMINATION

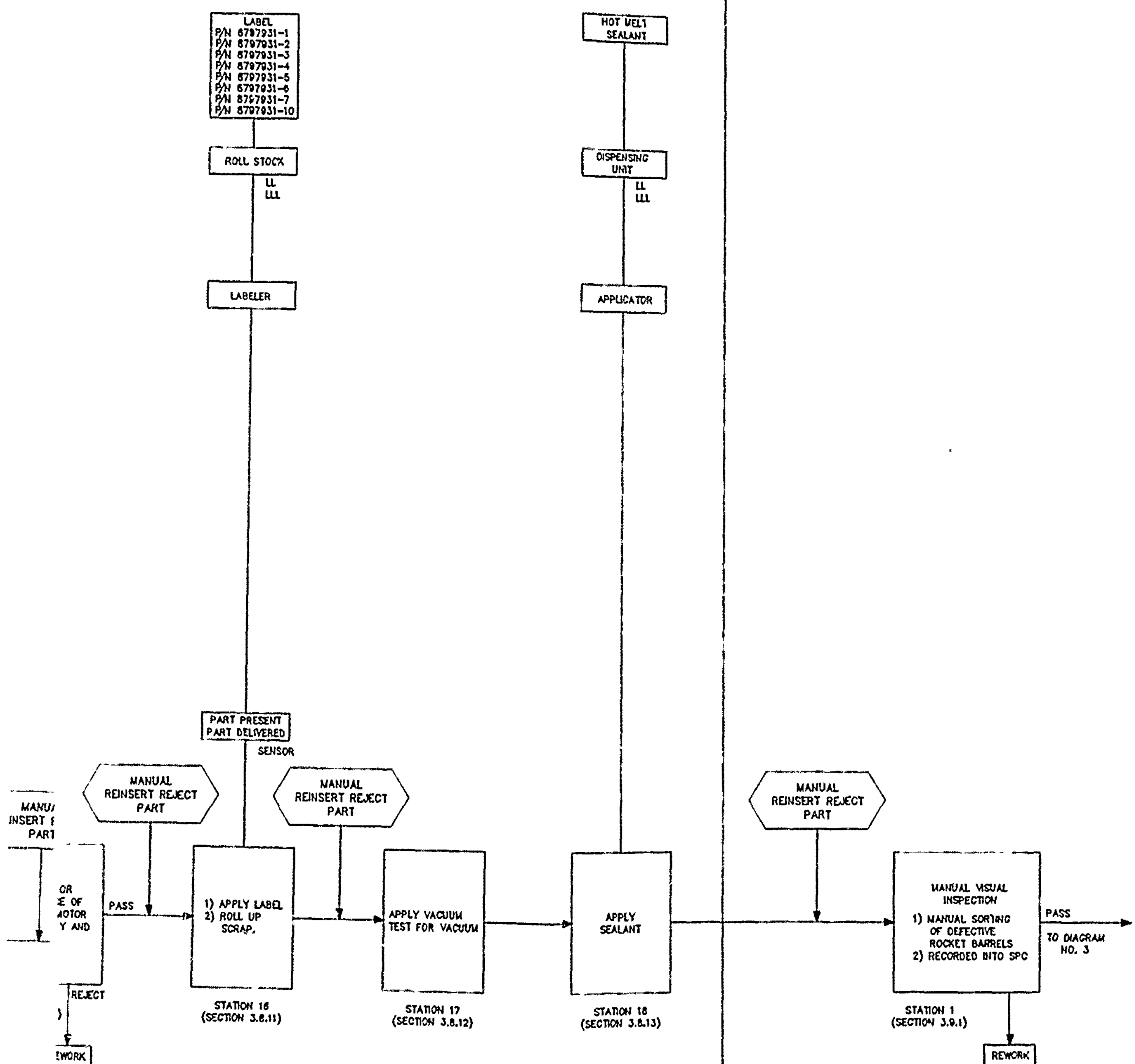


DIAGRAM N

SYSTEM DIAGRAM OF MANUAL INSPECTION STATION—HAND HELD SIGNAL ROCKET EXAMINATION

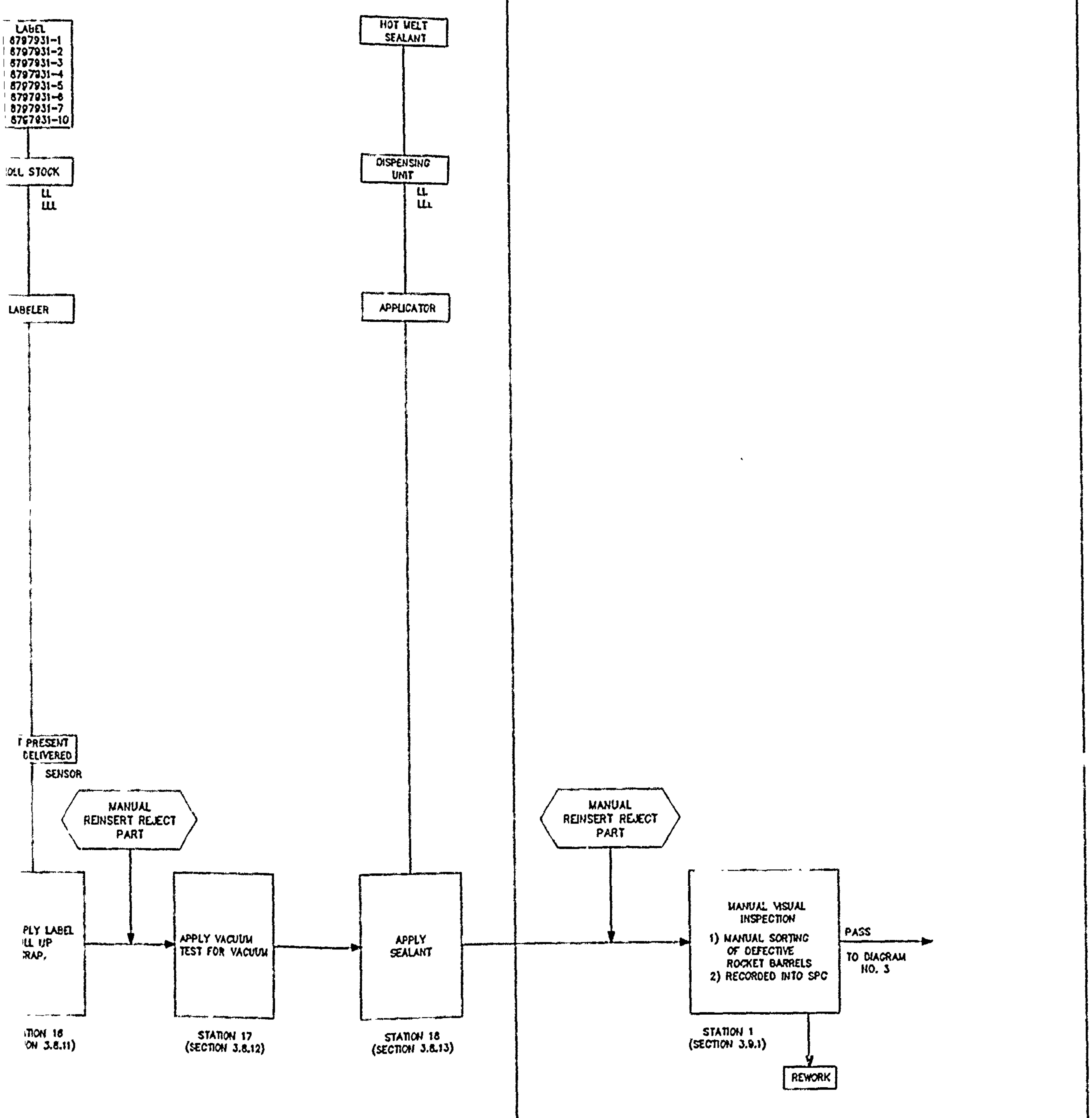


DIAGRAM NO. 2

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FROM DIAGRA
NO. 2

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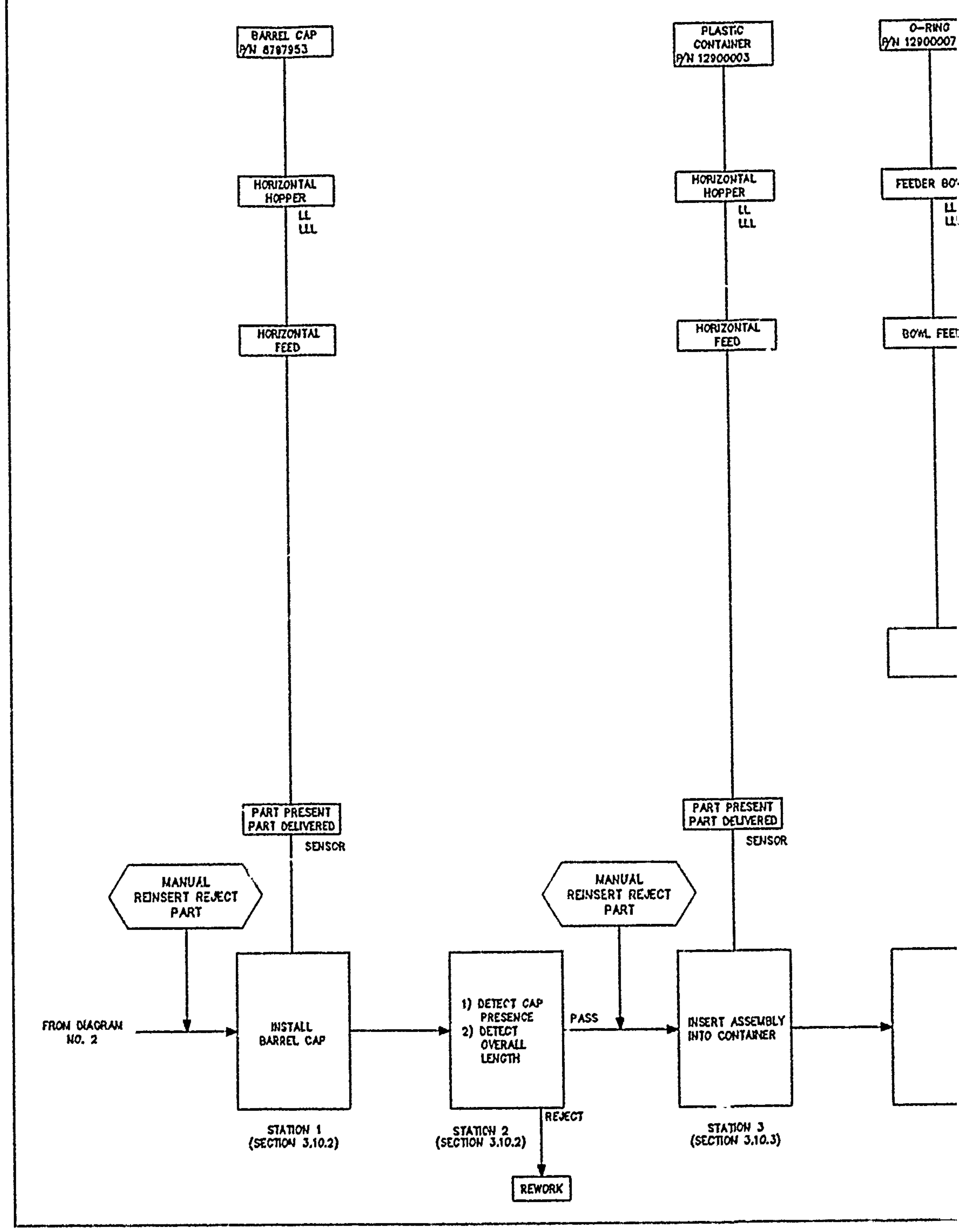
DATE: 12/08/89

SYSTEM DIAGRAM OF HAND HELD SIG



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DATE: 12/08/89

DIAGRAM OF HAND HELD SIGNAL CONTAINERIZATION MACHINE

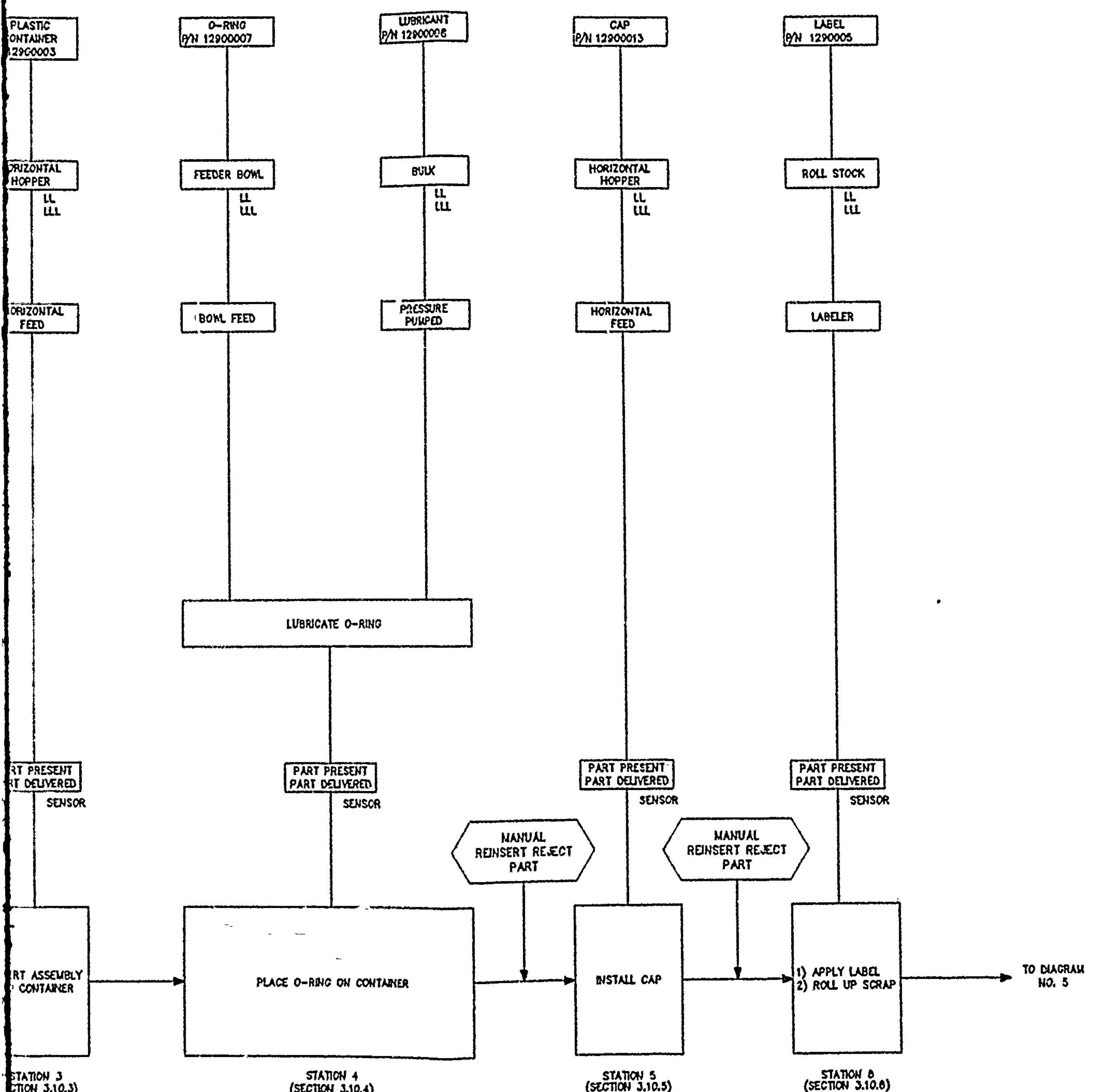

DIAGRAM NO. 3

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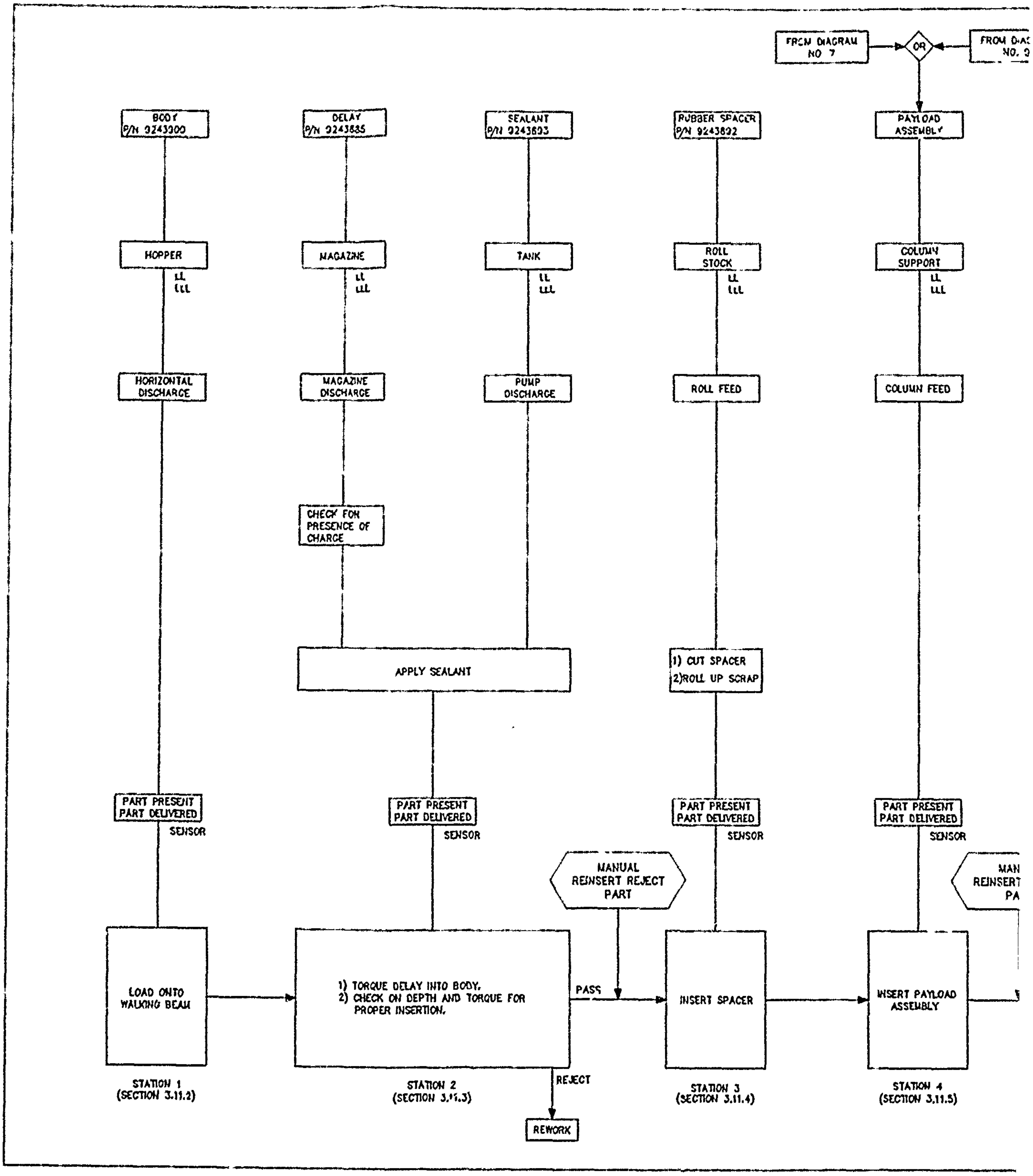
DATE: 12/08/89



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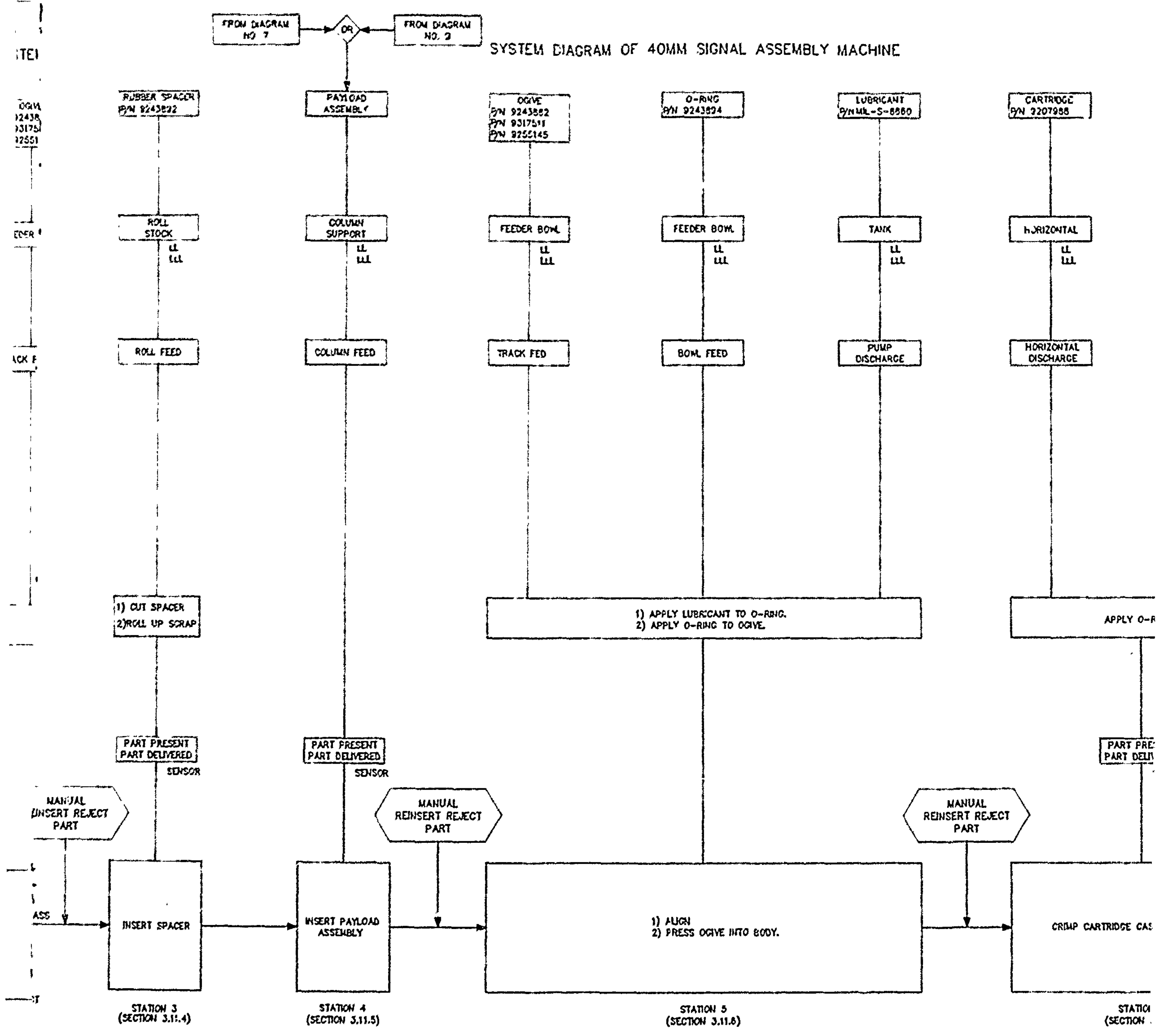
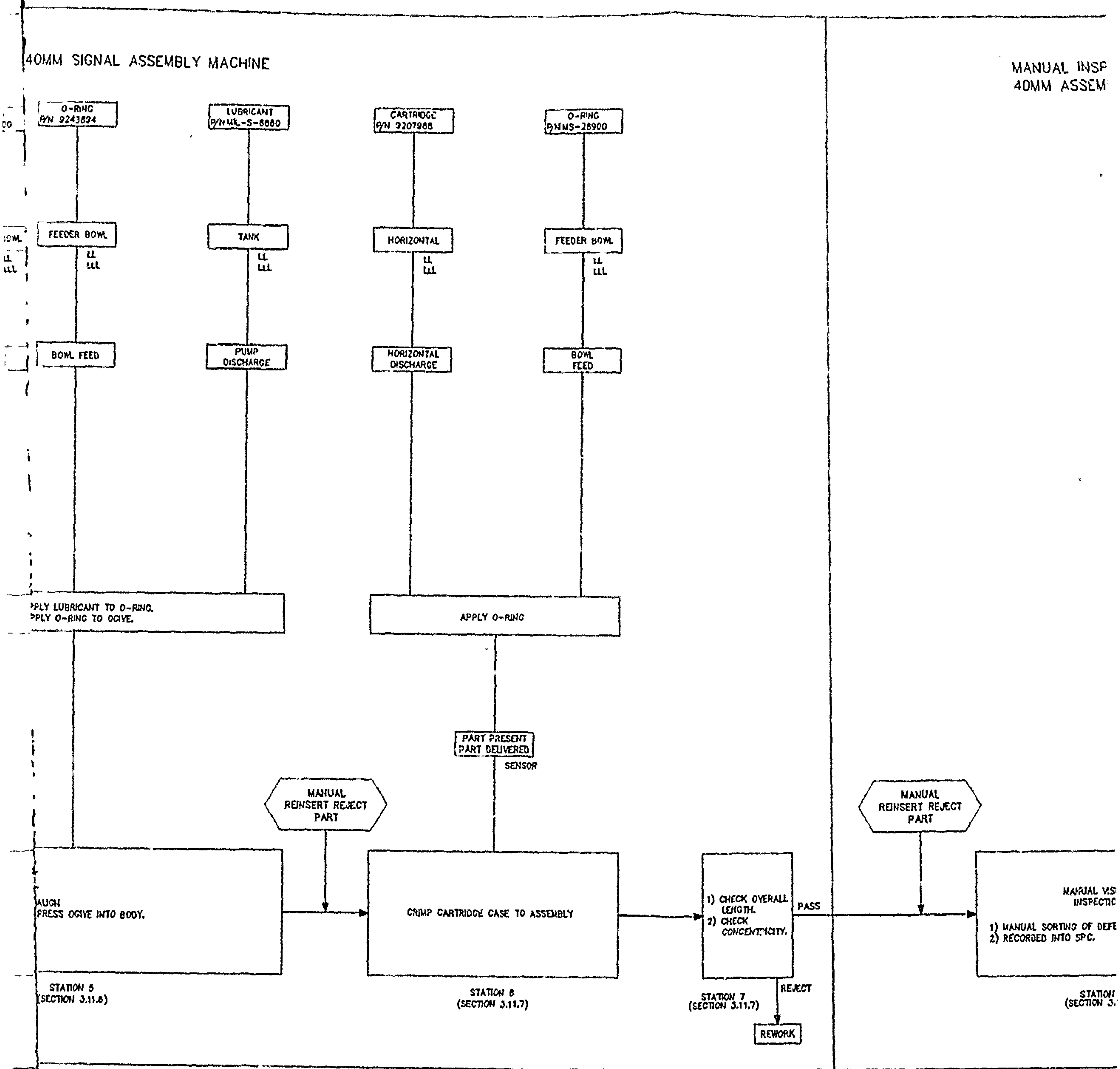
SYSTEM DIAGRAM OF 40MM SIGNAL ASSEMBLY MACHINE





40MM SIGNAL ASSEMBLY MACHINE
MANUAL INSP
40MM ASSEM
O-RING P/N 9243694
LUBRICANT P/N MIL-S-8660
CARTRIDGE P/N 9207968
O-RING P/N MS-28900
FEEDER BOWL
TANK
HORIZONTAL
FEEDER BOWL
BOWL FEED
PUMP DISCHARGE
HORIZONTAL DISCHARGE
BOWL FEED
PPLY LUBRICANT TO O-RING.
PPLY O-RING TO OGIVE.
APPLY O-RING
PART PRESENT
PART DELIVERED
SENSOR
MANUAL REINSERT REJECT PART
MANUAL REINSERT REJECT PART
ALIGN
PRESS OGIVE INTO BODY.
CRIMP CARTRIDGE CASE TO ASSEMBLY
1) CHECK OVERALL LENGTH.
2) CHECK CONCENTRICITY.
PASS
REJECT
REWORK
MANUAL VIS
INSPECTIO
1) MANUAL SORTING OF DEFE
2) RECORDED INTO SPC.
STATION 5 (SECTION 3.11.6)
STATION 6 (SECTION 3.11.7)
STATION 7 (SECTION 3.11.7)
STATION (SECTION 3.

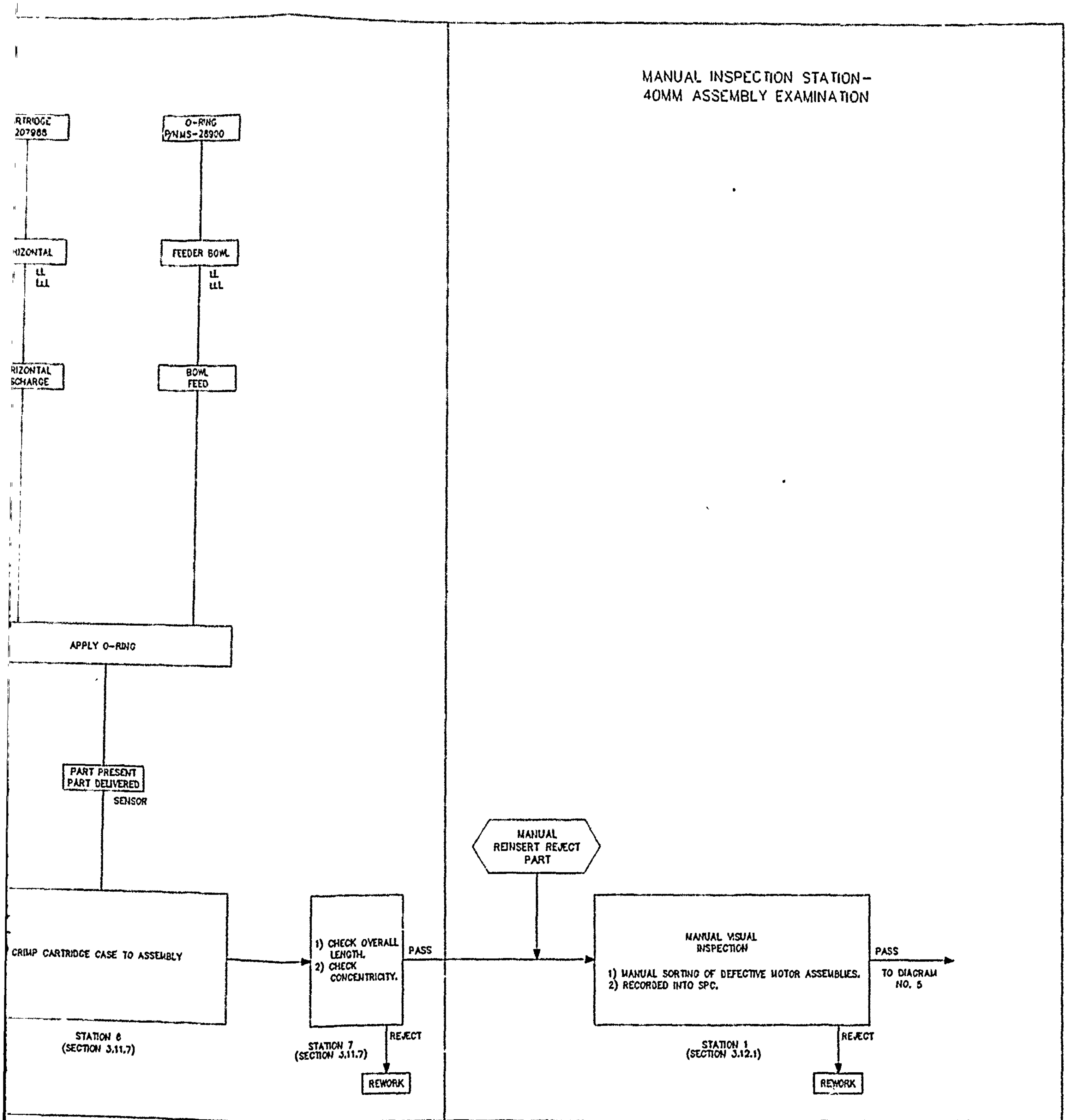

MANUAL INSPECTION STATION-
40MM ASSEMBLY EXAMINATION
RTRIDGE
207988
O-RING
P/N MS-28900
RIZONTAL
FEEDER BOWL
RIZONTAL
SCHARGE
BOWL
FEED
APPLY O-RING
PART PRESENT
PART DELIVERED
SENSOR
MANUAL
REINSERT REJECT
PART
CRIMP CARTRIDGE CASE TO ASSEMBLY
STATION 6
(SECTION 3.11.7)
1) CHECK OVERALL LENGTH.
2) CHECK CONCENTRICITY.
PASS
REJECT
STATION 7
(SECTION 3.11.7)
REWORK
MANUAL VISUAL
INSPECTION
1) MANUAL SORTING OF DEFECTIVE MOTOR ASSEMBLIES.
2) RECORDED INTO SPC.
PASS
TO DIAGRAM
NO. 5
REJECT
STATION 1
(SECTION 3.12.1)
REWORK

DIAGRAM NO. 4

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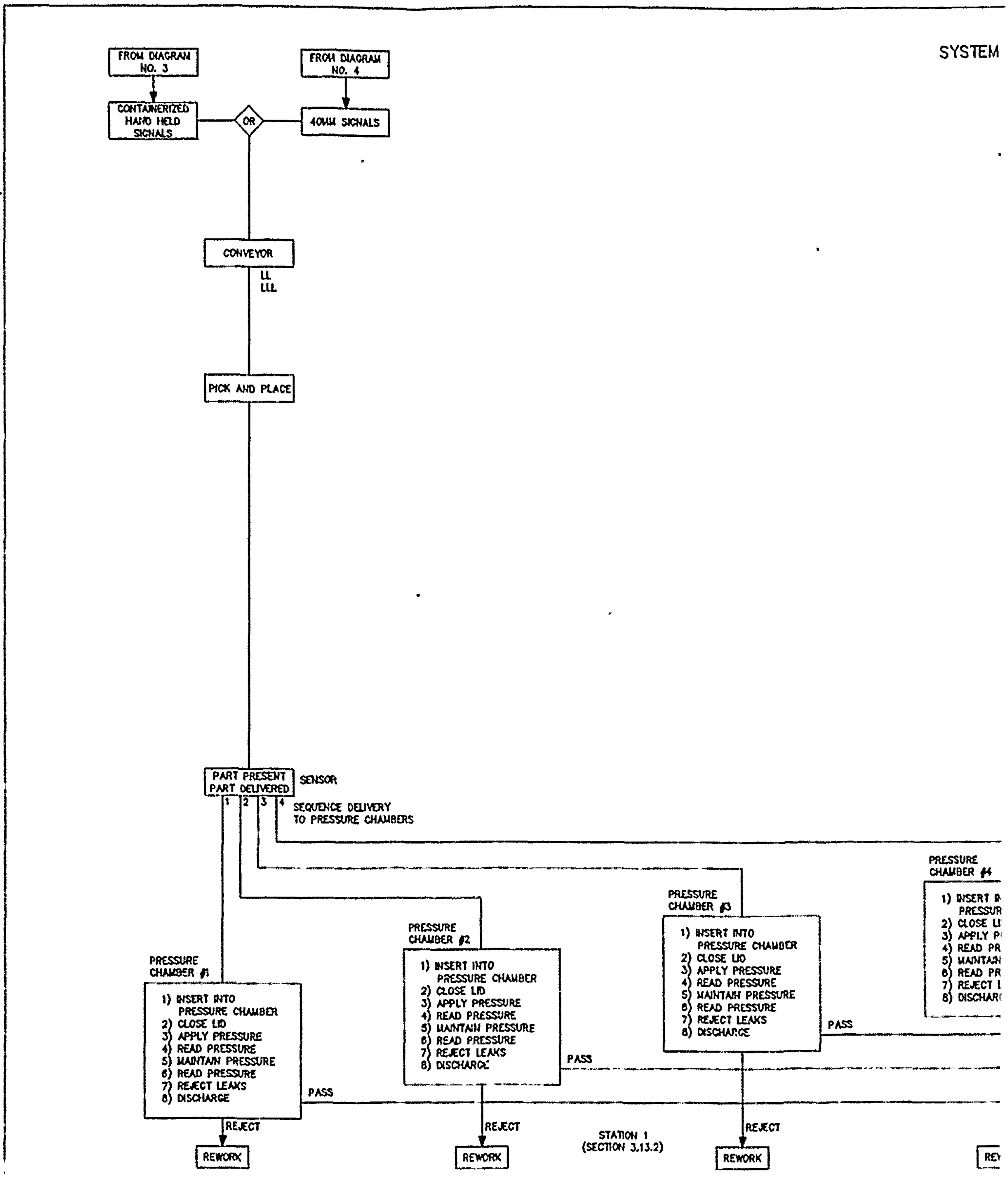
DATE: 12/08/89



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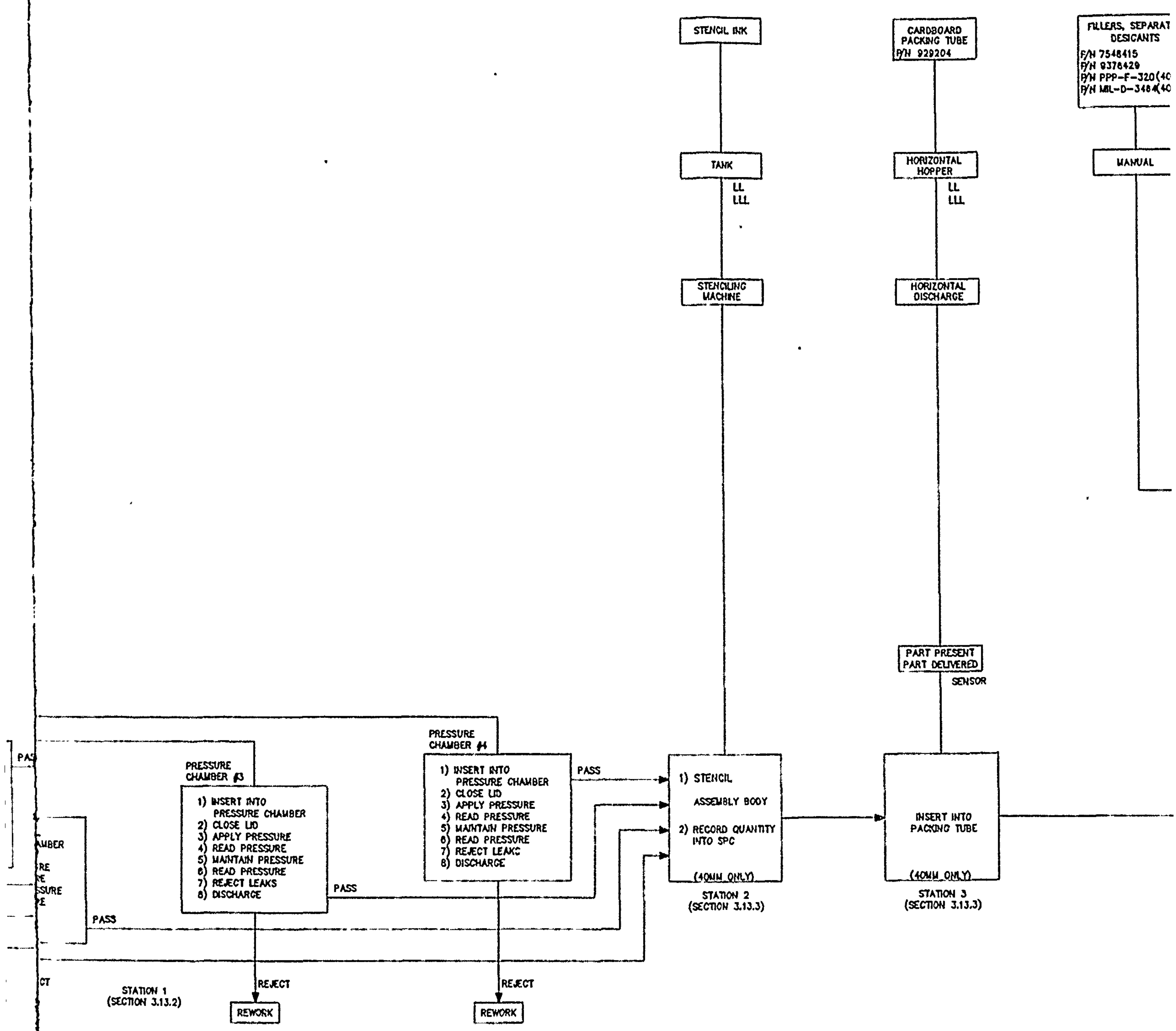
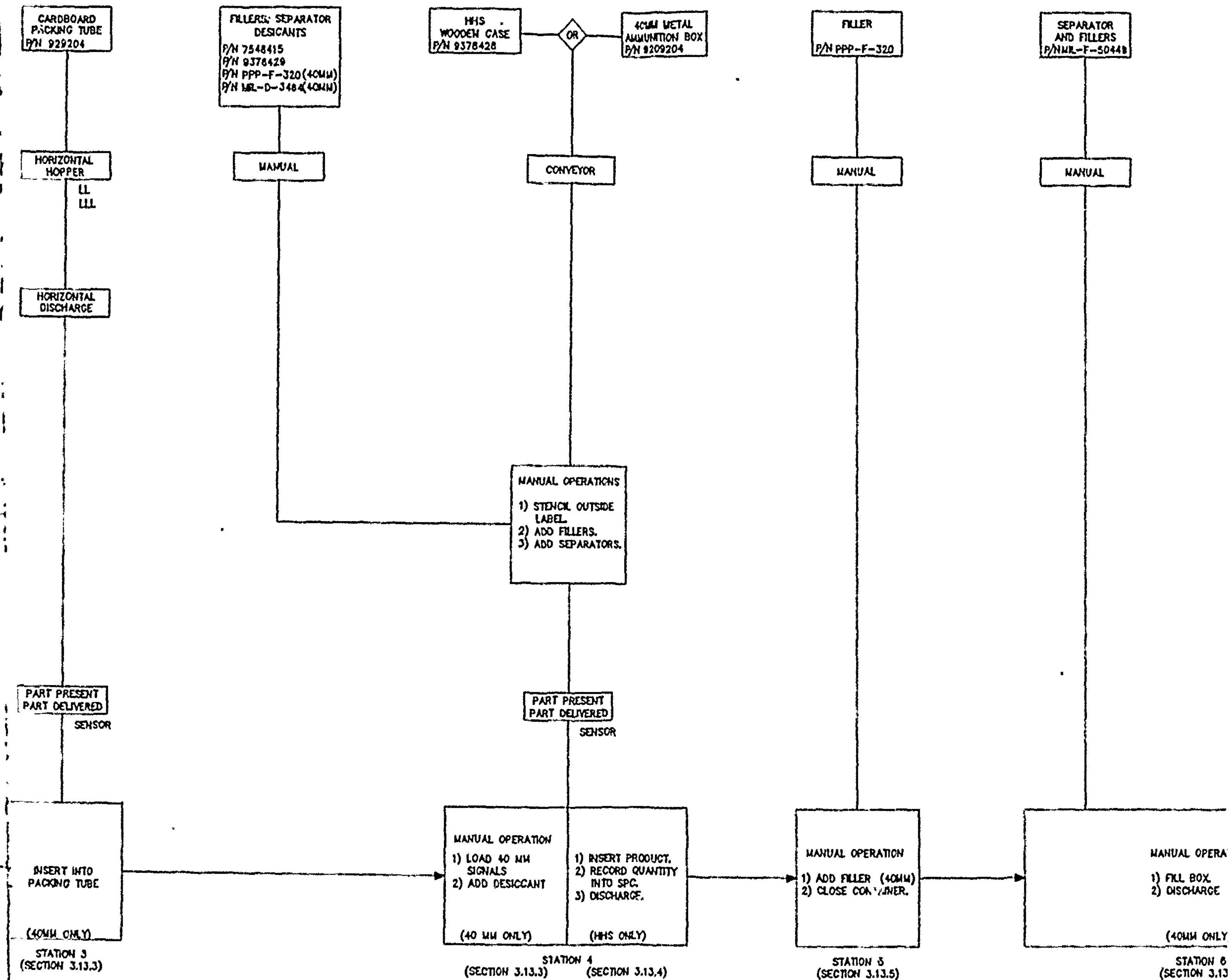
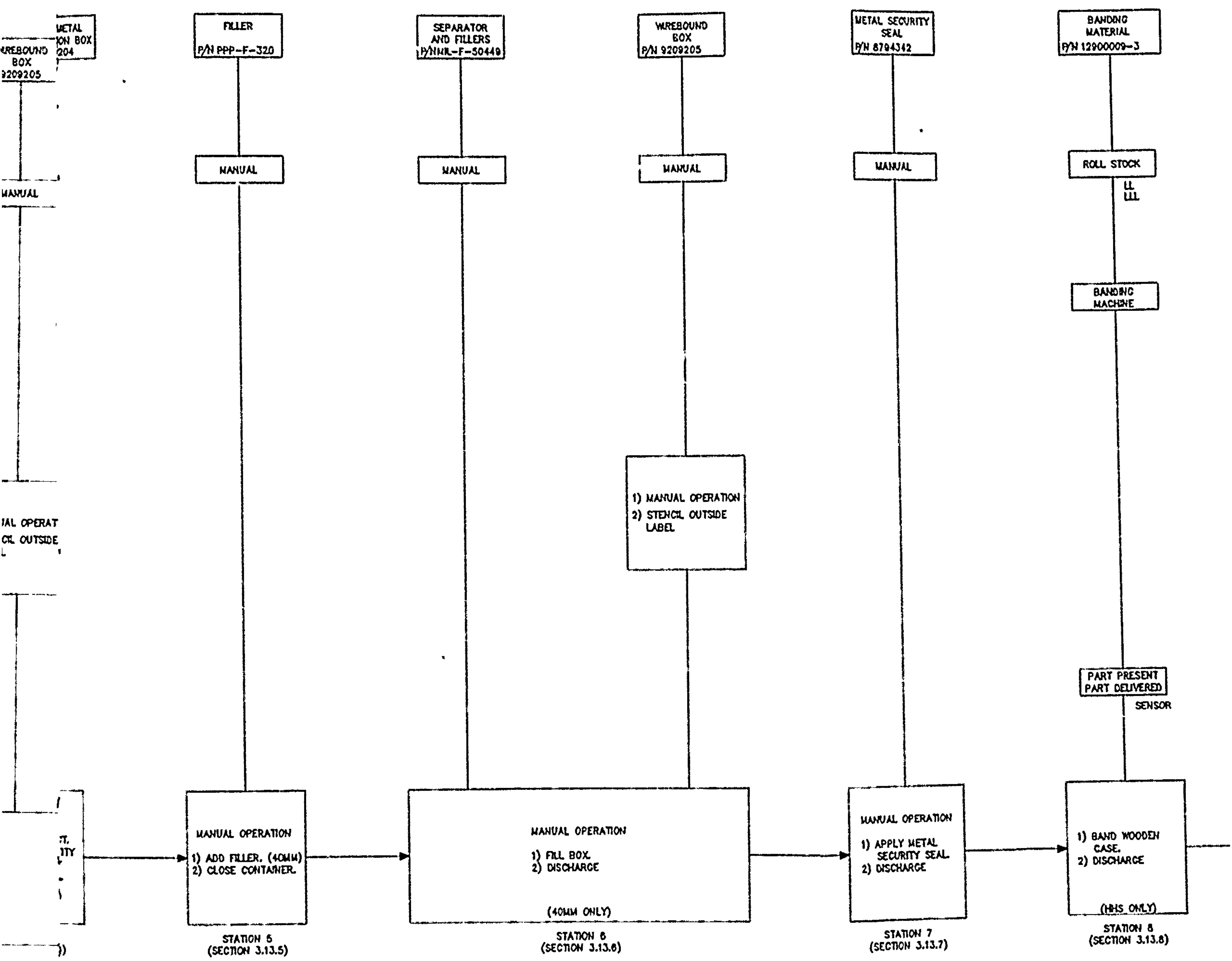
12/08/89

SYSTEM DIAGRAM OF LEAK TESTING AND PACKOUT MACHINE



INE


CARDBOARD PACKING TUBE P/N 929204
FILLERS SEPARATOR DESICANTS
P/N 7548415
P/N 9378429
P/N PPP-F-320 (40MM)
P/N MIL-D-3464 (40MM)
HHS WOODEN CASE P/N 9378428
OR
40MM METAL AMMUNITION BOX P/N 9209204
FILLER P/N PPP-F-320
SEPARATOR AND FILLERS P/N MIL-F-50448
HORIZONTAL HOPPER
LL
LLL
MANUAL
CONVEYOR
MANUAL
MANUAL
HORIZONTAL DISCHARGE
MANUAL OPERATIONS
1) STENCIL OUTSIDE LABEL.
2) ADD FILLERS.
3) ADD SEPARATORS.
PART PRESENT PART DELIVERED
SENSOR
PART PRESENT PART DELIVERED
SENSOR
INSERT INTO PACKING TUBE
(40MM ONLY)
STATION 3 (SECTION 3.13.3)
MANUAL OPERATION
1) LOAD 40 MM SIGNALS
2) ADD DESICCANT
(40 MM ONLY)
1) INSERT PRODUCT.
2) RECORD QUANTITY INTO SPC.
3) DISCHARGE.
(HHS ONLY)
STATION 4
(SECTION 3.13.3)
(SECTION 3.13.4)
MANUAL OPERATION
1) ADD FILLER (40MM)
2) CLOSE CON'/INER.
STATION 5 (SECTION 3.13.5)
MANUAL OPERA
1) FILL BOX.
2) DISCHARGE
(40MM ONLY
STATION 6 (SECTION 3.13



METAL
ON BOX
204
WIREBOUND
BOX
9209205
MANUAL
IAL OPERAT
CIL OUTSIDE
FILLER
P/N PPP-F-320
MANUAL
MANUAL OPERATION
1) ADD FILLER. (40MM)
2) CLOSE CONTAINER.
STATION 5
(SECTION 3.13.5)
SEPARATOR
AND FILLERS
P/N MIL-F-50449
MANUAL
WIREBOUND
BOX
P/N 9209205
MANUAL
1) MANUAL OPERATION
2) STENCIL OUTSIDE
LABEL
MANUAL OPERATION
1) FILL BOX.
2) DISCHARGE
(40MM ONLY)
STATION 6
(SECTION 3.13.6)
METAL SECURITY
SEAL
P/N 8794342
MANUAL
MANUAL OPERATION
1) APPLY METAL
SECURITY SEAL.
2) DISCHARGE
STATION 7
(SECTION 3.13.7)
BANDING
MATERIAL
P/N 12900009-3
ROLL STOCK
BANDING
MACHINE
PART PRESENT
PART DELIVERED
SENSOR
1) BAND WOODEN
CASE.
2) DISCHARGE
(HHS ONLY)
STATION 8
(SECTION 3.13.8)

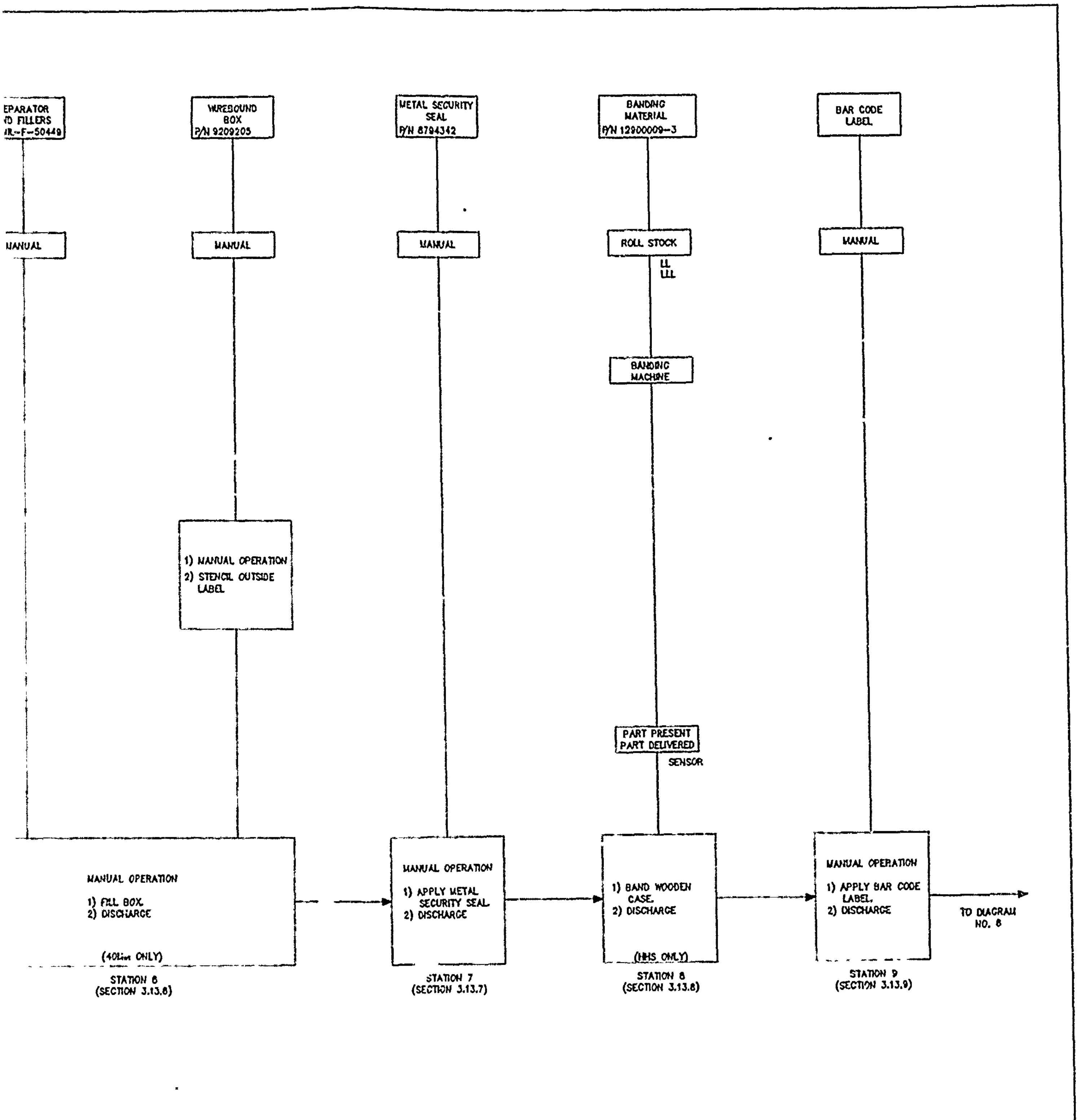

EPARATOR
D FILLERS
IL-F-50449
MANUAL
WIREBOUND
BOX
P/N 9209205
MANUAL
1) MANUAL OPERATION
2) STENCIL OUTSIDE
LABEL
METAL SECURITY
SEAL
P/N 8794342
MANUAL
BANDING
MATERIAL
P/N 12900009-3
ROLL STOCK
BANDING
MACHINE
PART PRESENT
PART DELIVERED
SENSOR
BAR CODE
LABEL
MANUAL
MANUAL OPERATION
1) FILL BOX
2) DISCHARGE
(40Lin ONLY)
STATION 6
(SECTION 3.13.6)
MANUAL OPERATION
1) APPLY METAL
SECURITY SEAL
2) DISCHARGE
STATION 7
(SECTION 3.13.7)
1) BAND WOODEN
CASE
2) DISCHARGE
(HHS ONLY)
STATION 8
(SECTION 3.13.8)
MANUAL OPERATION
1) APPLY BAR CODE
LABEL
2) DISCHARGE
STATION 9
(SECTION 3.13.9)
TO DIAGRAM
NO. 6

DIAGRAM NO. 5

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DATE: 12/08/89

SYSTEM DIAGRAM OF CASE PALLETIZER MACHINE

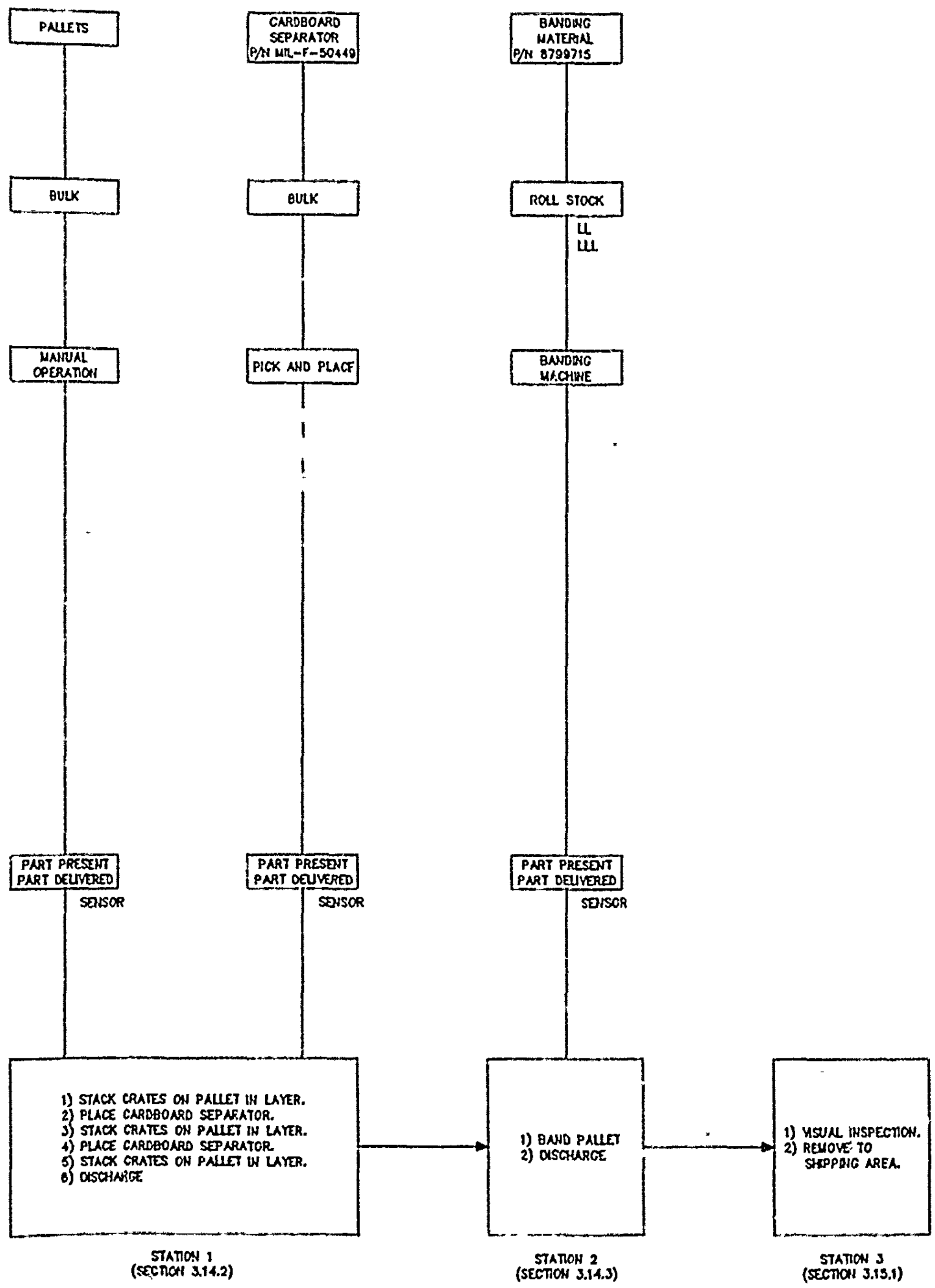

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DIAGRAM NO. 6

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DATE: 12/08/89

SYSTEM DIAGRAM OF PARACHUTE-PAYLOAD SUBASSEMBLY MACHINE

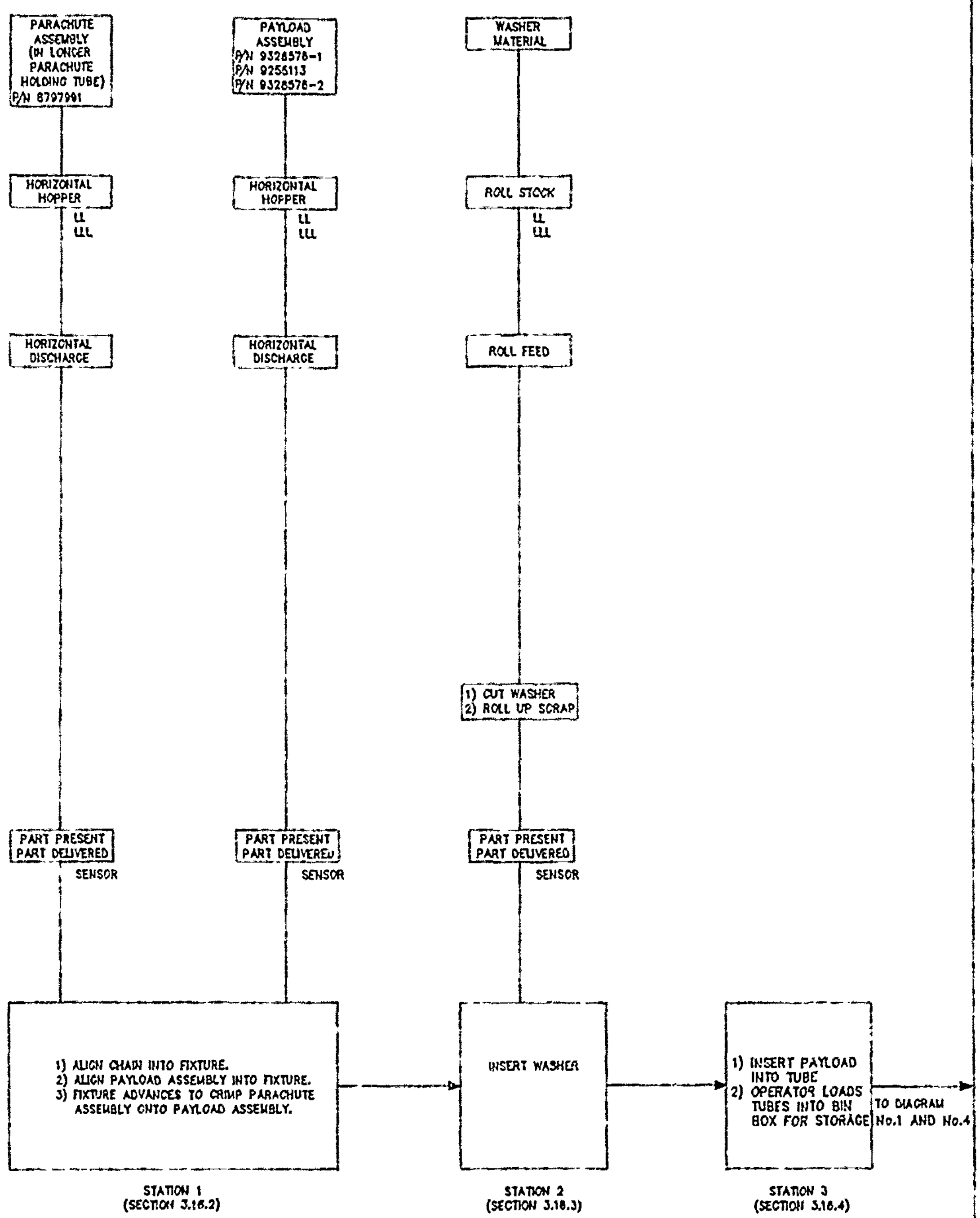

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DIAGRAM NO. 7

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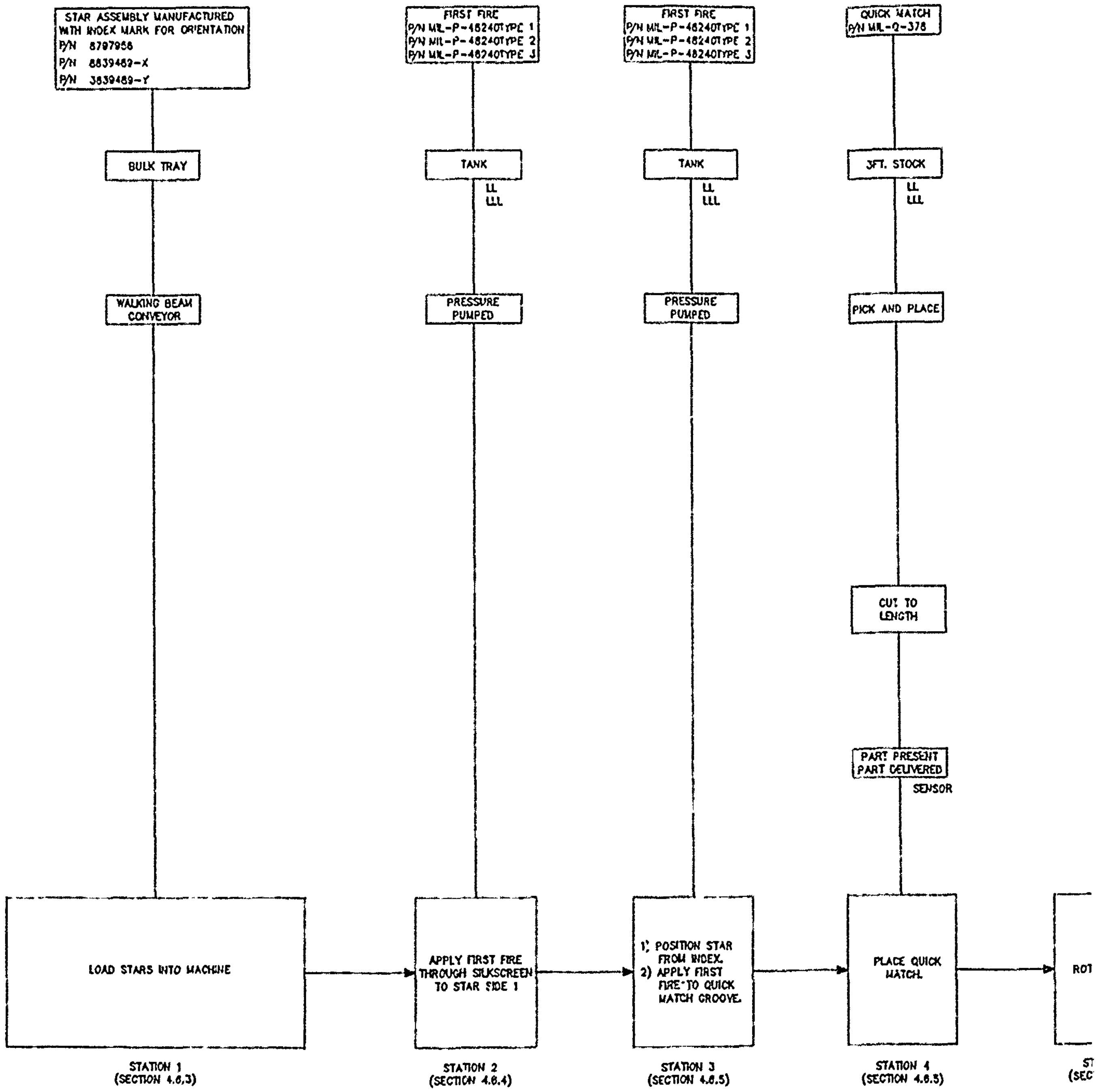
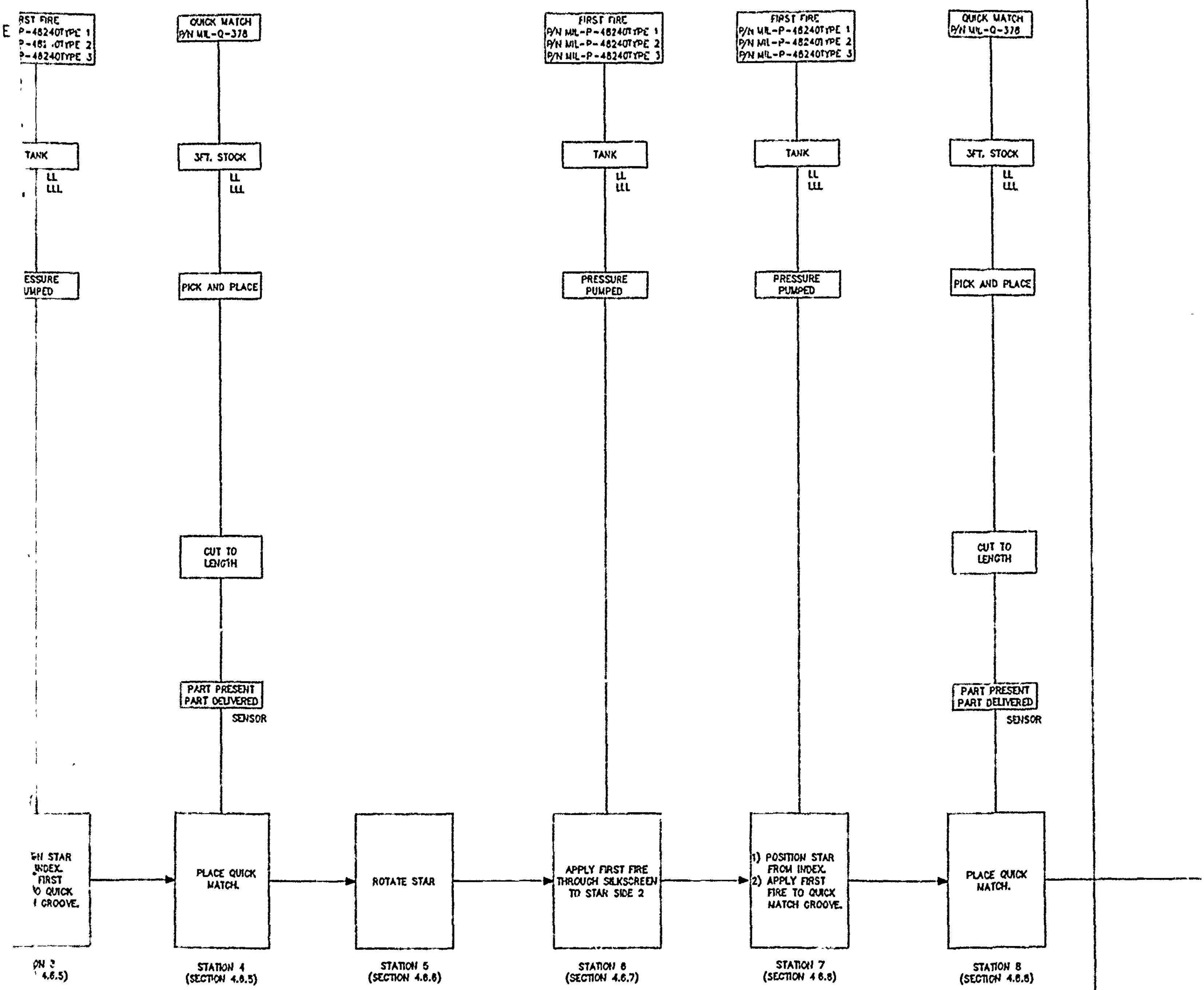
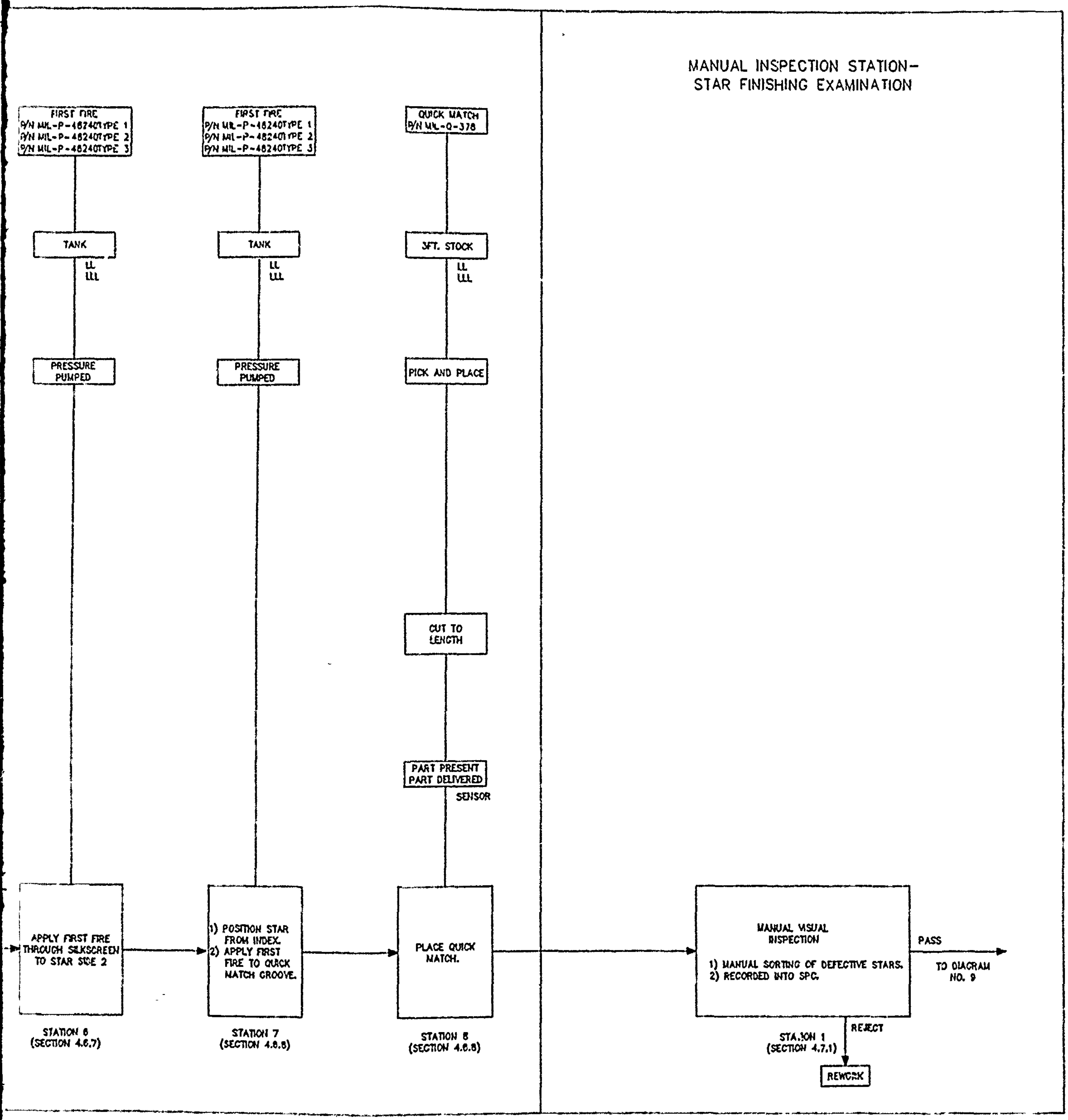
DATE: 12/08/89

SYSTEM DIAGRAM OF STAR FINISH



SYSTEM DIAGRAM OF STAR FINISHING MACHINE





MANUAL INSPECTION STATION–
STAR FINISHING EXAMINATION
FIRST FIRE
P/N MIL-P-46240TYPE 1
P/N MIL-P-46240TYPE 2
P/N MIL-P-46240TYPE 3
FIRST FIRE
P/N MIL-P-46240TYPE 1
P/N MIL-P-46240TYPE 2
P/N MIL-P-46240TYPE 3
QUICK MATCH
P/N MIL-Q-378
TANK
TANK
3FT. STOCK
PRESSURE PUMPED
PRESSURE PUMPED
PICK AND PLACE
CUT TO LENGTH
PART PRESENT
PART DELIVERED
SENSOR
APPLY FIRST FIRE THROUGH SILKSCREEN TO STAR SIDE 2
1) POSITION STAR FROM INDEX.
2) APPLY FIRST FIRE TO QUICK MATCH GROOVE.
PLACE QUICK MATCH.
MANUAL VISUAL INSPECTION
1) MANUAL SORTING OF DEFECTIVE STARS.
2) RECORDED INTO SPC.
PASS
TO DIAGRAM NO. 9
REJECT
REWORK
STATION 6
(SECTION 4.6.7)
STATION 7
(SECTION 4.6.8)
STATION 8
(SECTION 4.6.8)
STATION 1
(SECTION 4.7.1)

DIAGRAM NO. 8

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DATE: 12/08/89

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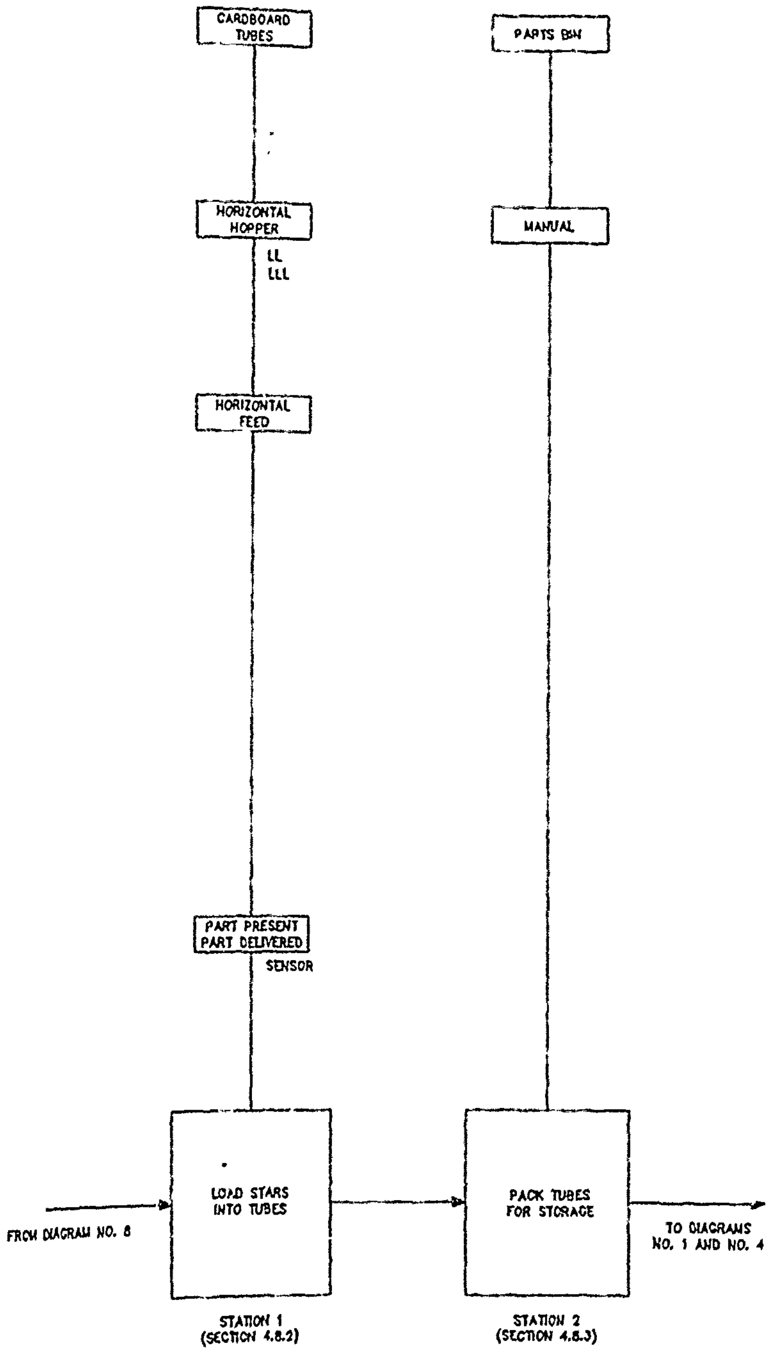
SYSTEM DIAGRAM OF STAR LOADING MACHINE



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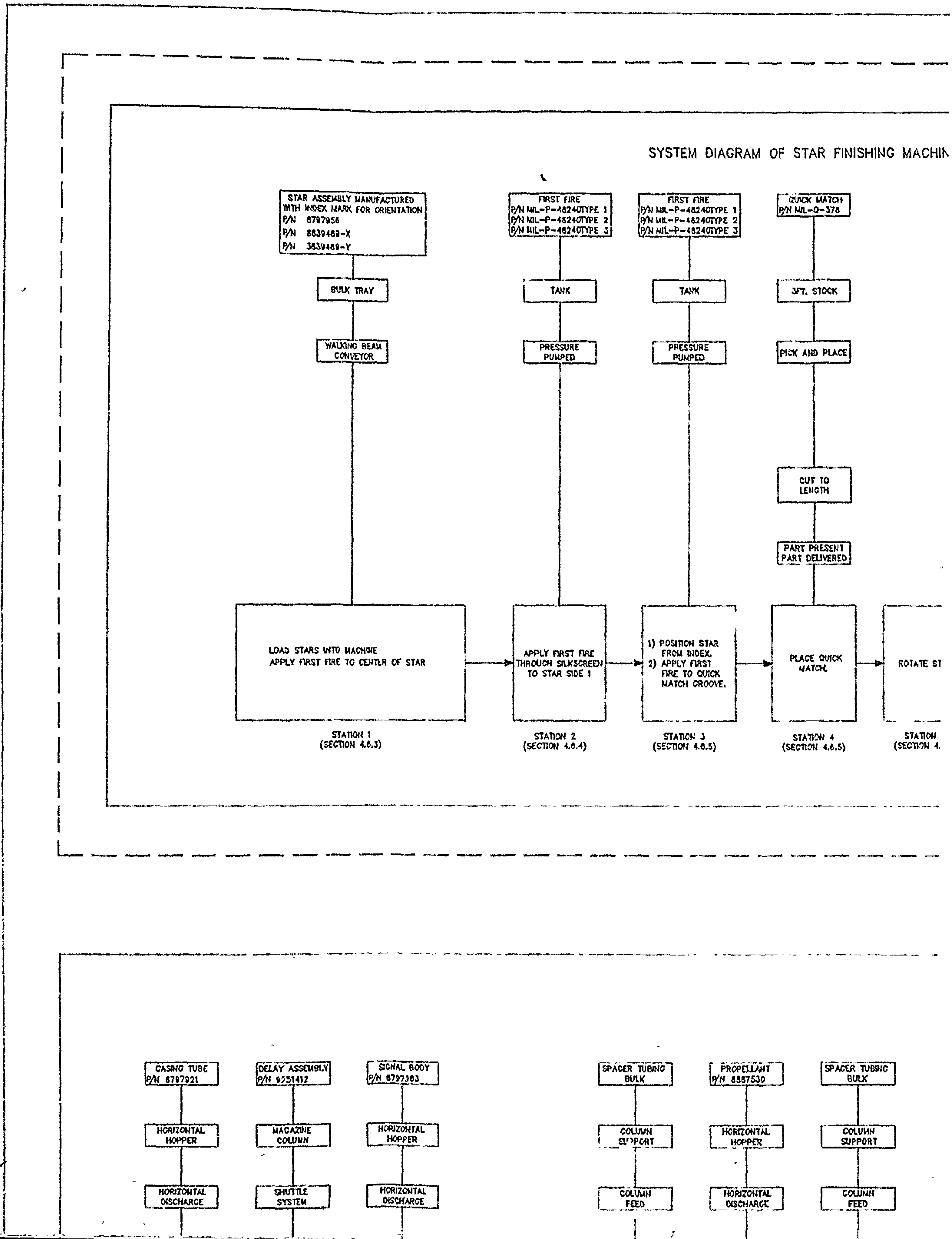
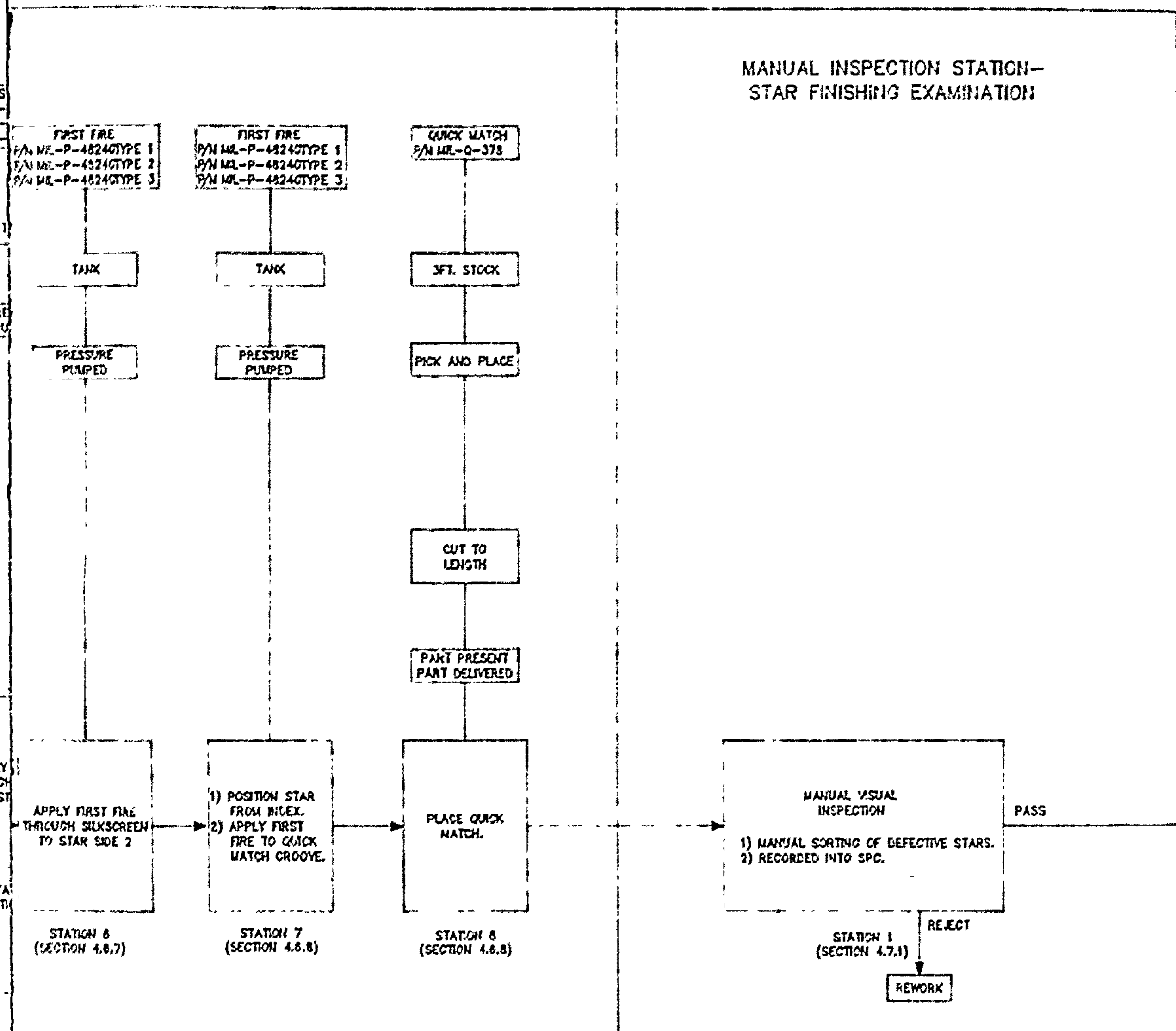
12/08/89

DIAGRAM NO. 9

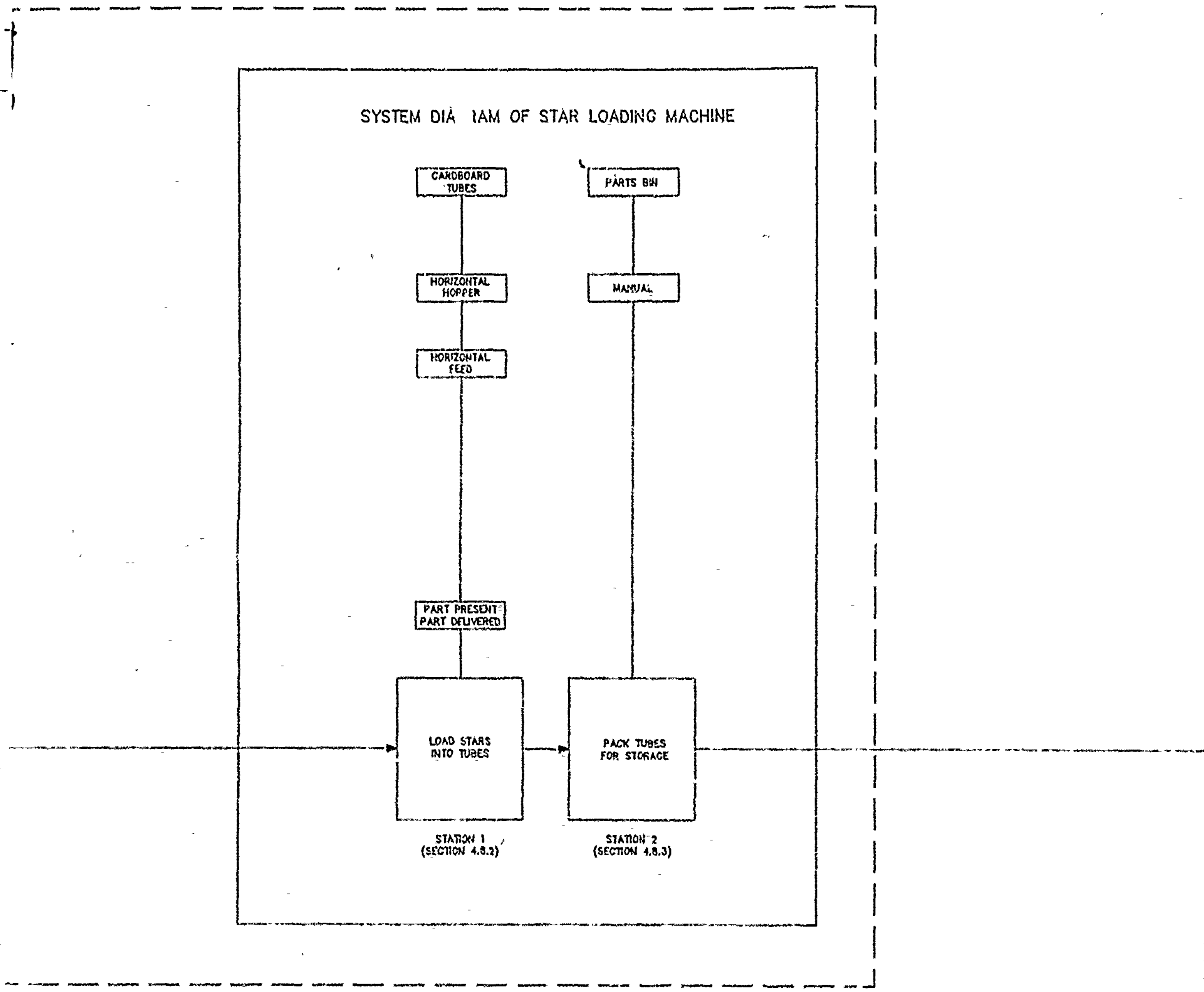


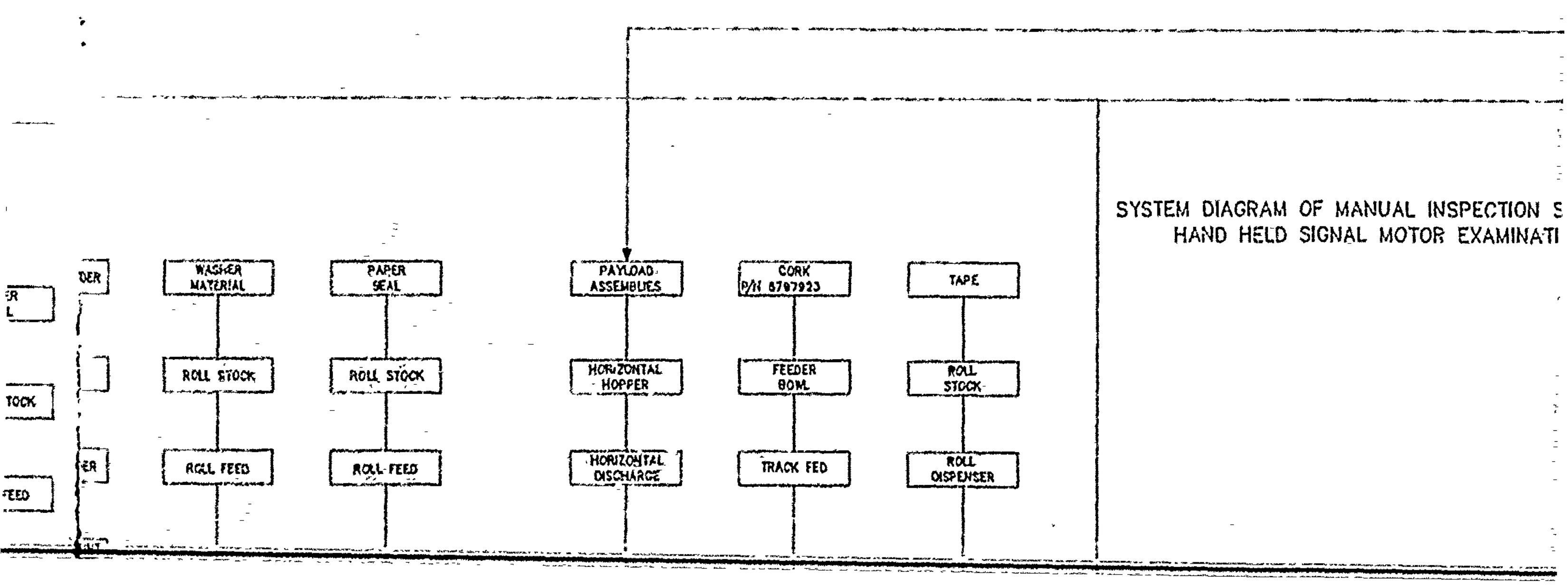
SYSTEM DIAGRAM OF STAR FINISHING MACHIN
STAR ASSEMBLY MANUFACTURED WITH INDEX MARK FOR ORIENTATION P/N 8797956 P/N 8839489-X P/N 3839489-Y
BULK TRAY
WALKING BEAM CONVEYOR
FIRST FIRE P/N MIL-P-46240TYPE 1 P/N MIL-P-46240TYPE 2 P/N MIL-P-46240TYPE 3
TANK
PRESSURE PUMPED
FIRST FIRE P/N MIL-P-46240TYPE 1 P/N MIL-P-46240TYPE 2 P/N MIL-P-46240TYPE 3
TANK
PRESSURE PUMPED
QUICK MATCH P/N MIL-Q-378
3FT. STOCK
PICK AND PLACE
CUT TO LENGTH
PART PRESENT PART DELIVERED
LOAD STARS INTO MACHINE APPLY FIRST FIRE TO CENTER OF STAR
APPLY FIRST FIRE THROUGH SILKSCREEN TO STAR SIDE 1
1) POSITION STAR FROM INDEX. 2) APPLY FIRST FIRE TO QUICK MATCH GROOVE.
PLACE QUICK MATCH.
ROTATE ST
STATION 1 (SECTION 4.6.3)
STATION 2 (SECTION 4.6.4)
STATION 3 (SECTION 4.6.5)
STATION 4 (SECTION 4.6.5)
STATION (SECTION 4.
CASING TUBE P/N 8797921
HORIZONTAL HOPPER
HORIZONTAL DISCHARGE
DELAY ASSEMBLY P/N 9351412
MAGAZINE COLUMN
SHUTTLE SYSTEM
SIGNAL BODY P/N 8797383
HORIZONTAL HOPPER
HORIZONTAL DISCHARGE
SPACER TUBING BULK
COLUMN SUPPORT
COLUMN FEED
PROPELLANT P/N 8887530
HORIZONTAL HOPPER
HORIZONTAL DISCHARGE
SPACER TUBING BULK
COLUMN SUPPORT
COLUMN FEED



BUILDING 34Y, STAR FINISHING AND LOADING

SYSTEM DIAGRAM OF HAND HELD SIGNAL MOTOR ASSEMBLY MACHINE


SYSTEM DIA IAM OF STAR LOADING MACHINE
CARDBOARD TUBES
HORIZONTAL HOPPER
HORIZONTAL FEED
PART PRESENT PART DELIVERED
PARTS BIN
MANUAL
LOAD STARS INTO TUBES
PACK TUBES FOR STORAGE
STATION 1 (SECTION 4.8.2)
STATION 2 (SECTION 4.8.3)


SYSTEM DIAGRAM OF MANUAL INSPECTION S
HAND HELD SIGNAL MOTOR EXAMINATI
WASHER MATERIAL
PAPER SEAL
PAYLOAD ASSEMBLIES
CORK P/N 8797923
TAPE
ROLL STOCK
ROLL STOCK
HORIZONTAL HOPPER
FEEDER BOWL
ROLL STOCK
ROLL FEED
ROLL FEED
HORIZONTAL DISCHARGE
TRACK FED
ROLL DISPENSER

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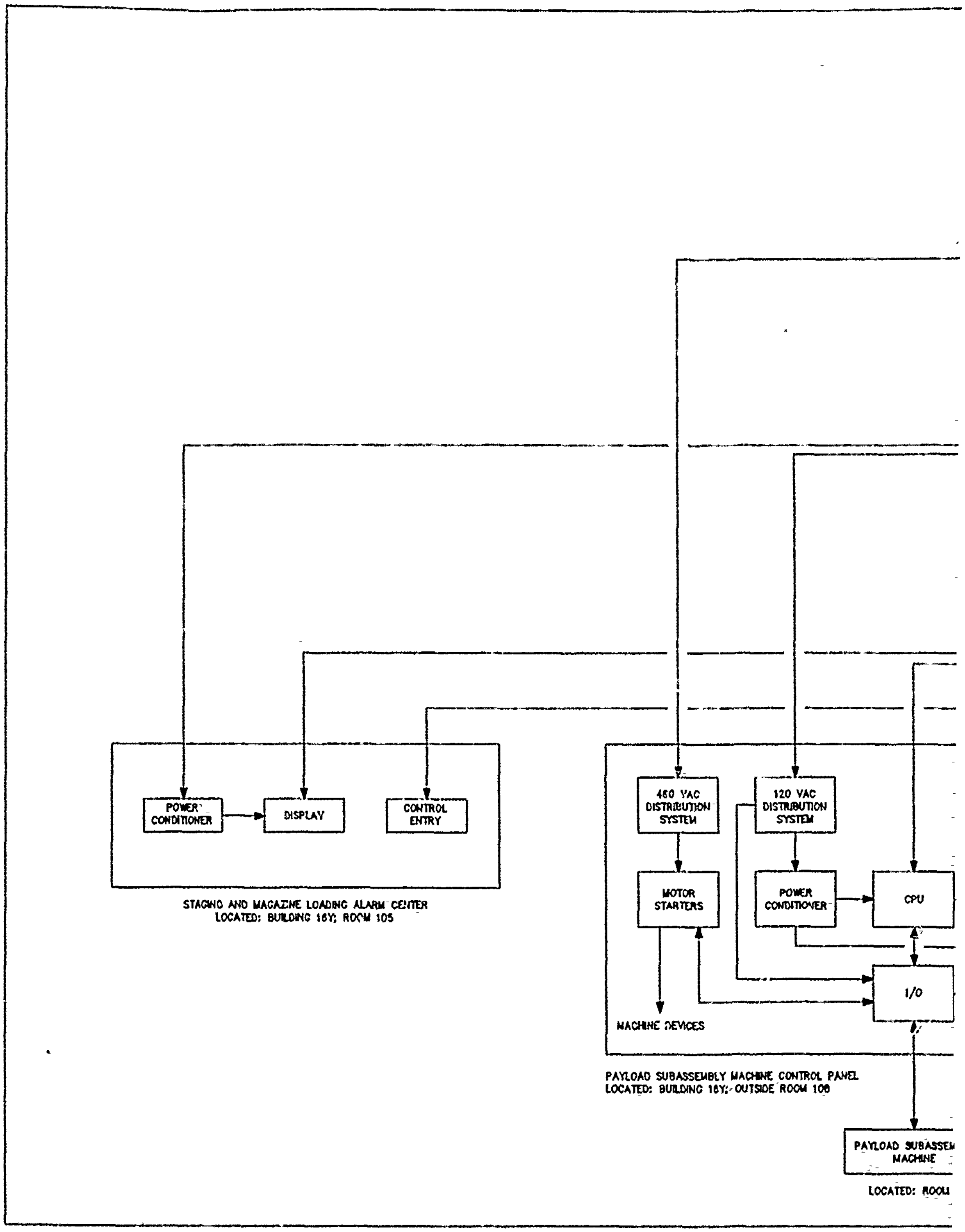
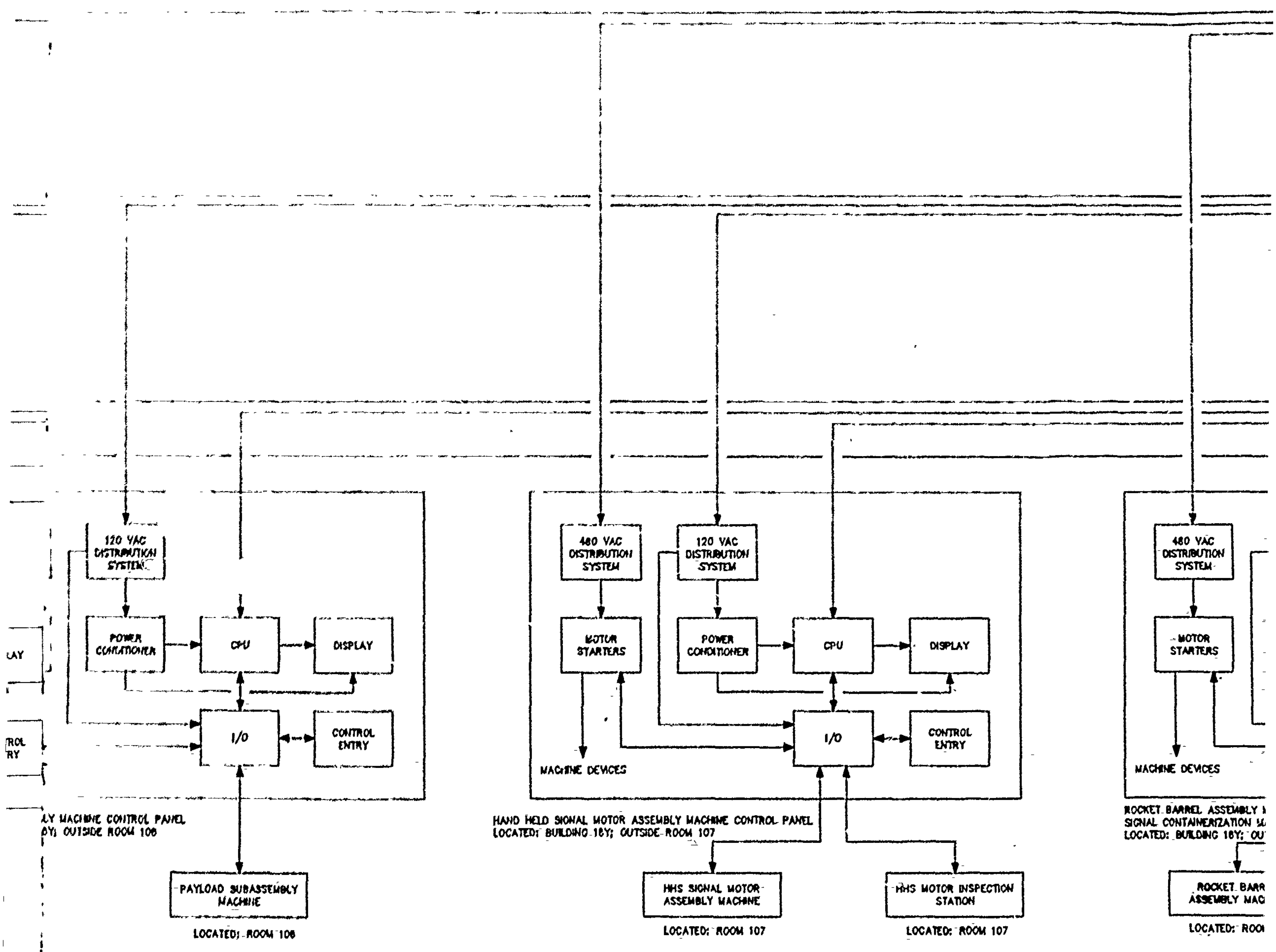
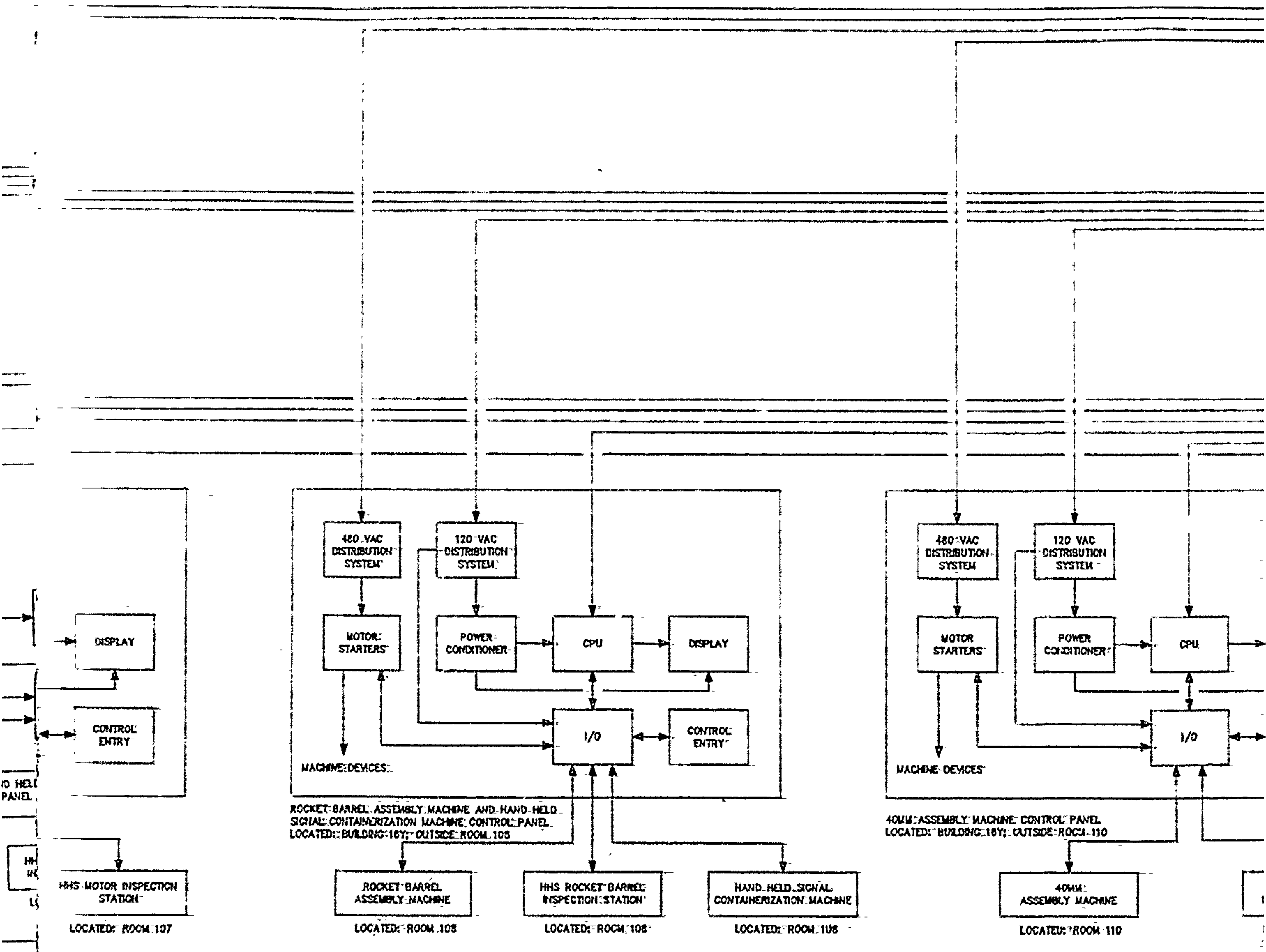
DATE: 12/06/89



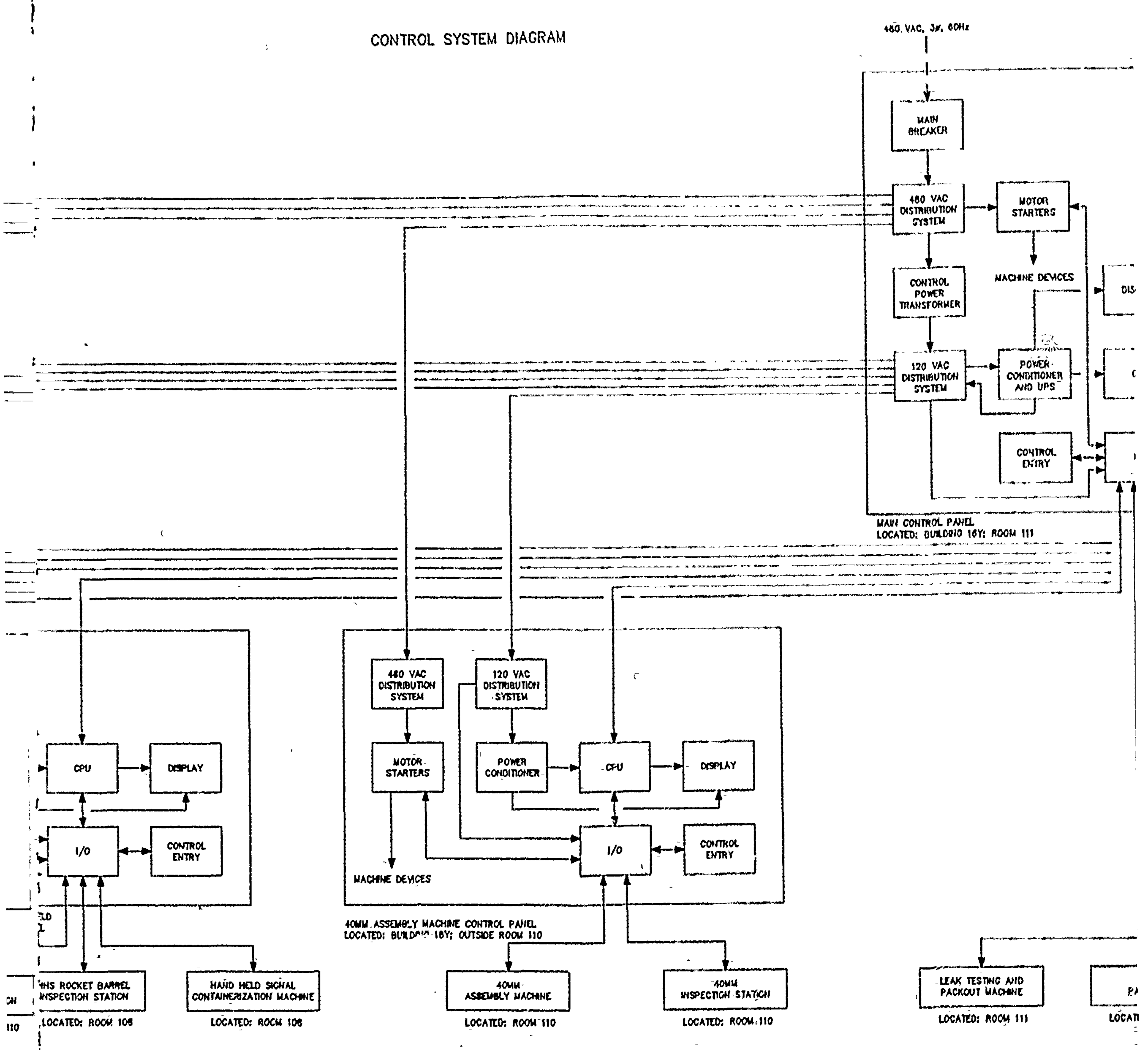
DWG FILE: C:\ACAD9\LONGHORN\DIA11
12/08/89

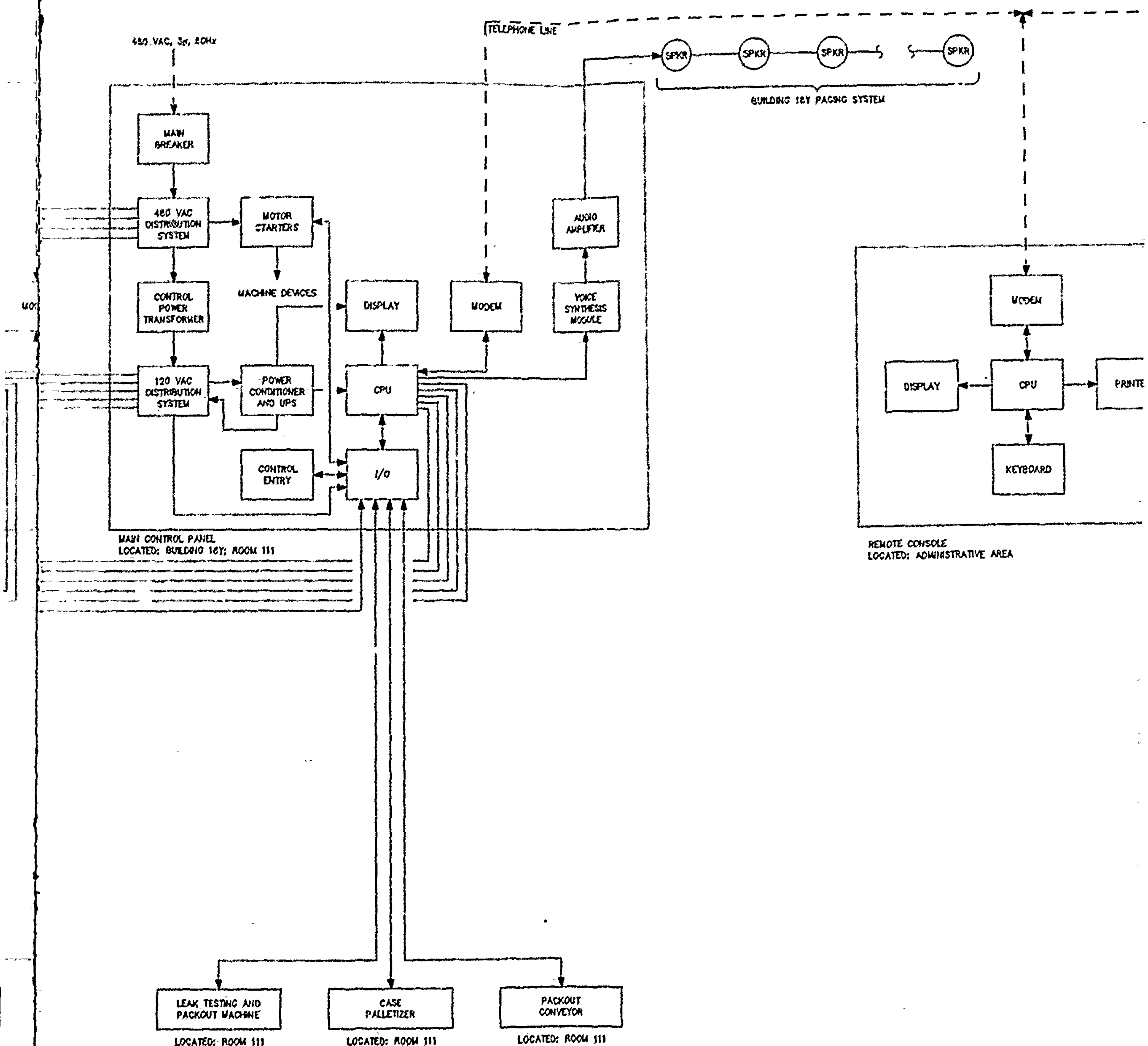

120 VAC DISTRIBUTION SYSTEM
POWER CONDITIONER
CPU
DISPLAY
I/O
CONTROL ENTRY
PAYLOAD SUBASSEMBLY MACHINE
LOCATED: ROOM 106
480 VAC DISTRIBUTION SYSTEM
120 VAC DISTRIBUTION SYSTEM
MOTOR STARTERS
POWER CONDITIONER
CPU
DISPLAY
I/O
CONTROL ENTRY
MACHINE DEVICES
HAND HELD SIGNAL MOTOR ASSEMBLY MACHINE CONTROL PANEL
LOCATED: BUILDING 18Y; OUTSIDE ROOM 107
HHS SIGNAL MOTOR ASSEMBLY MACHINE
LOCATED: ROOM 107
HHS MOTOR INSPECTION STATION
LOCATED: ROOM 107
480 VAC DISTRIBUTION SYSTEM
MOTOR STARTERS
MACHINE DEVICES

CONTROL SYSTEM DIAGRAM

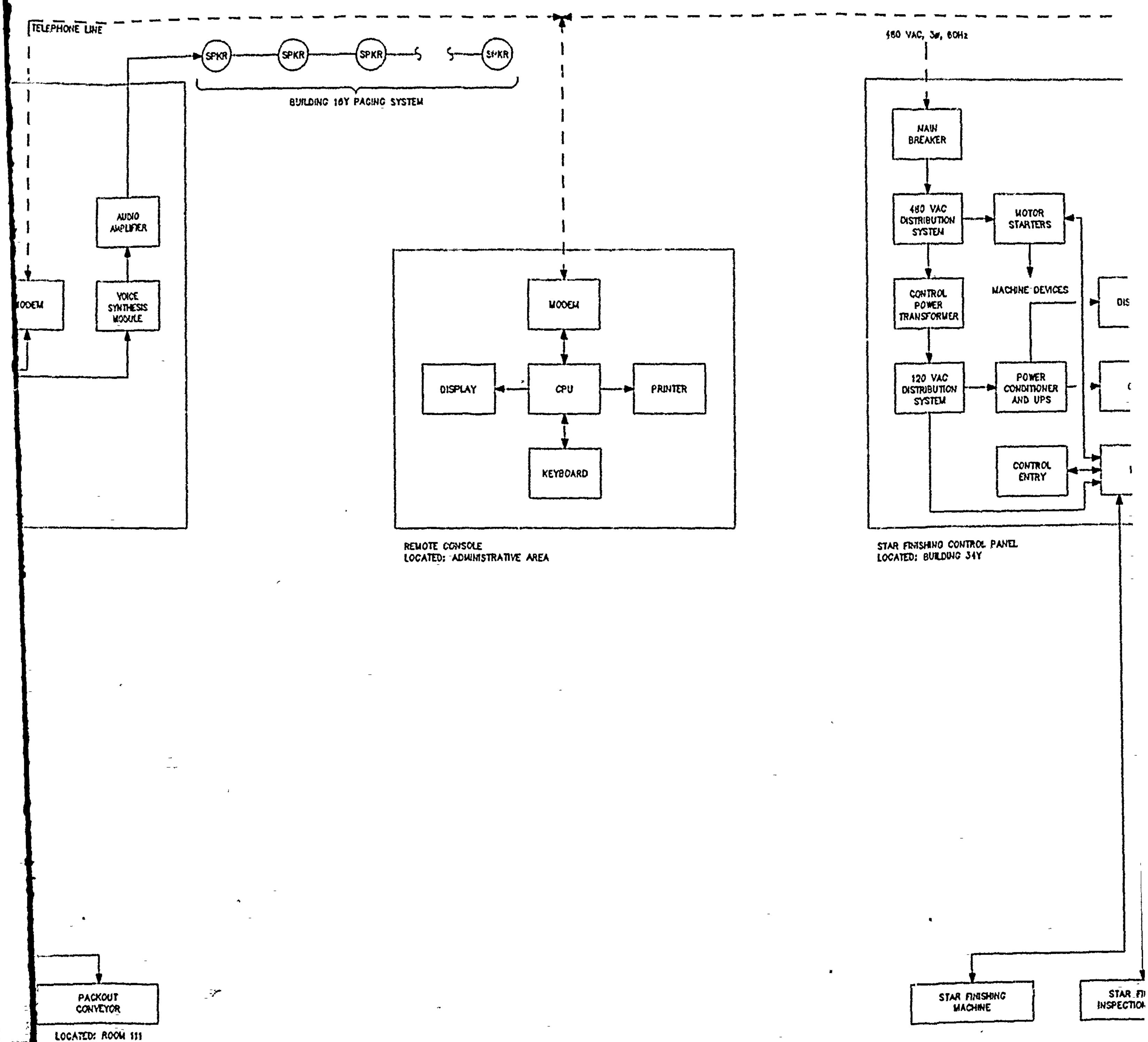


CONTROL SYSTEM DIAGRAM





480 VAC, 3φ, 60Hz
TELEPHONE LINE
SPKR
SPKR
SPKR
SPKR
BUILDING 16Y PAGING SYSTEM
MAIN BREAKER
480 VAC DISTRIBUTION SYSTEM
MOTOR STARTERS
MACHINE DEVICES
AUDIO AMPLIFIER
CONTROL POWER TRANSFORMER
DISPLAY
MODEM
VOICE SYNTHESIS MODULE
120 VAC DISTRIBUTION SYSTEM
POWER CONDITIONER AND UPS
CPU
CONTROL ENTRY
I/O
MAIN CONTROL PANEL
LOCATED: BUILDING 16Y; ROOM 111
MODEM
DISPLAY
CPU
PRINTE
KEYBOARD
REMOTE CONSOLE
LOCATED: ADMINISTRATIVE AREA
LEAK TESTING AND PACKOUT MACHINE
LOCATED: ROOM 111
CASE PALLETIZER
LOCATED: ROOM 111
PACKOUT CONVEYOR
LOCATED: ROOM 111



TELEPHONE LINE
SPKR
SPKR
SPKR
SPKR
BUILDING 16Y PAGING SYSTEM
AUDIO AMPLIFIER
VOICE SYNTHESIS MODULE
MODEM
DISPLAY
CPU
PRINTER
KEYBOARD
REMOTE CONSOLE
LOCATED: ADMINISTRATIVE AREA
480 VAC, 3ø, 60Hz
MAIN BREAKER
480 VAC DISTRIBUTION SYSTEM
MOTOR STARTERS
MACHINE DEVICES
CONTROL POWER TRANSFORMER
120 VAC DISTRIBUTION SYSTEM
POWER CONDITIONER AND UPS
CONTROL ENTRY
STAR FINISHING CONTROL PANEL
LOCATED: BUILDING 34Y
PACKOUT CONVEYOR
LOCATED: ROOM 111
STAR FINISHING MACHINE

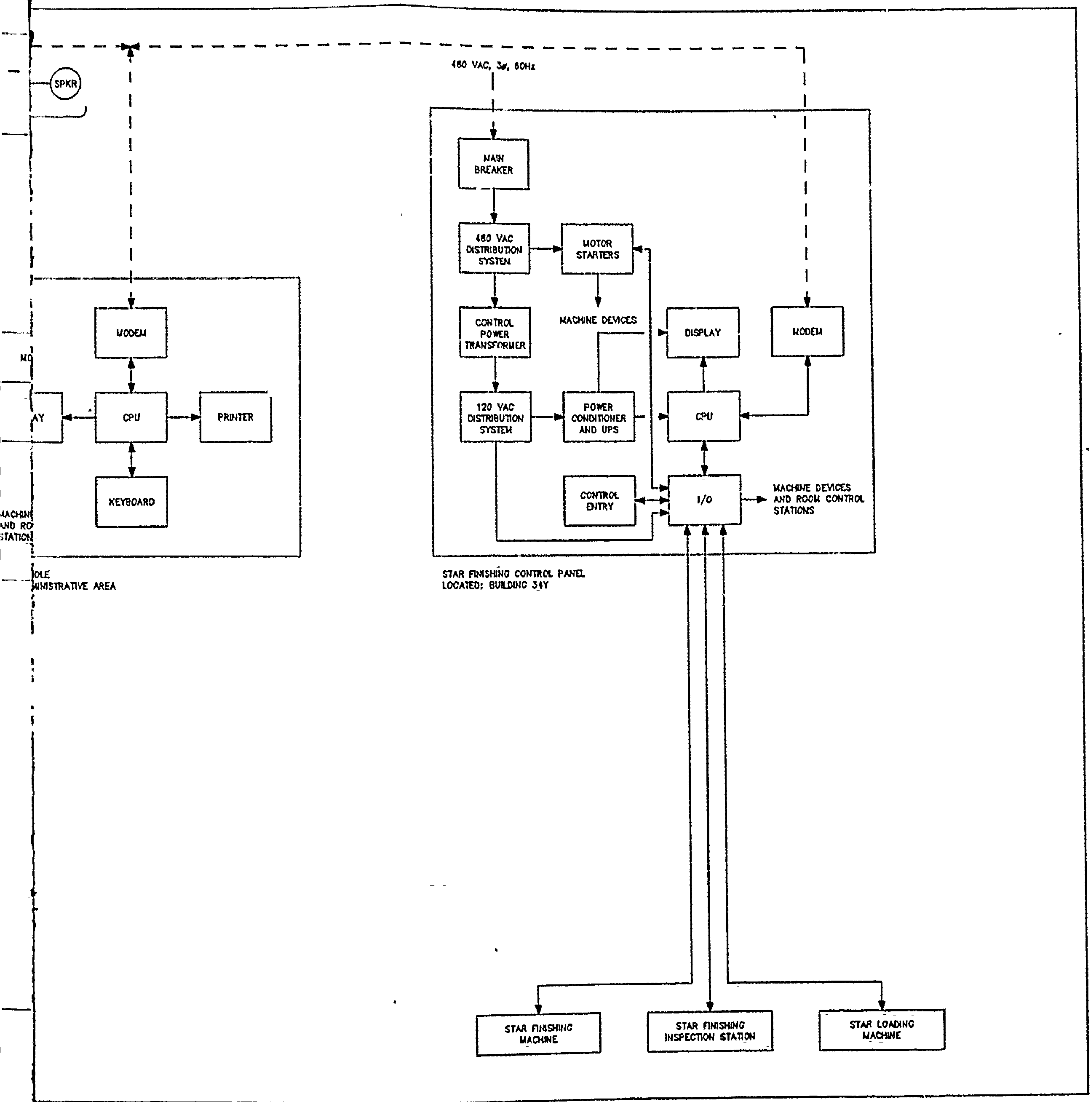

SPKR
MODEM
AY
CPU
PRINTER
KEYBOARD
ACHIN
ND RO
STATION
OLE
MINISTRATIVE AREA
460 VAC, 3ø, 60Hz
MAIN BREAKER
460 VAC DISTRIBUTION SYSTEM
MOTOR STARTERS
MACHINE DEVICES
CONTROL POWER TRANSFORMER
DISPLAY
MODEM
120 VAC DISTRIBUTION SYSTEM
POWER CONDITIONER AND UPS
CPU
CONTROL ENTRY
I/O
MACHINE DEVICES AND ROOM CONTROL STATIONS
STAR FINISHING CONTROL PANEL
LOCATED: BUILDING 34Y
STAR FINISHING MACHINE
STAR FINISHING INSPECTION STATION
STAR LOADING MACHINE

DIAGRAM 11

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
COMPONENT - FIRING CAP						
Critical	NONE					
Major	101 - Concentricity of cap with firing pin recess	X	X	X	Gage	Same
	102 - Depth of firing pin recess	X	X	X	Gage	Same
Minor	201 - Length of spring clip recess, min.	X	X	X	Gage	Same
	202 - Diameter of firing pin recess	X	X	X	Gage	Same
	203 - Diameter of rivet hole	X	X	X	Gage	Same
	204 - Poor workmanship	X	X	X	Visual	Same while loading machine
COMPONENT - HOUSING, DELAY						
Critical	NONE					
Major	101 - Diameter under flange	X	X	X	Gage	Same
	102 - Small outside diameter	X	X	X	Gage	Same
	103 - Pitch diameter of thread, max.	X	X	X	Gage	Same
	104 - Minor diameter of thread, max.	X	X	X	Gage	Same
	105 - Diameter of delay cavity	X	X	X	Gage	Same
	106 - Depth of delay cavity	X	X	X	Gage	Same
Minor	201 - Diameter of flange	X	X	X	Gage	Same
	202 - Length of diameter under flange	X	X	X	Gage	Same
	203 - Location of flash hole	X	X	X	Gage	Same
	204 - Poor workmanship	X	X	X	Visual	Same while loading machine
COMPONENT - EXHAUST PLATE						
Critical	1 - Exhaust hole missing	X	X	X	Gage	Same
Major	101 - Diameter at large end of taper	X	X	X	Gage	Same
	102 - Diameter at small end of taper	X	X	X	Gage	Same
	103 - Thickness, min.	X	X	X	Gage	Same

APPENDIX B – QUALITY CONFORMANCE INSPECTION POINTS – HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
	104 – Length to flange, max.	X	X	X	Gage	Same
	105 – Diameter of flange	X	X	X	Gage	Same
	106 – True position of bolt hole with diameter under flange, including perpendicularity	X	X	X	Gage	Same
	107 – True position of exhaust holes with diameter under flange	X	X	X	Gage	Same
	108 – Diameter under flange, min.	X	X	X	Gage	Same
	109 – Diameter of bolt hole, max	X	X	X	Gage	Same
Minor	201 – Thickness, max	X	X	X	Gage	Same
	202 – Diameter of bolt hole counter-bore, max	X	X	X	Gage	Same
	203 – Depth of bolt hole counterbore, max	X	X	X	Gage	Same
	204 – Finish improper	X	X	X	Visual	Same while loading machine
	205 – Poor workmanship	X	X	X	Visual	Same while loading machine
COMPONENT – PIN, FIRING						
Critical	NONE					
Major	101 – Profile of point	X	X	X	Gage	Same
	102 – Length from point to shoulder	X	X	X	Gage	Same
Minor	201 – Protective coating damaged exposing base metal	X	X	X	Visual	Same
	202 – Poor workmanship	X	X	X	Visual	Same
COMPONENT – GRAIN, PROPELLANT						
Critical	1 – Crack (4x magnification)	X	X	X	Visual	Same
	2 – Overall Density Test		X	X	4.5.5.1	Same
	3 – Sectional Density Test		X	X	4.5.5.2	Same

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
	4 - Propellant Ballistic Test		X	X	4.4.3.3	Same
Major	101 - Inside diameter	X	X	X	Gage	Same
	102 - Outside diameter	X	X	X	Gage	Same
	103 - Density	X			4.5.5	Same
Minor	201 - Poor workmanship	X	X	X	Visual	Same
COMPONENT - BOLT						
Critical	NONE					
Major	101 - Length, min.	X	X	X	Gage	Same
	102 - Pitch diameter of thread, min.	X	X	X	Gage	Same
	103 - Major diameter of thread, min.	X	X	X	Gage	Same
	104 - Diameter of flash holes, min.	X	X	X	Gage	Same
	105 - Length under head	X	X	X	Gage	Same
	106 - Diameter of head, min.	X	X	X	Gage	Same
	107 - Concentricity of head with thread	X	X	X	Gage	Same
	108 - Flash holes obstructed or fail to intersect each other	X	X	X	Visual	Same
	109 - Pull strength	X	X	X	4.5.7	Same
Minor	201 - Length from head to intersecting flash hole	X	X	X	Gage	Same
	202 - Poor workmanship	X	X	X	Visual	Same
COMPONENT - PROPELLANT ASSEMBLY						
Critical	1 - Pettman cement on interior surface	X	X	X	Visual	Same while loading machine
	2 - Pettman cement coating insufficient	X	X	X	Visual	Same while loading machine
	3 - Grain broken	X	X	X	Visual	Same while loading machine

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
Major	101 - Length, max.	X	X	X	Gage	Same
	102 - Glaze not removed from interior	X	X	X	Visual	Same while loading machine
Minor	201 - Sheath damaged	X	X	X	Visual	Same while loading machine
	202 - Marking misleading or unidentifiable	X	X	X	Visual	Same while loading machine
	203 - Poor workmanship	X	X	X	Visual	Same while loading machine
COMPONENT - DELAY ASSEMBLY						
Critical	1 - Delay charge missing	X	X	X	Visual	See Sec. 3.6.2 & 3.6.14 Also visual while loading machine
Major	101 - Delay composition above flash or more than max below flash	X	X	X	Gage	Same
	102 - Flash hole obstructed	X	X	X	Visual	Same while loading machine
Minor	201 - Evidence of poor workmanship		X	X	Visual	Same while loading machine
COMPONENT - TAIL ASSEMBLY						
Critical	1 - Tail fin missing, cracked or inverted	X	X	X	Visual	Same while loading machine
Major	101 - Length, max.	X	X	X	Gage	Same
	102 - Location of tail vanes & maximum vane extension	X	X	X	Gage	Same
	103 - Inside diameter of upper tail ring, min.	X	X	X	Gage	Same
	104 - Perpendicularity of ends with diameter	X	X	X	Gage	Same
	105 - Position of rib inside diameter with upper tail ring diameter	X	X	X	Gage	Same

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
	106 - Weld missing	X	X	X	Visual	Same while loading machine
	107 - Weld flash excessive	X	X	X	Visual	Same while loading machine
	108 - Weld peel test	X	X	X	4.5.10	Same
	109 - Hardness test	X	X	X	4.5.8	Same
Minor	201 - Clearance between lower tail ring and tail vane	X	X	X	Gage	Same
	202 - Poor workmanship	X		X	Visual	Same while loading machine
	203 - Poor workmanship		X		Visual	Same while loading machine

COMPONENT - BARREL, ROCKET

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
Critical	1 - Crack	X	X	X	Visual	Same while loading machine
	2 - Draw marks, inclusions, scratches more than .015" deep	X	X	X	Visual/Gage	Same while loading machine
Major	101 - Diameter of primer hole, max	X	X	X	Gage	Same
	102 - Concentricity of primer hole and counterbore w/inside dia.	X	X	X	Gage	Same
	103 - Inside diameter	X	X	X	Gage	Same
	104 - Depth of primer counterbore	X	X	X	Gage	Same
	105 - Outside of rear end	X	X	X	Gage	Same
	106 - Length of knurl, max.	X	X	X	Gage	Same
Minor	201 - Wall thickness, min.	X	X	X	Gage	Same
	202 - Thickness through bottom of charge cavity	X	X	X	Gage	Same
	203 - Diameter of charge cavity	X	X	X	Gage	Same
	204 - Total length	X	X	X	Gage	Same
	205 - Length to top of charge cavity	X	X	X	Gage	Same
	206 - Radii missing	X	X	X	Visual	Same while loading machine
	207 - Poor workmanship	X	X	X	Visual	Same while loading machine

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
COMPONENT - TUBE, CASING						
Critical	1 - Crack or split	X			Visual	Same while loading machine
	1 - Hydrostatic pressure test		X	X	4.5.6	Same
	2 - Pressure test performance symbol missing	X	X	X	Visual	Same while loading machine
	3 - Presence of cracks		X	X	Visual	Same while loading machine
Major	101 - Concentricity of ends including perpendicularity	X	X	X	Gage	Same
	102 - Total length, max.	X	X	X	Gage	Same
	103 - Inside diameter of ends, max.	X	X	X	Gage	Same
	104 - Inside diameter of body, max.	X	X	X	Gage	Same
	105 - Hydrostatic test	X			4.5.6	Same
Minor	201 - Poor workmanship	X	X	X	Visual	Same while loading machine
COMPONENT - SIGNAL BODY						
Critical	NONE					
Major	101 - Small inside diameter	X	X	X	Gage	Same
Minor	201 - Large outside diameter, max.	X	X	X	Gage	Same
	202 - Large inside diameter, min.	X	X	X	Gage	Same
	203 - Overall length	X	X	X	Gage	Same
	204 - Poor workmanship	X	X	X	Visual	Same while loading machine
COMPONENT - SMOKE ASSEMBLY						
Critical	1 - Color designation incorrect	X			Visual	Same while loading machine
Major	101 - Outside diameter, max.	X			Gage	Same
	102 - Any component missing	X			Visual	Same while loading machine
	103 - Wrapper overlaps holes	X			Visual	Same while loading machine
Minor	201 - Total length, max.	X			Gage	Same

APPENDIX B – QUALITY CONFORMANCE INSPECTION POINTS – HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
	202 – Marking misleading or unidentifiable	X			Visual	Same while loading machine
	203 – Poor workmanship	X			Visual	Same while loading machine
COMPONENT – ILLUMINANT ASSEMBLY						
Critical	1 – Color designation incorrect		X	X	Visual	Same while loading machine
Major	101 – Outside diameter, max.		X	X	Gage	Same
	102 – Quick match missing or not embedded in priming charge		X	X	Visual/Manual	See Sec. 4.6.5 & 4.6.8 & 4.6.10 also visual while loading machine
	103 – Candle power and color value test		X	X	4.5.10	Same
Minor	201 – Assembly damaged		X	X	Visual	Same while loading machine
	202 – Marking misleading or unidentifiable		X	X	Visual	Same
	203 – Priming charge on exposed portion of quick match		X	X	Visual	Same
	204 – Poor workmanship		X	X	Visual	Same while loading machine
COMPONENT – PARACHUTE ASSEMBLY						
Critical	NONE					
Major	101 – Torn, holes, improperly tied to suspension cord	X		X	Visual	Same
	102 – Shrouds twisted	X		X	Visual	Same
Minor	201 – Poor workmanship	X		X	Visual	Same

APPENDIX B – QUALITY CONFORMANCE INSPECTION POINTS – HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
ASSEMBLY – FIRING CAP & SPRING CLIP ASSEMBLY						
Critical	NONE					
Major	101 – Diameter over rivet head, max.	X	X	X	Gage	Same
	102 – Rivet head protrudes inside wall	X	X	X	Visual	Same
	103 – Firing pin missing or loose	X	X	X	Visual/ Manual	Same
	104 – Spring clip missing or loose	X	X	X	Visual/ Manual	Same
	105 – Push Test – Firing cap & spring assembly prior to insertion of primer	X	X	X	4.5.9	Same
Minor	201 – Poor workmanship	X	X	X	Visual	Same
ASSEMBLY – SIGNAL BODY AND DELAY ASSEMBLY						
Critical	NONE					
Major	101 – Gap between body and delay housing over max.		X		Gage	See Sec. 3.6.2 & 3.6.14
Minor	201 – Marking misleading or unidentifiable	X	X	X	Visual	Same
	202 – Designation incorrect	X	X	X	Visual	Same
	203 – Poor workmanship	X	X	X	Visual	Same at manual inspection station
ASSEMBLY – SIGNAL BODY AND DELAY ASSEMBLY						
Critical	1 – Tail assembly binds on tube casing	X	X	X	Visual	See Sec. 3.6.7 & 3.6.14
	2 – Exhaust plate flange missing or inadequate and/or engages tail assembly	X	X	X	Visual	See Sec. 3.6.6 & 3.6.7 &

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
						3.6.14
Major	101 - Bolt or casing tube loose	X	X	X	Manual	See Sec. 3.6.7 & 3.7.1 & 3.6.14
	102 - Bolt flash hole obstructed	X	X	X	Visual	Same while loading machine
	103 - Propellant assembly loose	X	X	X	Manual	See Sec. 3.6.5 & 3.7.1 & 3.6.14
Minor	201 - Poor workmanship	X	X	X	Visual	Same at manual inspection station
ASSEMBLY - SIGNAL AND DELAY ASSEMBLY						
Critical	NONE					
Major	101 - Weight of expelling charge, min	X	X	X	Balance	See Sec. 3.6.8 & 3.6.14
	102 - Expelling charge missing	X	X	X	Visual	See Sec. 3.6.8 & 3.6.14
Minor	201 - Poor workmanship	X	X	X	Visual	Same at manual inspection station
ASSEMBLY - SIGNAL BODY & DELAY ASSEMBLY AFTER TAIL, PROPELLANT, EXHAUST PLATE, WASHER AND DISC, ILLUMINANT ASSEMBLIES, BOLT & BACKING WASHER						
Critical	NONE					
Major	101 - Illuminant assembly missing		X		Visual	See Sec. 3.6.10 & 3.6.14
	102 - Washer & disc assembly missing		X		Visual	See Sec. 3.6.9 & 3.6.14
Minor	201 - Poor workmanship		X		Visual	Same at manual inspection station

APPENDIX B – QUALITY CONFORMANCE INSPECTION POINTS – HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
ASSEMBLY –	SIGNAL BODY AND DELAY ASSEMBLY AFTER ASSEMBLY OF TAIL ASSEMBLY, PROPELLANT, EXHAUST PLATE AND BOLT, WASHER DISC ASSEMBLY AND ILLUMINANT ASSEMBLY, BUT PRIOR TO INSERTING PARACHUTE IN BODY					
Critical	NONE					
Major	101 – Suspension cord insecurely tied to illuminant assembly			X	Visual	Same See Also Sec. 3.16.2 & 3.16.6
	102 – Component missing or damaged to extent that function may be impaired or chain bead assembly improperly attached to illuminant assembly			X	Visual	Same See Also Sec. 3.16.2 & 3.16.6
Minor inspection	201 – Poor workmanship			X	Visual	Same at manual station
ASSEMBLY –	PRIOR TO PLACING ROCKET ASSEMBLY IN ROCKET BARREL					
Critical	1 – Weight of initiating charge, min.	X	X	X	Balance	See Sec. 3.8.4 & 3.8.15
	2 – Initiating charge missing	X	X		Visual	See Sec. 3.8.4 & 3.8.15
Major	101 – Primer missing or not sealed	X			Visual	See Sec. 3.8.3 & 3.8.15
	101 – Initiating charge over max		X		Balance	See Sec. 3.8.4 & 3.8.15
	101 – Rocket barrel washer missing			X	Visual	See Sec. 3.8.5, 3.8.7 & 3.8.15
	102 – Rocket barrel washer assy.. miss.	X			Visual	See Sec. 3.8.6, 3.8.7 & 3.8.15
	102 – Primer missing or not sealed		X	X	Visual	See Sec. 3.8.3 & 3.8.15

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
	103 - Initiating charge over max.	X			Balance	See Sec. 3.8.4 & 3.8.15
	103 - Rocket barrel washer missing		X		Visual	See Sec. 3.8.5, 3.8.7 & 3.8.15
	103 - Initiating charge missing			X	Visual	See Sec. 3.8.4 & 3.8.15
Minor	201 - Poor workmanship	X	X	X	Visual	Same at manual inspection station
ASSEMBLY - SIGNAL, ILLUMINATION, GROUND STAR CLUSTER						
Critical	1 - Designation incorrect		X	X	Visual	Same at manual inspection station
	2 - Firing cap assembled on primer end		X	X	Visual	See Sec. 3.10.2 & 3.10.8
Major	101 - Total length, max		X	X	Gage	See Sec. 3.10.2 & 3.10.8
	102 - Label missing		X	X	Visual	Same at manual inspection station
	103 - Assembly damaged to the extent that function will be impaired		X	X	Visual	Same at manual inspection station
Minor	201 - Marking misleading or unidentifiable		X	X	Visual	Same at manual inspection station
	202 - Contents loose		X	X	Manual	Same at manual inspection station
	203 - Knurl not color coated		X		Visual	Same at manual inspection station
	203 - Poor workmanship			X	Visual	Same at manual inspection station
	204 - Poor workmanship		X		Visual	Same at manual inspection station
	204 - Knurl not color coated			X	Visual	Same at manual inspection station

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
ASSEMBLY - PRIOR TO INSERTING SEAL ON ROCKET BARREL						
Critical	NONE					
Major	NONE					
Minor	201 - Tape missing, insufficient or incorrectly applied on cork seal	X	X	X	Visual	Same See Sec. 3.9.1
	202 - Poor workmanship	X	X	X	Visual	Same See Sec. 3.9.1
ASSEMBLY - PRIOR TO ASSEMBLING FIRING CAP AND SPRING CLIP ASSEMBLY						
Critical	1 - Color of coating on rocket barrel seal incorrect	X	X	X	Visual	Same at manual inspection station
Major	101 - Rocket barrel seal missing	X	X	X	Visual	See Sec. 3.8.13 & 3.8.15
	102 - Thickness of lacquer coating insufficient except that pin holes surface roughness caused by cork are acceptable	X	X	X	Visual	Not applicable with new rocket barrel sealer
	103 - Rocket barrel dented	X	X	X	Visual	Same at manual inspection station
Minor	201 - Poor workmanship	X	X	X	Visual	Same at manual inspection station
ASSEMBLY - CONTAINER PRIOR TO SEALING						
Critical	NONE					
Major	101 - Signal inverted	X	X	X	Visual	See Sec. 3.10.3
	102 - Packing component missing	X	X	X	Visual	Same while loading machine

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
Minor	201 - Poor workmanship	X	X		Visual	Same at manual inspection station
ASSEMBLY - CONTAINER SEALED						
Critical	1 - End color missing or incorrect		X	X	Visual	Same at manual inspection station
	2 - Embossing missing or incorrect		X	X	Visual	Same at manual inspection station
Major	101 - Key missing		X		Visual	Not applicable with new container
	102 - Container damaged		X		Visual	Same at manual inspection station
	103 - Leakage test		X		4.5.3	Same See Also Sec. 3.13.2
	103 - Key missing			X	Visual	Not applicable with new container
	104 - Tear strip test		X		4.5.4	Not applicable with new container
	104 - Container damaged			X	Visual	Same at manual inspection station
	105 - Leakage test			X	4.5.3	Same See also Sec. 3.13.2
	106 - Tear strip test			X	4.5.4	Not applicable with new container
Minor	201 - Marking misleading or unidentifiable		X	X	Visual	Same at manual inspection station
	202 - Contents loose		X	X	Manual	Same at manual inspection station
	203 - Protective coating damaged exposing base metal		X	X	Visual	Same at manual inspection station
	204 - Poor workmanship		X	X	Visual	Same at manual inspection station

APPENDIX B – QUALITY CONFORMANCE INSPECTION POINTS – HAND HELD SIGNALS

	ITEM	MIL-S-13 303G	MIL-S-13 261G	MIL-S-13 257H	PRESENT METHOD	NEW INSPECTION METHOD
ASSEMBLY – WOOD PACKING BOX AFTER PACKOUT						
Critical	NONE					
Major	101 – Box damaged to extent that contents are exposed	X	X	X	Visual	Same with manual inspection
	102 – Hdw. or strapping missing, broken, loose, or improperly assembled	X	X	X	Visual/ Manual	Same with manual inspection
	103 – Board broken	X	X	X	Visual	Same with manual inspection
Minor	201 – Contents loose	X	X	X	Manual	Same with manual inspection
	202 – Carton seal missing, unsealed cr improperly engaged	X			Visual/ Manual	Same with manual inspection
	202 – Hardware or strapping improperly assembled		X	X	Visual/ Manual	Same with manual inspection
	203 – Marking misleading or unidentifiable	X			Visual	Same with manual inspection
	203 – Carton seal missing, unsealed or improperly engaged		X	X	Visual/ Manual	Same with manual inspection
	204 – Poor workmanship	X			Visual	Same with manual inspection
	204 – Marking misleading or unidentifiable		X	X	Visual	Same with manual inspection
	205 – Poor workmanship		X	X	Visual	Same with manual inspection

APPENDIX B – QUALITY CONFORMANCE INSPECTION POINTS – 40MM SIGNALS – SPEC. MIL-C-63092

	ITEM	PRESENT METHOD	NEW INSPECTION METHOD
COMPONENT – BODY, PRIOR TO PAINTING			
Critical	NONE		
Major	101 – Largest outside diameter	Gage	Same
	102 – Concentricity of largest outside dia. with second largest outside diameter	Gage	Same
	103 – Second largest outside diameter	Gage	Same
	104 – Concentricity of second largest outside diameter with smallest inside diameter	Gage	Same
	105 – Concentricity of largest inside diameter with smallest inside diameter	Gage	Same
	106 – Salt spray	4.5.3	Same
	107 – Pitch diameter of thread	Gage	Same
	108 – Minor diameter of thread, max.	Gage	Same
	109 – Perpendicularity of open end with smallest inside diameter	Gage	Same
	110 – Metal defective	Visual	Same while loading machine
Minor	201 – Smallest outside diameter	Gage	Same
	202 – Groove diameter	Gage	Same
	203 – Width of rotating bands	Gage	Same
	204 – Total length	Gage	Same
	205 – Width of flange	Gage	Same
	206 – Distance to rotating band	Gage	Same
	207 – Poor workmanship	Visual	Same while loading machine
COMPONENT – BODY AFTER PAINTING			
Critical	NONE		
Major	101 – Second largest outside diameter	Gage	Same
Minor	201 – Color incorrect	Visual	Same while loading machine

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - 40MM SIGNALS - SPEC. MIL-C-63092

	ITEM	PRESENT METHOD	NEW INSPECTION METHOD
COMPONENT - OGIVE			
Critical	1 - Incorrect letter	Visual	Same while loading machine
Major	101 - Excessive flash below shoulder in groove	Gage	Same
	102 - Second largest outside diameter	Gage	Same
Minor	201 - Total length	Gage	Same
	202 - Large outside diameter	Gage	Same
	203 - Diameter of groove	Gage	Same
	204 - Width of groove	Gage	Same
	205 - Poor workmanship	Visual	Same while loading machine
	206 - Inside diameter	Gage	Same
COMPONENT - TUBE			
Critical	NONE		
Major	101 - Outside diameter	Gage	Same
	102 - Perpendicularity of ends	Gage	Same
Minor	201 - Total length	Gage	Same
	202 - Poor workmanship	Visual	Same while loading machine
	203 - Wall thickness	Gage	Same
COMPONENT - DELAY CARRIER			
Critical	NONE		
Major	101 - Salt spray	4.5.3	Same
	102 - Pitch diameter of thread	Gage	Same
	103 - Small inside diameter	Gage	Same
	104 - Concentricity of small inside diameter with large inside diameter	Gage	Same
	105 - Large inside diameter	Gage	Same
Minor	201 - Length to flange	Gage	Same
	202 - Concentricity of body diameter with large inside diameter	Gage	Same

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - 40MM SIGNALS - SPEC. MIL-C-63092

	ITEM	PRESENT METHOD	NEW INSPECTION METHOD
	203 - Diameter of thread undercut	Gage	Same
	204 - Poor workmanship	Visual	Same while loading machine
COMPONENT - PLUG ANCHOR			
Critical	NONE		
Major	101 - Largest outside diameter	Gage	Same
Minor	201 - Total length	Gage	Same
	202 - Holes missing	Visual	Same while loading machine
	203 - Poor workmanship	Visual	Same while loading machine
	204 - Width of slot incorrect	Gage	Same
	205 - Depth of slot incorrect	Gage	Same
	206 - Flange thickness	Gage	Same
	207 - Second largest outside diameter	Gage	Same
COMPONENT - ILLUMINANT LOADING ASSEMBLY			
Critical	NONE		
Major	101 - Length from shoulder to end	Gage	Same
	102 - Diameter, max.	Gage	Same
	103 - Anchor plug insecure	Manual/Visual	Same
	104 - Assembly damaged to extent that function may be impaired	Visual	Same while loading machine
	105 - Static test	Visual, 4.4.3.2, 4.4.3.3 & 4.5.4	Same
Minor	201 - Poor workmanship	Visual	Same while loading machine
COMPONENT - PARACHUTE ASSEMBLY			
Critical	NONE		
Major	101 - Tears or holes in parachute	Visual	Same

	ITEM	PRESENT METHOD	NEW INSPECTION METHOD
	102 – Shroud lines not attached to parachute	Visual	Same See Also Sec. 3.16.2 & 3.16.6
	103 – Shroud lines tangled	Visual	Same See Also Sec. 3.16.2 & 3.16.6
	104 – Coupling not secure to shroud lines	Visual	Same See Also Sec. 3.16.2 & 3.16.6
COMPONENT – PROJECTILE ASSEMBLY, PRIOR TO ASSEMBLING ILLUMINANT ASSEMBLY			
Critical	NONE		
Major	101 – Coupling of illuminant assembly not secure to chain	Visual	Sec. 3.16.2 & 3.16.6
COMPONENT – PROJECTILE ASSEMBLY, PRIOR TO ASSEMBLING OGIVE			
Critical	NONE		
Major	101 – Parachute missing	Visual	Same
	102 – O-ring missing	Visual	Same
	103 – Spring pin missing	Visual	Same
COMPONENT – PROJECTILE ASSEMBLY			
Critical	NONE		
Major	101 – Disassembly torque of delay assembly, improper	4.5.5	Same
	102 – Color incorrect	Visual	Same while loading machine
Minor	201 – Poor workmanship	Visual	Same while loading machine
COMPONENT – CARTRIDGE			
Critical	1 – Chamber gage failure	Dwgs. 9202770, 9202783, 8827895	See Sec. 3.13.2 & 3.13.11

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - 40MM SIGNALS - SPEC. MIL-C-63092

	ITEM	PRESENT METHOD	NEW INSPECTION METHOD
	2 - Incorrect ogive	Visual	Same at manual inspection station
	3 - Marking incorrect	Visual	Same at manual inspection station
Major	101 - Marking unidentifiable	Visual	Same at manual inspection station
	102 - Pull test	4.5.6	Same
	103 - Transportation - vibration	4.4.3.5, 4.4.3.8 & 4.5.7	Same
	104 - Air pressure	4.4.3.4, 4.4.3.6, 4.4.3.9 & 4.5.8	Same
	105 - Functioning	4.4.3.7, 4.4.3.10 & 4.5.9	Same
Minor	201 - Total length	Gage	See Sec. 3.11.7 & 3.11.9
COMPONENT - UNSEALED METAL BOX			
Critical	NONE		
Major	101 - Incorrect number of cartridges	Visual	Same while loading metal box
	102 - Desiccant bags missing	Visual	Same while loading metal box
	103 - Rubber gasket damaged or improperly assembled	Visual	Same while loading metal box
Minor	201 - Fillers missing	Visual	Same while loading metal box
	202 - Tube missing	Visual	Same while loading metal box
COMPONENT - SEALED METAL BOX			
Critical	NONE		
Major	101 - Air pressure	4.5.10	Same
Minor	201 - Marking misleading or unidentifiable	Visual	Same with manual inspection

APPENDIX B - QUALITY CONFORMANCE INSPECTION POINTS - 40MM SIGNALS - SPEC. MIL-C-63092

	ITEM	PRESENT METHOD	NEW INSPECTION METHOD
	202 - Contents loose	Manual	Same with manual inspection
COMPONENT - SEALED WOODEN PACKING BOX			
Critical	NONE		
Major	NONE		
Minor	201 - Marking misleading or unidentifiable	Visual	Same with manual inspection
	202 - Contents loose	Visual	Same with manual inspection
	203 - ICC nomenclature missing	Visual	Same with manual inspection

APPENDIX C - LIST OF MAJOR EQUIPMENT BY MACHINE

HAND HELD SIGNAL MOTOR ASSEMBLY MACHINE

Station	Section	Equipment
	3.6.1	Walking Beam Conveyor
1	3.6.2	Hopper and Feeder for Signal Body
		Hopper and Feeder for Casing Tube
		Assembly Press
		Magazines and Shuttle for Delay
2	3.6.2	Concentricity Tester
		Length Tester
3	3.6.3	Bulk Tube Feeder
		Ring Cut Off
		Shuttle Device
		Slot Cutter
		Insertion Tool
4	3.6.4	Hopper and Feeder for Propellant
		Insertion Tool
5	3.6.5	Bulk Tube Feeder
		Ring Cut Off
		Shuttle Device
		Insertion Tool
6	3.6.5	Probe for Presence of Propellant and Spacer
7	3.6.6	Conveyor for Tail Assembly
		Pick and Place for Tail Assembly
		Feeder Bowl and Track to Feed Exhaust Plate
		Assembly Press
8	3.6.7	Hopper and Orienting Rolls for Bolt
		Sealant Applicator
		Bolt Driver with Torque and Depth Control
9	3.6.7	Air Blast to Spin Tail Assembly
		Proximity Switch to Detect Movement
		Three Probes to Sense Exhaust Plate
10	3.6.8	Pick and Place (Robot)
		Scale
		Weigh Loss Feeder
		Black Powder Feeder
11	3.6.8	Pick and Place (Robot)
		Scale
		Weigh Loss Feeder
		Black Powder Feeder
12	3.6.9	Die Cutter (2)
		Felt Rolling and Unrolling System
		Paper Rolling and Unrolling System
		Paper Seal Label Applicator
		Insertion Tool
13	3.6.10	Hopper and Feeder for Payload
		Insertion Tool

14	3.6.11	Feeder Bowl and Track to Feed Cork Seal
		Insertion Tool
15	3.6.12	Tape Dispenser

MANUAL INSPECTION STATION - HAND HELD SIGNAL MOTOR EXAMINATION

Station	Section	Equipment
1	3.7.2	Manual Inspection Station for SPC Counts

ROCKET BARREL ASSEMBLY MACHINE

Station	Section	Equipment
	3.8.1	Walking Beam Conveyor
1	3.8.2	Feeder Bowl and Track to Feed Primers
		Insertion Tool
		Hopper and Feeder for Rocket Barrels
2	3.8.3	Waterproofing Applicator
		Probe to Detect Presence of Primer
3	3.8.3	Waterproofing Presence Detector (Sniffer)
		Air Purge System
4	3.8.4	Pick and Place (Robot)
		Scale
		Weigh to Loss Feeder
		Black Powder Feeder
5	3.8.4	Pick and Place (Robot)
		Scale
		Weigh to Loss Feeder
		Black Powder Feeder
6	3.8.5	Die Cutter
		Felt Rolling and Unrolling System
		Insertion Tool
7	3.8.6	Feeder Bowl and Track to Feed Washer
		Label Applicator for Paper Seal
		Insertion Tool
		Die Cutter
		Paper Rolling and Unrolling System
8	3.8.7	Feeder Bowl and Track to Feed Retaining Washer
		Insertion Tool
9	3.8.7	Probe for Presence of Washers
		Pick and Place Unit
10	3.8.9	Conveyor to Transport Signal Body
		Pick and Place Unit
11	3.8.8	Die Cutter
		Rubber Rolling and Unrolling System
		Insertion Tool
12	3.8.9	Feeder Bowl and Track to Feed Wooden Disk
		Insertion Tool
13	3.8.9	Fixture & Insertion Tool for Installing Motor into Rocket Barrel

14	3.8.10	Feeder Bowl and Track to Feed Cork Seal Insertion Tool
15	3.8.10	Probe to Verify Presence of Components
16	3.8.11	Label Applicator
17	3.8.12	Vacuum Unit Offline Vacuum Station
18	3.8.13	Hot Melt Applicator

MANUAL INSPECTION STATION - HAND HELD SIGNAL ROCKET EXAMINATION

Station	Section	Equipment
1	3.9.2	Manual Inspection Station for SPC Input

HAND HELD SIGNAL CONTAINERIZATION MACHINE

Station	Section	Equipment
	3.10.1	Walking Beam Conveyor
1	3.10.2	Insertion Tool Hopper and Feed for Barrel Caps
2	3.10.2	Probe to Measure Length and Presence of Cap
3	3.10.3	Hopper and Feed for Container Insertion Tool
4	3.10.4	Feeder Bowl and Track to Feed O-ring Lubrication Applicator Expanding Tool Insertion Tool
5	3.10.5	Hopper and Feeder for Container Cap Cap Installing Device (Torque)
6	3.10.6	Label Applicator

40MM ASSEMBLY MACHINE

Station	Section	Equipment
	3.11.1	Walking Beam Conveyor
1	3.11.2	Hopper and Feeder for Body
2	3.11.3	Magazine and Shuttle for Delays Sensor for Detecting Presence of Charge Sealant Application System Torque Driver
3	3.11.4	Die Cutter Insertion Tool Rubber Rolling and Unrolling System
4	3.11.5	Hopper and Feeder for Payload Insertion Tool

5	3.11.6	Feeder Bowl and Track to Feed Ogive Feeder Bowl and Track to Feed O-ring Lubrication Applicator O-ring Expander and Installation Tool Assembly Press
6	3.11.7	Hopper and Feeder for Cartridges Feeder Bowl and Track to Feed O-ring O-ring Expander and Application Tool Crimping Press
7	3.11.7	Concentricity Tester Length Tester

MANUAL INSPECTION STATION - 40MM ASSEMBLY EXAMINATION

Station	Section	Equipment
1	3.12.2	Manual Inspection Station with SPC Recording System

LEAK TESTING AND PACKOUT MACHINE

Station	Section	Equipment
	3.13.1	Conveyor From Capping Machine
1	3.13.2	Pick and Place (Robot) Pressure Chambers
2	3.13.3	Stenciling Unit SPC Recording System
3	3.13.3	Hopper and Feeder Insertion Tool
4	3.13.4	Fixture for Loading Boxes Conveyor For Wooden Boxes SPC Recording System
5	3.13.5	None
6	3.13.6	None
7	3.13.7	Security Tagger (Plier Type)
8	3.13.8	Banding Machine
9	3.13.9	None

CASE PALLETIZER

Station	Section	Equipment
1	3.14.2	Pallet Station Automatic Pallet Loading Unit
2	3.14.3	Bander for Pallet
3	3.15.1	Conveyor

MANUAL INSPECTION STATION - PACKOUT AREA EXAMINATION

Station	Section	Equipment
1	3.15.2	Manual Inspection Station for SPC Recording System

PAYLOAD SUBASSEMBLY MACHINE

Station	Section	Equipment
	3.16.1	Walking Beam Conveyor
1	3.16.2	Hopper and Feeder (2)
		Align and Crimp Tool
2	3.16.3	Insertion Tool
		Roll Feed
		Die Cutter
		Felt Unrolling and Rolling System
	3.16.4	Insertion Tool

STAGING AND MAGAZINE LOADING ALARM CENTER

Station	Section	Equipment
	3.17.2	Staging and Magazine Loading Alarm Center Enclosure
		Annunciator Panel
	3.17.3	Power Conditioner
		Control Entry Devices

MAIN CONTROL SYSTEM - BUILDING 16Y

Station	Section	Equipment
	3.18.2	Main Control Panel Enclosure
	3.18.2	Central Processing Unit and I/O Rack
	3.18.5	Main Breaker
	3.18.5	480 volt 3 phase Distribution System
	3.18.5	120 volt 1 phase Distribution System
	3.18.5	Power Conditioner
	3.18.2	Control Entry Devices
	3.18.2	Motor Starters
	3.18.3	Display
	3.18.3	Voice Synthesis Module
	3.18.3	Audio Amplifier
	3.18.3	Speaker System
	3.18.6	Modem

3.16.5	Payload Subassembly Machine Control Panel Enclosure
	Central Processing Unit and I/O Rack
	480 volt 3 phase Distribution System
	120 volt 1 phase Distribution System
	Power Conditioner
	Control Entry Devices
	Motor Starters
	Display
3.6.13	Hand Held Signal Motor Assembly Machine Control Panel Enclosure
	Central Processing Unit and I/O Rack
	480 volt 3 phase Distribution System
	120 volt 1 phase Distribution System
	Power Conditioner
	Control Entry Devices
	Motor Starters
	Display
3.8.14	Rocket Barrel Assembly Machine and Hand Held Signal Contai'nerization
	Machine Control Pane. Enclosure
	Central Processing Unit and I/O Rack
	480 volt 3 phase Distribution System
	120 volt 1 phase Distribution System
	Power Conditioner
	Control Entry Devices
	Motor Starters
	Display
3.11.10	40MM Assembly Machine Control Panel Enclosure
	Central Processing Unit and I/O Rack
	480 volt 3 phase Distribution System
	120 volt 1 phase Distribution System
	Power Conditioner
	Control Entry Devices
	Motor Starters
	Display

STAR FINISHING MACHINE

Station	Section	Equipment
	4.6.1	Walking Beam Conveyor
1	4.6.2	Automated Marking Unit
	4.6.3	None
2	4.6.4	Tank
		Pressure Pump
		Automated Silkscreen Unit

3	4.6.5	Tank
		Pressure Pump
		Applicator
		Rotary Actuator
4	4.6.5	Pick and Place Robot
		Cutter (Shear Type)
5	4.6.6	Rotary Actuator
6	4.6.7	Tank
		Pressure Pump
		Automated Silkscreen Unit
7	4.6.8	Tank
		Pressure Pump
		Applicator
		Rotary Actuator
8	4.6.8	Pick and Place Robot
		Cutter (Shear Type)

MANUAL INSPECTION STATION - STAR FINISHING EXAMINATION

Station	Section	Equipment
1	4.7.2	Manual Inspection Station for SPC Input

STAR LOADING MACHINE

Station	Section	Equipment
1	4.8.2	Fixture and Insertion Tool
		Hopper and Feeder
2	4.8.3	Stacking Fixture

MAIN CONTROL SYSTEM - BUILDING 34Y

Station	Section	Equipment
	4.9.2	Main Control System Enclosure
		Central Processing Unit and I/O Rack
		Main Breaker, Power Conditioner, Control Entry Devices, Motor Starters
	4.9.3	Display
		Alarm Horn
	4.9.4	480 volt 3 phase Distribution System
		120 volt 3 phase Distribution System
	4.9.5	Modem

REMOTE

Station	Section	Equipment
	5.1	Microprocessor Computer (Minimum Configuration Requirements as Detailed in Section 5.1)

APPENDIX D - LIST OF MAJOR EQUIPMENT BY TYPE

Air Blast
Air Compressor
Air Purge System
Alarm Horn
Align and Crimp Tool
Applicator
Assembly Press
Audio Amplifier
Automated Marking Unit
Automated Silkscreen Unit
Automatic Pallet Loading Unit
Bander for Pallet
Banding Machine
Bolt Driver
Breaker
Cap Installing Device
Central Processing Unit (CPU)
Concentricity Tester
Control Entry Devices
Conveyor
Crimping Press
Cutter
Die Cutter
Display
Dot Matrix Printer
Enclosure
Expanding Tool
Feeder
Feed Bowl
Fixture for Installing Motor into Rocket Barrel
Fixture for Loading Boxes
Fixture for Loading Stars
Fixture for Stacking Stars
Hopper
Hot Melt Applicator
I/O Rack
Insertion Tool
Label Applicator
Length Tester
Lubrication Applicator
Magazines
Manual Inspection Station
Microprocessor Computer
Modem
Motor Starter
Offline Vacuum Station
Orienting Rolls
O-ring Expander and Installation Tool

Pallet Station
Pick and Place Robot
Power Conditioner
Pressure Chambers
Tanks
Tape Dispenser
Torque Driver
Track Feeder
Voice Synthesis Module
Vacuum Unit
Walking Beam Conveyor
Waterproofing Applicator
Waterproofing Presence Detector
Weigh to Loss Feeder

APPENDIX E - MANUFACTURER'S INFORMATION

Air Blast		
	McCullough Kansas City, MO 64134	Best Tool North Kansas City, MO 64117
Air Compressor		
	Cooper Industries Quincy, IL	Sullair Corporation Michigan City, IN
Air Purge System		
	Omega Stamford CT	Astro International Corp. League City, TX
Align and Crimp Tool		
	McCullough Kansas City, MO 63134	Best Tool North Kansas City, MO 64117
Applicator		
	Loc-Tite Corp. Newington, CT 06111	3M St. Paul, MN
Assembly Press		
	Precision Detroit Cleveland, OH	Hudson Auto Machine Tool Clark, NJ
Audio Amplifier		
	Gai-Tronics Corp. Reading, PA 19603	Accusonic Systems Corp. New Hyde Park, NY 11040
Automated Marking Unit		
	Marsh Belleville, IL	Industrial Marking Equipment Riviera Beach, FL
Automated Silkscreen Unit		
	United Silicone Inc. Lancaster, NY 14068	GML Inc. St. Paul, MN 55110
Automatic Pallet Loading Unit		
	FMC Corp. Hoopeston, IL	GMF Robotics Birmingham, MI
Bander for Pallet		
	FMC Corp. Hoopeston, IL	Interlake Packaging Co. Oak Forest, IL
Banding Machine		
	Clinch-Tite Sandy Point, PA	USS Packaging Systems Chicago, IL

Bolt Driver

Black & Webster
Waltham, MA

Weldun
Bridgman, MI

Breaker

Westinghouse
Houston, TX 77001

Cutler-Hammer
Houston, TX

Cap Installing Device

Consolidated Packaging Mach.
Alden, NY 14004

New Jersey Machinery
Fairfield, NJ 07006

Central Processing Unit (CPU)

Allen Bradley
Milwaukee, WI 53204

Fisher
Marshalltown, IA 50158

Concentricity Tester

Omega
Stamford, CT

Astro International
League City, TX

Control Entry Devices

Allen Bradley
Milwaukee, WI 53204

Micro Switch
Freeport, IL 61032

Conveyor

Hytrol
Jonesboro, AR

J.B. Webb
Farmington, MI

Crimping Press

Joraco
Smithfield, RI

Drake Corp.
Phoenix, AZ

Die Cutter

Roll Cut
Harbour City, CA 90710

Peerless Machinery Co.
Marion, IN 46952

Display

Cherry Electrical Products
Waukegan, IL 60087

Industrial Data Technologies
Westerville, OH 43081

Enclosure

Killark
St. Louis, MO 63115-0325

Nelson Electric
Tulsa, OK

Expanding Tool

Dixon Automatic Tool
Rockford, IL

Weldun
Bridgman, MA

Feeder

Automation Devices
Fairview, PA

Performance Feeder
Clearwater, FL

Feeder Bowl

Automation Devices Fairview, PA	Moorefeed Indianapolis, IN

Fixture for Installing Motor into Rocket Barrel

Weldun Bridgman, MA	Back & Webster Waltham, MA

Fixture for Loading Boxes

Weldun Bridgman, MA	Hendricks Engineering Indianapolis, IN

Fixture for Loading Stars

Weldun Bridgman, MA	Hendricks Engineering Indianapolis, IN

Fixture for Stacking Stars

Weldun Bridgman, MA	Haumiller Engineering Co. Elgin, IL

Hopper

Hendricks Engineering Indianapolis, IN	Lipe Automation Equipment Syracuse, NY

Hot Melt Applicator

Nordson Norcross, GA	Seal-O-Matic East Newark, NJ

I/O Rack

Allen Bradley Milwaukee, WI 53204	Fisher Marshalltown, IA 50158

Insertion Tool

Weldun Bridgman, MA	Dixon Automatic Tool Rockford, IL

Label Applicator

Aucry Philadelphia, PA	Spirol Automation Danielson, CT

Length Tester

Weldun Bridgman, MA	Dixon Automatic Tool Rockford, IL

Lubrication Applicator

Permatex Industrial Corp. Newington, CT	Lubriquip Cleveland, OH

Magazines

Aidlin Sarasota, FL	FTI Machesney Park, IL

Micro Processor Computer IBM Montvale, NJ 07645	United States Data Corporation Richardson, TX 75081
Modem U.S. Robotics Skokie, IL 60076	Motorola Albuquerque, NM 87113
Motor Starter Allen Bradley Milwaukee, WI 53204	Square D Palatine, IL 60067
Offline Vacuum Station Venturi's Fraser, MI	Flow Dyne Engineering Ft. Worth, TX
Orienting Rolls Dixon Automatic Tool Rockford, IL	Automatic Feeder Co. Elk Grove Village, IL
O-Ring Expander and Installation Tool Dixon Automation Tool Rockford, IL	Weldun Bridgman, MA
Pick and Place Robot Adept San Jose, CA	GMF Robotics Birmingham, MI
Power Conditioner Topaz San Diego, CA 92123	Superior Electric Bristol, CT 06010
Pressure Chambers Weldun International Bridgman, MI	Daytronics Corp. Miamiasburg, OH
Proximity Switches Turck Minneapolis, MN	Micro Switch Freeport, IL 61032
Ring Cut Off Ace Paper Tube Cleveland, OH 44102	Yorktown Paper York, PA
Rolling and Unrolling System Systemation Engineering Prod. Avon, CT	Crestwood Machine Shaumburg, IL
Rotary Actuator Rotac Berne, IN	PHD Fort Wayne, IN

Rule Die

Diemasters Kansas City, MO 64111	Dieinc Kansas City, MO 64116

Scales

Satorius Corp. Bohemia, NY	Fairbanks Scales St. Johnsbury, VT

Sealant Applicator

CRS Plus Burlington, Ontario Canada	EFD Inc. East Providence, RI

Shuttle

Weldun Bridgman, MA	Dixon Automation Rockford, IL

Slot Cutter

Ace Paper Tube Cleveland, OH 44102	Yorktown Paper York, PA

Speaker System

Gai-Tronics Reading, PA 19603	Accusonic Systms Corp. New Hyde Park, NY 11040

Tape Dispenser

3M St. Paul, MN	Apex Machine Fort Lauderdale, FL

Torque Driver

Weber Mt. Kisco, NY	Spirol Danielson, CT

Track Feeder

Automation Devices Fairview, PA	Moorfeed Indianapolis, IN

Voice Synthesis Module

Square D Palatine, IL	Micro Chip Technology Chandler, AZ 85224

Vacuum Unit

Venturi's Fraser, MI	Flow Dyne Engineering Miamiasburg, OH

Walking Beam Conveyor

Rapistan Grand Rapids, MI	ASI Kansas City, MO

Waterproofing Applicator

Weber Marking System Arlington Heights, IL	Labl-Mark Marietta, GA

Waterproofing Presence Detector	
Omega Stamford, CT	Astro International Corp. League City, TX
Weigh to Loss Feeder	
Accurate White Water, WI	K-Tron Pittman, NJ

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