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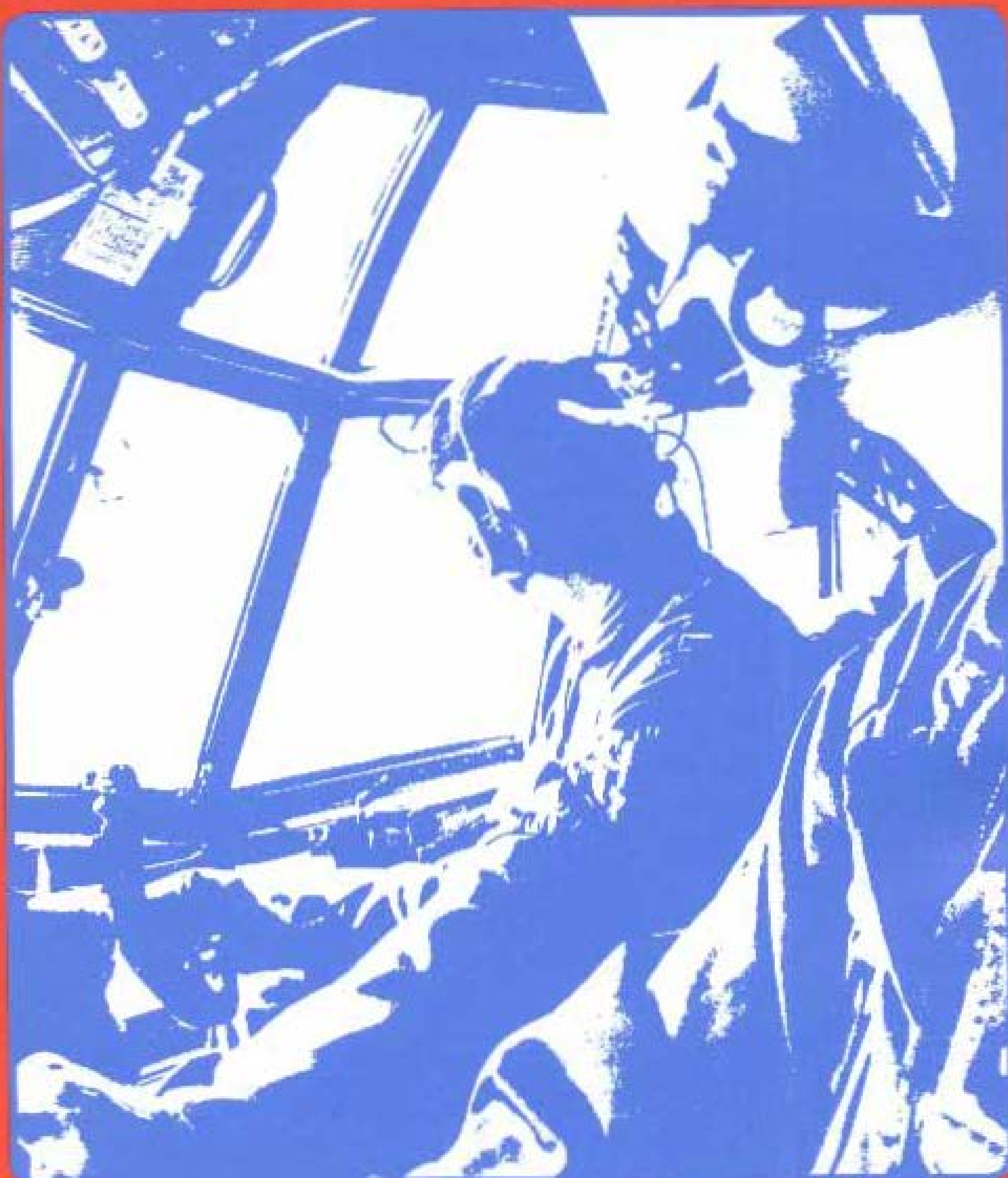
A SERVICE PUBLICATION OF LOCKHEED AERONAUTICAL SYSTEMS COMPANY-GEORGIA



service news

NESA WINDOWS

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A SERVICE PUBLICATION OF LOCKHEED AERONAUTICAL SYSTEMS COMPANY-GEORGIA

Editor
Charles I. Gale

Associate Editors
James A. Loftin
Robert J.R. Rockwood

Art Director
Darrel C. Benfield

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Cover: Few aircraftoffertheflightcrewsofine a field of view as the Hercules airlifter, but keeping those spacious windshield panels clear involves a good deal more than meets the eye.

Focal Point

J.D. Adams

Lockheed Tech Reps: Balancing The Equation

The modern aircraft is universally perceived as one of the proudest achievementsof the industrial age. No other product of human ingenuity has had so profound an impact on the technical and economic progress of the nations of the world, and nothing else has demonstrated such a powerful and enduring hold on the imagination.

For all its power and symbolicsignificance, however, a large aircraft is still fundamentally a tool, a way of getting things done better and faster. It is a very powerful tool to be sure, but for its purpose to be fulfilled, an aircraft must be able to work, and work hard.

While quality in design and manufacture are prime factors in determining how effective a tool it can be, an aircraft also has to be operated and maintained properly for its full potential to be realized. Excellence in all of the hardware elements of an airplanewill count for little it it is not supported by excellence on the human side of the equation.

The more than 50 nations of the world that have invested in the Hercules aircraft know from personal experience how much difference excellence on the human side can make. They have not only acquired the world's most versatile airlifter, but they are also supported by the experience and knowhow of the finest field service organization in the industry.

The Lockheed Field Service Representative, or Tech Rep as he is often called, is the living embodiment of that support and that organization. He is, moreover, not merely a point of contact or just the man from the factory. He is the on-the-scene expert on all aspects of operating and maintaining the Hercules aircraft.

A Lockheed Field Service Representative can tip the scales in your favor, greatly increasing the success potential of any operating or maintenance organization. Supported at the factory by the key people listed below, he can be counted upon to help you maximize the return on your investment in one of the most successful products of the aerospace industry-the Hercules airlifter.

Sincerely,

J.D. Adams, General Manager
Field Service

C-130/Hercules Service Department
Joe Parnigoni, Manager
Telephone 404-933-l 31 1
Telex 542642
Fax 404-933-l 353

Domestic Service Section
Ray Brandt, Supervisor
Telephone 404-933-l 319

Foreign Service Section
Jim Barnes, Supervisor
Telephone404-933.1318

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NESA WINDOWS:
All About Electrically Heated Glass

Nine windshield panels on the C-130 aircraft, and seven on the L-100 aircraft are electrically heated (Figure 1). These windows are of a type generally referred to by trade names such as Electrapane or, more commonly, NESA. NESA is an acronym that evolved from the term Non-Electrostatic Formulation A. It is a trademark of PPG Industries.

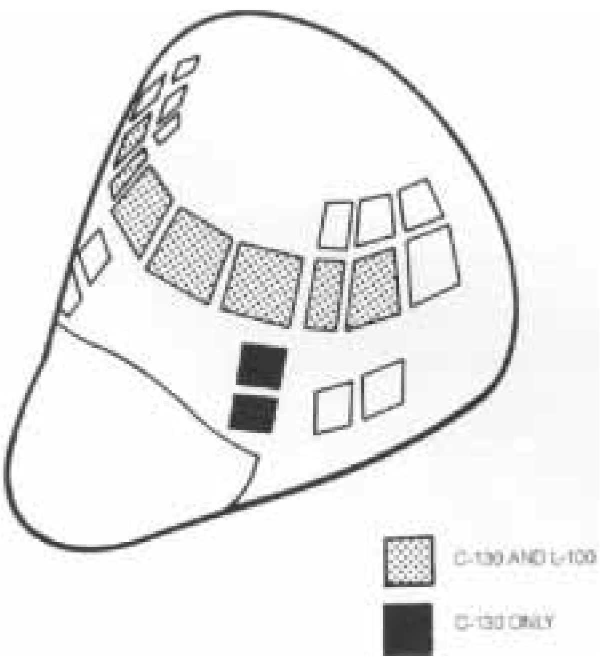


Figure 7. Electrically heated windows-Hercules aircraft.

The NESA windows on Hercules aircraft are of either five-layer or three-layer construction (Figure 2). In the case of the five-layer panels, a central structural glass layer is sandwiched between two vinyl layers, which in turn arc enclosed between two layers of glass.

The three-layer panels consist of a single layer of vinyl between two glass panels. No adhesive is used between the vinyl and glass layers in either the three-layer or five-layer panels. The layers are bonded by heat and pressure during manufacture.

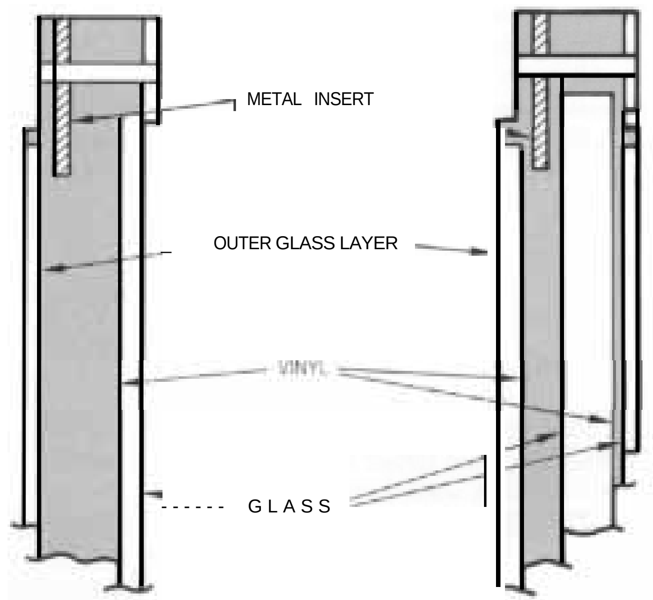


Figure 2. NESA window cross sections. Left, three-layer panel; right, five-layer panel.

On L-100 models of the Hercules aircraft, live-layer NESA panels are used for the pilot's front, copilot's front, and the center windshields, and in the pilot's and copilot's hinged clear-vision windshields. Three-layer panels are used in the side windshields.

C-130 aircraft built to U.S. military specifications use three-layer NESA panels in all of the above locations. The pilot's forward upper and lower windows, which are not installed on commercial versions of the aircraft, also contain three-layer NESA panels.

NESA FUNCTIONS

There are two reasons for providing electrical heating to aircraft windshield panels: one is to ensure that the panels remain clear and ice-free under all operating conditions. The other, also important, is the fact that heated windows offer more physical protection for the crew. NESA windows are significantly stronger and more resistant to shattering due to impact from hail, birds, and other solid objects when they are maintained at their design operating temperatures.

The desired birdproof and fail-safe characteristics of a NESA windshield depend to a large degree on the plasticity of the vinyl interlayer of the panel. The physical characteristics of vinyl are markedly affected by temperature, however, and the wide range of temperatures routinely encountered in a modern aircraft's operating environment can produce significant changes in the contribution the vinyl makes to the strength of a windshield.

Vinyl tends to be brittle in the colder part of the operating range, and quite pliable in the warmer part. The ability of the windshield panels to withstand impact declines rapidly with lower temperatures. For example, a panel's capacity to protect against a birdstrike is reduced by 30 to 50 percent when still at a relatively moderate temperature of 60 degrees F. The optimum temperature range for maximum energy absorption by the vinyl is between 80 degrees F and 120 degrees F, which is the range in which the electrically heated panels are normally maintained.

Windshield Heating

The heating capability of NESA windows is provided by coating the inner surface of the outer glass layer on both types of NESA windows with a thin film of stannic oxide. This is a transparent, resistive material which heats up when an electric current is passed through it (Figure 3).

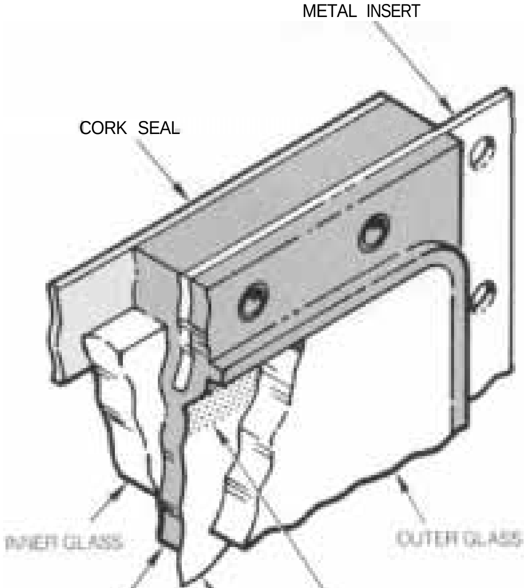
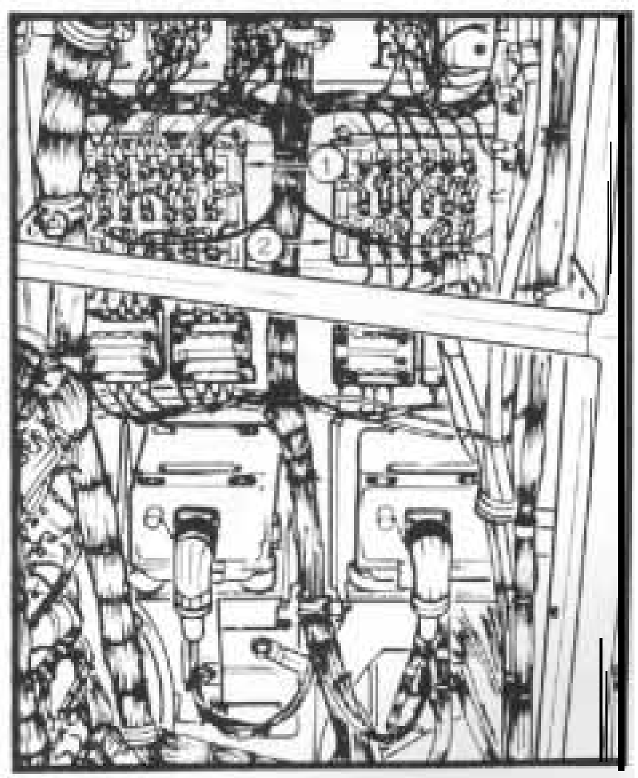


Figure 3. Detail of NESA window construction.

The electric power necessary to produce the required heat is supplied through metallic coatings across the top and bottom of each window which are connected to the stannic oxide and act as bus bars. Electrical connectors joined to these bus bars receive AC power from the NESA window system transformers when the applicable electrical control circuit is energized. This provides a current llow through the stannic oxide film, increasing the temperature of the window.

Power Distribution

Provision for supplying the electric power required to heat the windows is divided between two electrical control systems located in the copilot's distribution panel (Figure 4). One 3-phase transformer supplies AC power to the three center windshield panels directly forward of the two pilots. A second 3-phase transformer provides power to the pilot's and copilot's clear-vision windows and side windows and. on the C-130, to the pilot's two forward windows.



COPILOT'S DISTRIBUTION PANEL

1. MAIN NESA WINDSHIELDTRANSFORMER

2 SIDE AND LOWER NESA WINDSHIELD TRANSFORMER

Figure 4. NESA window power transformer locations

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These systems are supplied with three-phase 1151200 VAC, 400-Hertz, AC power for heating from the left-hand AC bus through the NESA window circuit breakers on the pilot's upper circuit breaker panel. The transformers are used to step up the voltage, and provide two heating rates for the panels.

Approximately 290 VAC is supplied at the NORMAL, and 4.50 VAC at the HI setting of the center windshield panels circuit. **The clear-vision,** side, and pilot's forward window circuit provides about 205 VAC at the NORMAL position, and 320 VAC at the HI position.

Temperature Control

Control of the NESA window heating systems is automatic. Electrical resistance units commonly called thermistors are embedded in the vinyl layers of several of the window panels (Figure 5). A typical installation in a NESA window is shown in Figure 6. The thermistor resistances are part of a 28 VDC control circuit powered from the main DC bus through the NESA window circuit breakers on the copilot's lower circuit breaker panel. The control circuit serves to energize and dc-energize the power relay shown in Figure 7, which applies power to the windows.

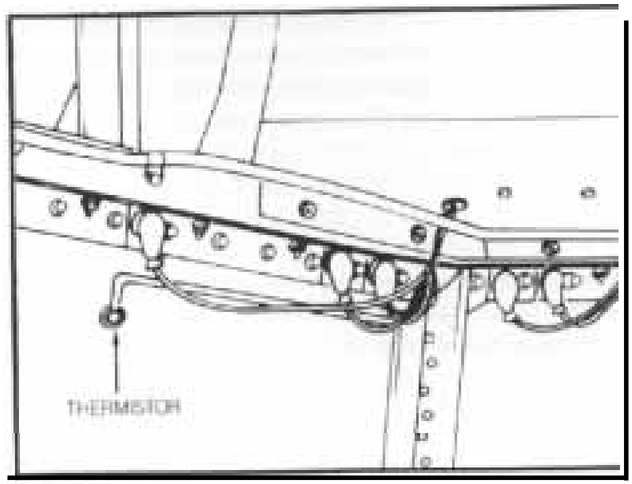

Figure **6.** Typical thermistor installation.

The control circuit is designed to take advantage of the fact that the electrical characteristics of thermistors are affected by changes in temperature. The thermistors used in the NESA window control circuit have a negative temperature coefficient: their electrical resistance decreases when the temperature rises, and increases when the temperature falls

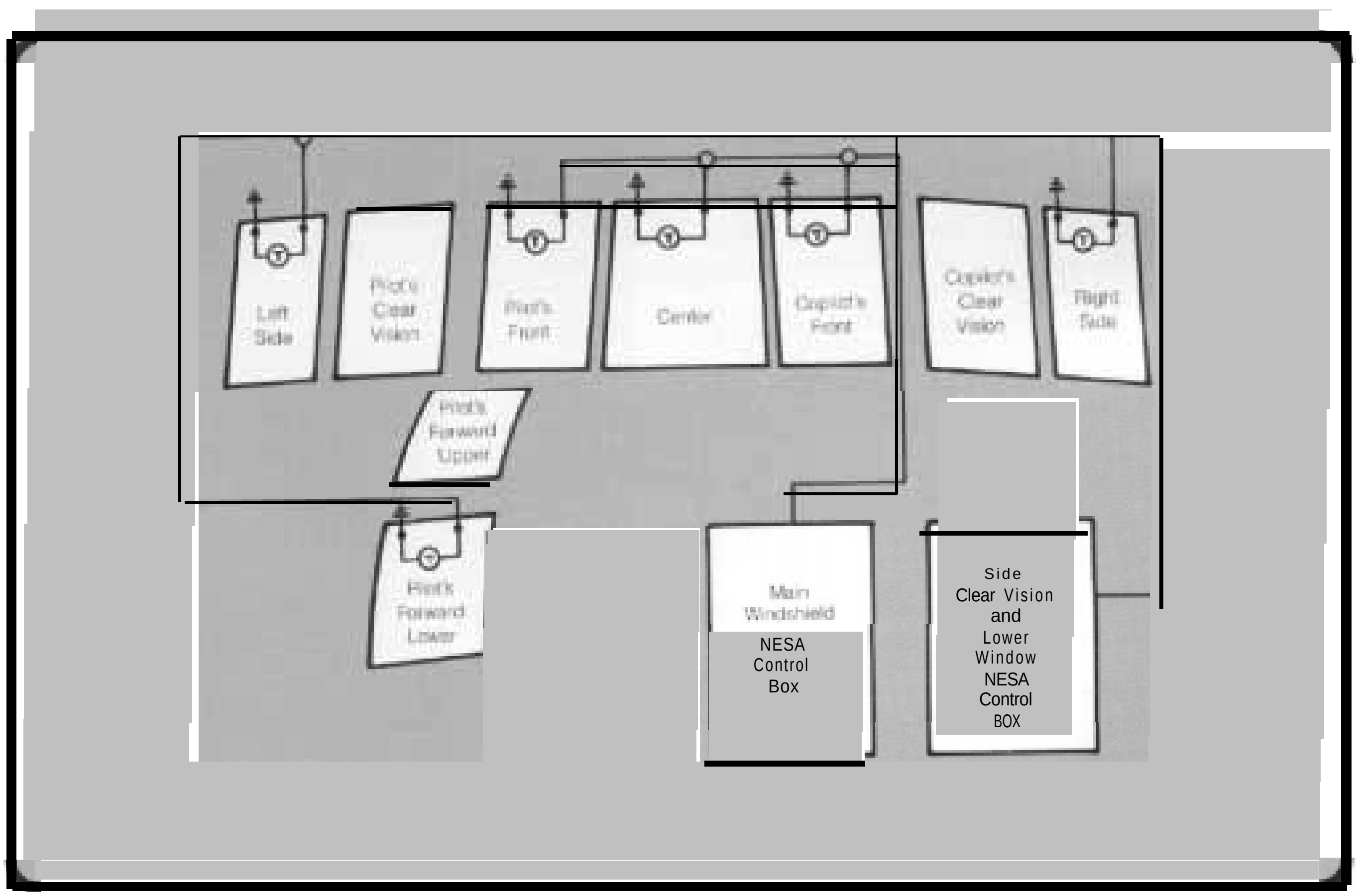

Figure 5. NESA windshield thermistor circuits (simplified).

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Figure 7 presents a simplified version of a resistance bridge circuit that provides the temperature control sensing for the windshield heat. Note that for the sake of clarity, only one phase of the three-phase power circuit to the windshield heaters is shown.

When the control switch is in NORMAL or HI, DC power is supplied from the main DC bus to the NESA control box, The resistance bridge divides the voltage between preset variable resistances to ground. One leg of the bridge connects through a fail-safe relay coil and three thermistors to ground. A galvanometer relay coil is connected across the bridge output. A slave relay is energized from the main DC bus through the contacts of the galvanometer and fail-safe relays.

Window temperature is controlled in the following manner. When the windows are cold, thermistor resistance is high and the fail-safe relay is energized. The bridge is unbalanced and the galvanometer relay contacts close, supplying DC power to the slave relay, which energizes the power relay to heat the windows. When the windows become warm, the thermistor resistance is low. The bridge then becomes balanced and the contacts open to deenergize the slave and power relays to shut off window heat.

With the heat off, window temperature will decrease, causing the thermistor resistance to build gradually to a point at which the galvanometer relay closes and heat is again applied. This cycling will continue as long as the NESA control switches on the overhead anti-icing panel are in either the NORMAL or HI positions.

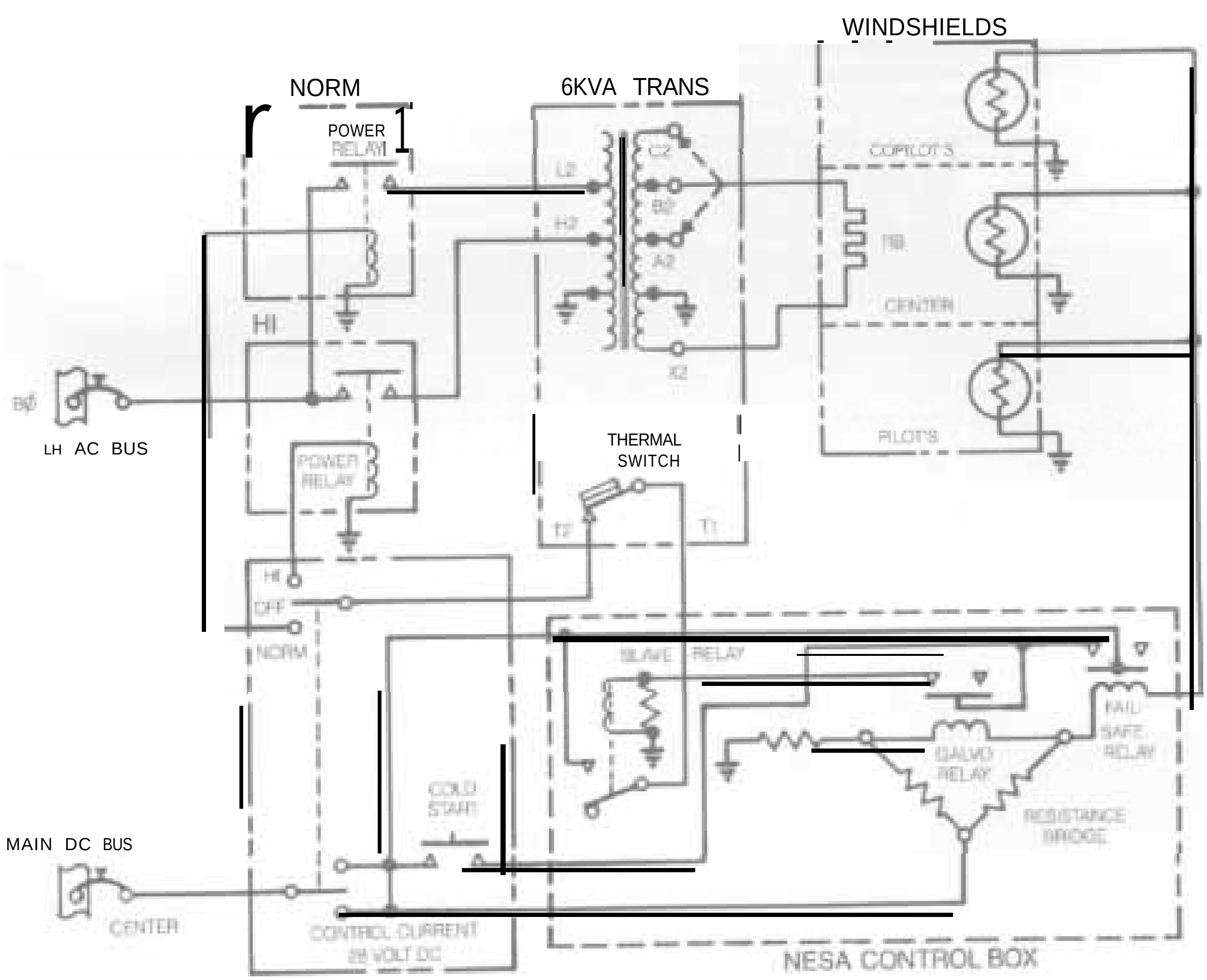

Figure 7. NESA windshield control system (simplified).

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The NORMAL and HI selections provide different rates of heating for the various kinds of icing conditions which may be encountered. NORMAL is the appropriate choice in almost all circumstances where windshield heating is required; HI heat should not be used except during extreme inflight icing conditions.

Cold Weather Operation

When the windshield thermistors are extremely cold, not enough current will flow through them to energize the fail-safe relay. A special cold-start provision is therefore included in the system for initiating operation during ambient ground temperatures below approximately -45 degrees F.

Manually pressing the cold start switches on the anti-icing control panel (Figure 8) permits DC power to bypass the normal control system and allows AC power to heat the windows sufficiently for automatic operation to begin. In practice, these push-type momentary switches must be operated on for 5 seconds and off for 10 seconds for several cycles to allow the windshield temperature to rise slowly. Too rapid heating could result in damage to the windshield panels.

Figure 8. Cold start switch locations.

WINDOW REPLACEMENT CRITERIA

Windshield panels are mounted within the nose section of the aircraft and are exposed to a great deal of physical punishment. They are deluged by rain, pounded by hail and ice, and bombarded by airborne solid particles of almost every conceivable size and kind.

In addition, the windows are exposed to repeated pressurization loads. The pressurization cycles cause the windows to flex outward, and the changing temperatures force the windows to expand and contract. It is not difficult to understand why some windows eventually fail under these conditions.

The decision to replace a window depends largely upon the nature of the failure and its severity. Let us look at some general guidelines on the replacement criteria for various categories of windshield panel failure.

Superficial Defects

Light scratches, and minor chips, nicks, and spalls caused by contact with solid objects may in general be disregarded as long as visibility through the pane1 is not seriously affected.

Such damage is significant mainly in that small defects may represent a starting point for more serious problems. A deep chip, for example, may cause a local weakening in a panel and serve as a focus for crack development. Even superficial defects, such as those caused by the dry operation of the windshield wipers, can predispose a panel to premature failure.

That is why it is always a good idea to carry out periodic inspections of areas where minor damage is known to have occurred. It is important to be certain that minor damage does in fact remain minor.

Cracks

The appearance of a crack in a NESA panel means that a glass layer of the affected panel has broken, even though both pieces are still being held in position by the contacting vinyl layer.

Windshield cracks do not in general present an immediate threat to safety of flight because the NESA windows used in Hercules aircraft are very strong and have a wide built-in margin of operational safety. They remain safe for pressurized flight even when a number of obvious defects are present. Damaged NESA panels are more likely to

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require prompt replacement for reasons of reduced visibility or electrical malfunction than because of concern for their structural integrity.

The immediate action that is required when a cracked panel is discovered is in general similar for both military and commercial, the exceptions being primarily due to differences in construction (three-layer versus five-layer panels) at some locations.

A NESA window with a cracked outer glass layer may be continued in service, provided that the panel continues to heat properly, and visibility is not significantly impaired.

A three-layer windshield panel that develops a crack in the inner glass layer should be replaced as soon as it is convenient. In the meantime, pressurization must be limited to 5 psi. The strength of the vinyl layer may be counted upon to prevent the panel from blowing out, but a weakened window will flex excessively at normal pressurization levels, and this may lead to arcing or loss of electrical conductivity.

Either of these conditions will disturb the resistance values critical to the proper operation of the temperature control system and may cause the other windows in the circuit to overheat. It is therefore important that the electrical operation of a cracked window be monitored carefully.

The heat may be left on if it is needed, but watch for electrical arcing and turn the heat off immediately if arcing is noted. In addition, check the heating of the other panels in the same circuit by placing your hand against them. If any of these panels is too hot to touch with the bare hand, turn off the heat.

The guidelines are much the same for the five-layer NESA panels in commercial models. There should be no cracks, chips, or scratches in the center glass panel. Any panel that exhibits such defects must be replaced.

Crazing

Crazing may be considered an aggravdtcd or advanced stage of window cracking. A cracked window can sooner or later be expected to craze-become covered with an interlocking network of tine cracks.

From the standpoint of both military and commercial replacement criteria, crazing is considered to be a form of cracking, and the same requirements apply. Note, however, that crazing will sometimes result in an almost complete loss of visibility through the affected panel. In such cases, the affected window must be replaced immediately.

Arcing or loss of electrical heating is again a possibility, even more so with a crazed window than with one that is just cracked. Monitor the electrical system closely and turn the heat off if either condition is apparent.

An extra note of caution to the maintenance technician is in place here. The heating operation of a crazed outer glass panel should not be checked with the bare hand when the NESA switches arc on. The voltages involved may exceed 400 VAC and electrical shock is a real possibility.

Bubbles and Delamination

Separation between the glass and vinyl layers is called delamination. Bubbles are small air pockets between the glass and vinyl layers. NESA windows are structurally acceptable with either of these faults.

A window that shows some evidcncc of delamination may be continued in service unless vision is seriously impaired or overheating is noted. Panels containing bubbles that are larger than 0.1 inch in diameter and closer than one inch to adjacent bubbles, or within one inch of the embcdded metal frame that supports the vinyl interlayer, are not acceptable. A window in which delamination appears extensive enough to prevent a vinyl layer from properly supporting the associated glass layers during pressurization flexure should likewise be replaced.

Separation between the embedded metal insert frame and the vinyl layer may affect the electrical heating of the panel. When delamination occurs in the immediate vicinity of a thermistor, the thermistor may sense inaccurate tcmperatures and cause the other windows in the circuit to overheat. Check the other windows and turn off the system if these windows feel uncomfortably warm.

Vinyl Rupture

Vinyl rupture is a longitudinal separation or break which has formed within the vinyl layer itself. In early stages, vinyl rupture appears as a bright silver-colored line originating at and parallel to the metal insert. This can be detected by careful visual inspection using a strong, hand-held light source.

The silver line may show transverse streaks, which are comparable to craze marks in the plastic. The silver-colored line will appear somewhat wider than the edge of the insert and may extend inboard or outboard from the edge. Extension both ways is an indication that the vinyl has completely separated from the insert.

NESA panels containing vinyl layers which show evidence of having ruptured or separated may no longer be able to provide adequate protection against an impact such as a birdstrike. It could be unsafe to continue such windows in service.

Corrosion

Occasionally, corrosion or evidence of moisture is discovered along the embedded metal insert frame. Milky, foggy, or cloudy areas around the border of a window are evidence of moisture and corrosion. Such panels should be replaced.

Arcing

Arcing in an electrically heated window is caused by the electrical current jumping a gap in the resistance coating. If a window is found to be arcing, the NESA system should he turned off. The intense local heating at the spot where the arcing occurs can cause the window to delaminate and crack, and the longer arcing continues, the more opportunity there is for damage to occur.

The kind of damage that will result and how the arcing will affect the other windows in the circuit depends primarily upon the location of the arcing.

Arcing in the area of the power studs, where the electrical harness lugs are connected to the window, will cause the stud and its wire or insulator to be damaged or hurned. Inflight fires have occurred when corrosive delamination immediately around a power stud has allowed the stud to arc to the bus bar.

If arcing occurs in the vicinity of a thermistor, the thermistor or its wires will be damaged by the heat. This will unbalance the control circuit bridge, and may cause the windows in the circuit to overheat.

Arcing that occurs in areas of the window which are not at the edges or near the thermistor can still cause the windows in the circuit to overheat. This will not happen in every instance because a great deal depends upon the sevcrity of the arc and the effect it has on thermistor sensing. There is nevertheless a good chance that the other windows will eventually begin to overheat.

When arcing occurs around the edges of a panel and along the bus bars, it may be due to the entrance of moisture. It is especially important to turn the system off immediately to prevent further damage in this situation because arcing of this type can often be corrected, as described in the next section.

It is always preferable to turn a NESA system off immediately when arcing occurs. The final decision on whether to leave a system on or turn it off will, of course, rest with the pilot. Under some flight conditions, such as when icing is occurring, it may be necessary to leave a system on in order to ensure adequate visibility for safe flight.

If an arcing panel must be left on. it should be done with the knowledge that the arcing panel and the other windows in the same circuit may suffer further damage.

Preventing Window Arcing

In many cases where arcing is noted, it is found in the vicinity of the bus bars. The problem can often be traced to an area along the top of the window where the vinyl layer and the outer glass have begun to separate. The separation of the layers allows moisture to enter and cause arcing, which in turn can cause further delamination and deterioration of the window.

The remedy for arcing problems of this kind is to seal the mating line between outer glass and vinyl to keep out moisture. Although this area may have been sealed when the panel was first installed, pressurization loads cause the glass to be pushed outward repeatedly, which tends to open the parting line between the outer glass panel and the vinyl (Figure 9).

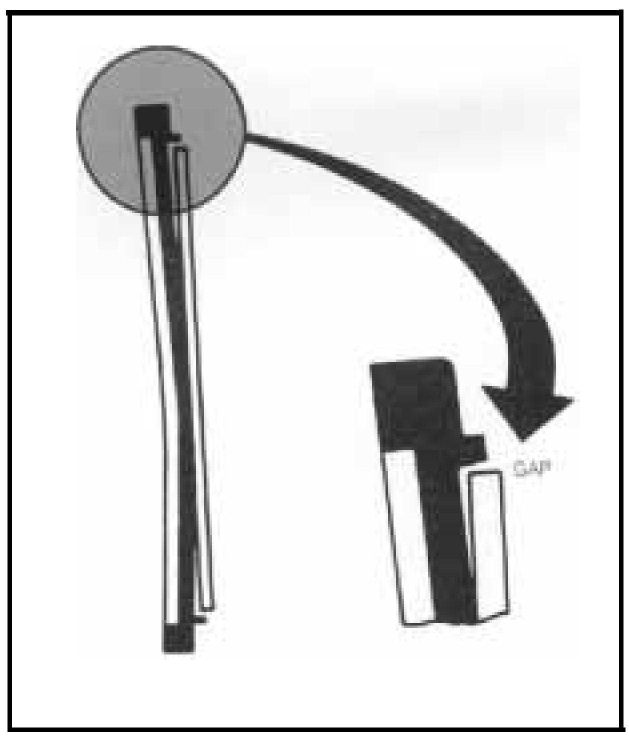

Figure 9. Gap development caused by pressurization cycling and vinyl shrinkage.

Another cause of glass and vinyl separation is the hardening of the vinyl with age. The vinyl contains a compound called a plasticizer, which keeps it pliable. The plasticizer tends to evaporate out of the exposed edges of the panel. causing the vinyl to shrink and recede along the edges of the glass.

These potential sources of trouble mean that it is advisable to inspect the edges of the glass periodically for loose, cracked, or weathered sealant. New sealant should be applied as necessary to prevent moisture from entering, even when the windows are not being replaced.

Improperly installed or overtorqued power studs can also be a potential source of arcing. There have been more than a few instances of NESA windows arcing or shorting out against the airplane frame where the electrical harness lug connects to the window power stud. Always make sure that power studs of the correct size and type are used, and torque them to 20 to 25 inch-pounds when they are initially installed.

Note also that an insulating sleeve is used to cover the harness lug, and arcing may occur if it slips or becomes damaged and insufficient clearance exists between the aircraft frame and the window terminal.

The power studs are exposed to moisture that condenses on the inside of the aircraft skin and runs down the windows, and they should be checked periodically for corrosion. The corrosion is often found between the aircraft frame and the power stud. If present, the corrosion products should be wiped off with aliphatic naphtha. If the stud is corroded beyond cleaning, it should be replaced. A corroded stud presents a potential inflight fire hazard.

NESA WINDOW REMOVAL AND INSTALLATION

Window damage and reduced service life can sometimes be traced to improper removal and installation techniques. It is therefore important that the technical personnel assigned to NESA window maintenance tasks be properly trained and certified, and that only the materials and procedures described in the authorized maintenance manuals be used in removing, installing, and sealing NESA panels.

Two technicians are required to remove and install a NESA windshield. During removal, someone is needed outside the aircraft to hold the screws securing the windshield panel to the airframe while someone else inside is loosening and removing the nuts.

During installation, the individual on the outside must insert the screws through the airframe to the interior of the airplane while the person inside positions windshield panels and retainers and holds them in place. The technician on the inside then places nuts on the screws and keeps them from turning while the person on the outside tightens the screws.

Before starting to remove an old windshield, it is important to be sure that the area immediately below and around the window is covered to prevent debris and loose objects from falling into cracks and crevices and damaging critical components. Particular attention should be given to protecting engine controls, flight controls, and propeller feather override buttons. Make certain that the protective cover is still securely in place when it comes time to install the new windshield.

The removal and installation procedures for NESA panels require the use of industrial solvents such as aliphatic naphtha, trichloroethane, and Federal Specification P-D-680, Type II, or their equivalents. Some of these substances are flammable, and all are toxic to the skin, eyes, and respiratory tract. Always be sure to wear skin and eye protection when handling industrial solvents, and use them only in a well-ventilated area, away from open flames or other sources of combustion.

NESA window removal, installation, and sealing require the use of plastic, phenolic, or other nonmetallic materials in such tools as cutters, putty knives, wedges, blocks, scrapers, and spatulas. Metallic tools can damage both the windows and the airframe and must never be used.

Note that the best and safest techniques in the world will not ensure a successful window replacement if one common pitfall is overlooked: windows should never be installed while the aircraft is on jacks. A windshield installed on a jacked aircraft may crack when the aircraft comes off the jacks.

With these preliminaries in mind, let us review techniques for removal and installation that will help ensure maximum service life of your NESA windows.

Removal of NESA Windows

To remove a NESA window, disconnect all of the panel's electrical connectors, remove all screws and clips from the retainers around the windshield panel, and then remove the retainers and spacers.

If the window is a clear-vision panel, remove the screws and nuts that fasten the hinge assembly to the fuselage

(Figure 10). If the clear vision panel is a military model, remove the cable assembly and safety pin.

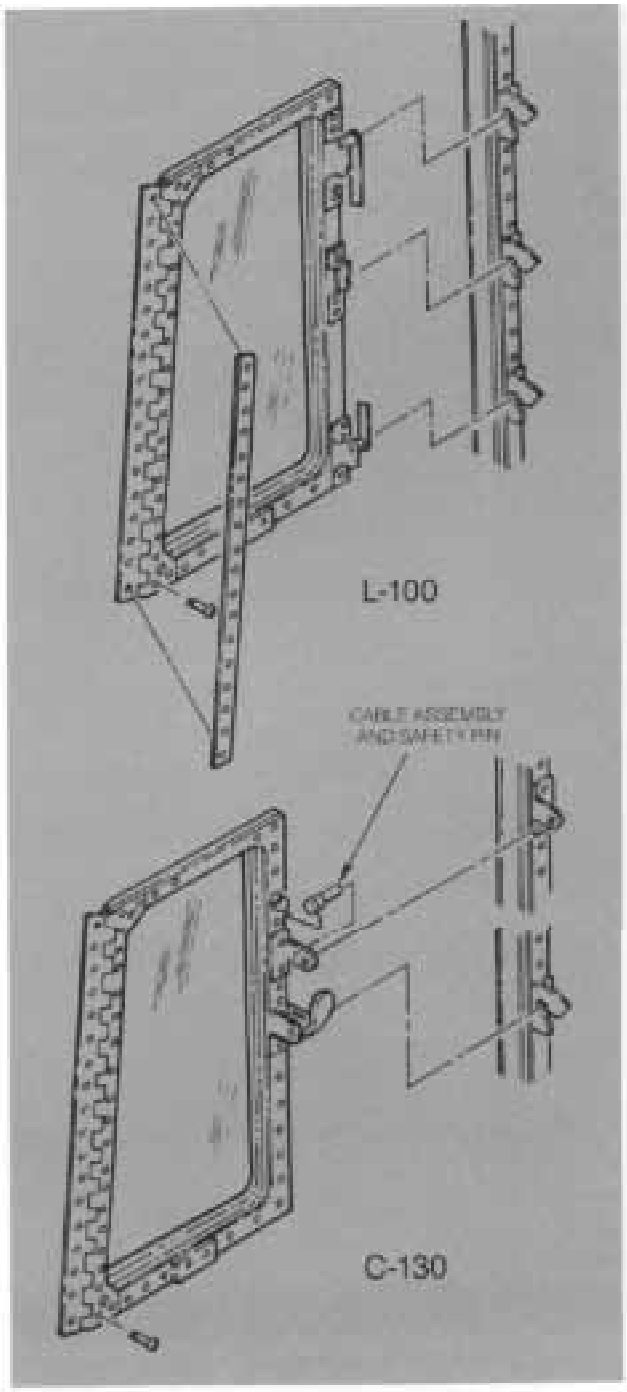

Figure 10 Commercial and military clear-vision windows.

Using a sharp cutter, slice through and pull away the old sealant from around both sides of the windshield panel, as well as from the edge of the adjacent panel if it shares the same frame post. On the exterior side, insert a putty knife or similar tool between the exterior edge of the windshield and the underside of the frame near one of the lower corners of the windshield.

Insert thin wedges spaced 2 to 3 inches apart into the crevice thus formed. Tap on the wedges with a plastic mallet to cause a peeling action of the windshield away from the frame. Continue to add wedges until the windshield breaks loose. After the windshield begins to come loose, take care that the panel does not suddenly pop out of the frame.

When a window is being removed, it is sometimes discovered that an incorrect sealant or parting agent (or no parting agent) was used to install it. If you find that an improper sealant-such as regular fuel tank sealant-has been used instead of the authorized sealant, the removal task will be more difficult, but there are still some things you can do to make the job easier.

Work under normal room temperature, or apply heat if the airplane is out of doors in cold weather. After all the retainers have been removed, a thin spatula inserted between the aircraft frame and the damaged window will help loosen it. Apply steady pressure; avoid pounding on the panel with your hand or anything else. Pressure and patience will go a long way toward loosening glass panels. It is important to resist the temptation to use excessive force, which can damage the aircraft structure. A bent window frame may prove next to impossible to seal.

Several maintenance organizations have reported good results from the use of a simple special tool during window removal. The tool consists of two 4-inch pieces of wooden dowel about the thickness of a broom handle, and a two-foot length of 0.032 safety wire (Figure 11).

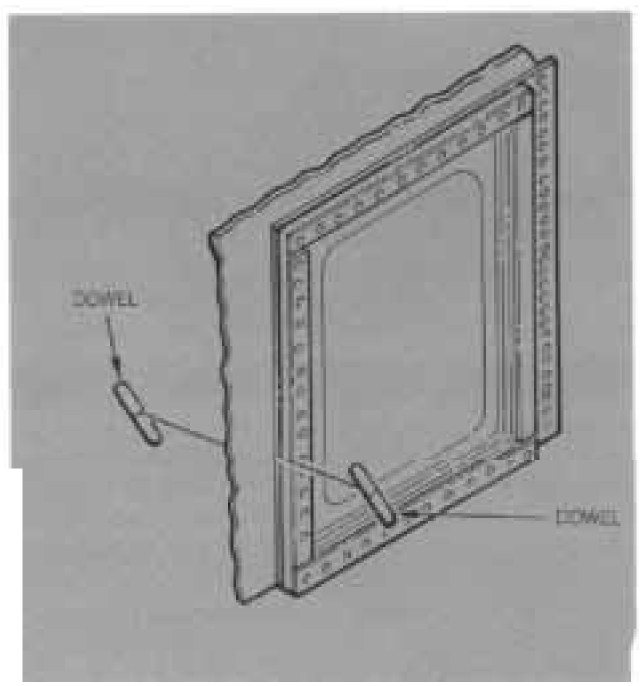

Figure 11. Window removal tool (locally manufactured).

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To use it, first make a small opening in the sealant hetween the window and the frame with a putty knife and wedges, and then thread one end of the safety wire through. Secure both ends of the wire to the dowels; one inside the aircraft and one outside. Using a sawing motion, two technicians can then draw the wire all the way around the windshield frame, cutting the old sealant in the process. After the sealant has been cut, a little pressure on the glass will usually remove even the most stubborn panel.

Preparation of NESA Windows and Mounting Surfaces

Before a NESA window can be installed on the aircraft, the panel must be prepared. A padded work table is required for this. If the windshield is new, carefully peel back the protective paper covering approximately one inch from the edge on each side of the glass, taking care not to expose the glass surface of the panel to possible damage by removing more protective covering than necessary.

Fold the protective paper covering hack and crease it. Insert a blunt-pointed knife or similar tool into the crease and carefully cut the paper along the crease line, taking care to avoid scratching or marking the glass while cutting.

Moisten a clean, lint-free rag with aliphatic naphtha. Clean the mounting surfaces of the windshield, using a two-rag system. Apply the solvent with one rag. and then dry the surface immediately with a second clean, lint-free rag. refolding frequently to keep a clean section of rag on the surface being cleaned. After cleaning, he careful not to touch the area with your fingers or anything that could contaminate it.

Apply l-inch wide pressure-sensitive parting agent tape to the cleaned mounting surface of the windshield that will come into contact with the windshield frame. It is acceptable to overlap the parting agent tape at the corners, but do not apply tape to the vinyl bumper strip (Figure 12). Trim the parting agent tape to conform to the shape of the windshield.

Remove any old sealant, dirt, and grease from the area around the windshield opening on the aircraft back to a distance of about 2 inches. Clean the mounting surfaces of the airframe, again employing the two-rag system; but this time use trichloroethane or P-D-680, Type II, cleaning solvent. Wipe the surface clean with a rag moistened with the solvent. Dry immediately with the second clean rag, refolding frequently to keep a clean section of rag on the surface being cleaned.

Inspect the airframe mounting surfaces. Any evidence of corrosion or other damage that could interfere with the proper installation of the panel should be reported and appropriate action initiated.

Now lift the windshield into the frame and align it with the frame mounting holes. Use size B drill blanks to aid in making the alignment. Hold the windshield in this position while an assistant outside of the windshield applies 2-inch masking tape approximately 1/8 inch inside the edge of the glass and parallel with the frame edge.

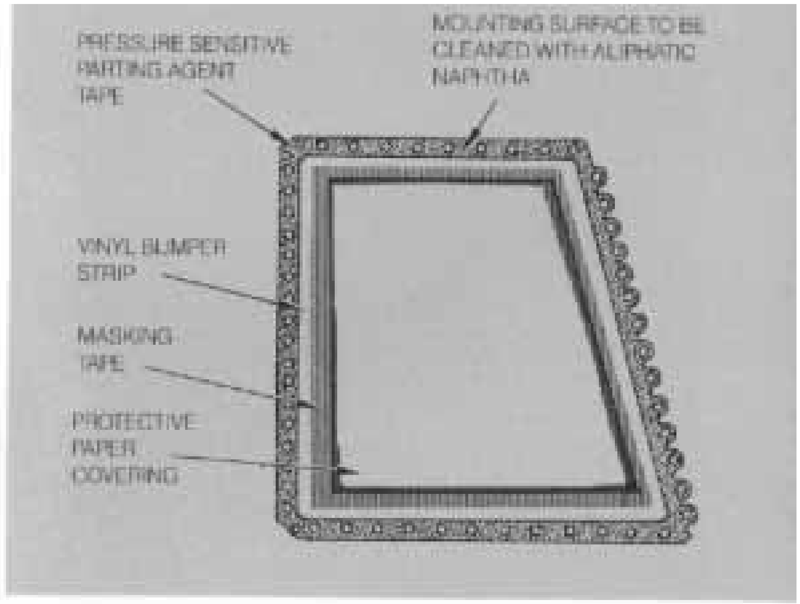


figure 12 Preparing a windshield panel for installation.

Apply a strip of 2-inch masking tape to the outside skin surfaces adjacent to the windshield opening to keep sealant off the structure and minimize cleanup. Use tape up to the edge of the windshield opening. Trim out each hole idcntified to receive a ‘fastener so that when the fastener is installed, no part of the tape will he trapped between the fastener and the **hole.**

Installing NESA Windows-Fixed Panels

Note that the following is intended as a general description of typical NESA window installation procedures. Be sure to consult the authorized maintenance manuals for the specific procedures that apply to your particular aircraft.

Apply a heavy fillet of PRl403G low-adhesion sealant or equivalent to the clean airframe mounting surface. Use an air-driven sealant gun with spatula tip to apply the sealant, or spread it manually with a spatula. Apply a sufficiently thick layer of the sealant to form a complete seal between the mounting surfaces of the windshield and the airframe.

Lift the windshield panel into the airframe opening from the inside, and position it on the mounting surface of the airframe. Hold it in place with four or more size B drill blanks or equivalent. Have an assistant on the outside install as many windshield screws as necessary to allow the windshield to be “floated” into place. Use large washers on the inside to help distribute the weight of the panel.

Using a criss-cross pattern to maintain even pressurc, tighten several fastener nuts sufficiently to float the windshield panel on the sealant to within 0.050 inch of the outer skin. Avoid floating the windshield panel higher than the surface of the outer skin because this might cause too much sealant to be extruded, leaving no cushion of sealant between the glass and the metal.

Sealant Fill and Trim

Fill all depressions and voids between the airframe and windshield with specification MIL-S-8784, Class B, low-adhesion sealant. Carefully examine the outer surface of the window along the edges of the frame where the vinyl and the outer glass layer meet. Apply sealant as necessary to ensure a smooth, continuous seal between the window frame and the glass insert (Figure 13). Remove any excess.

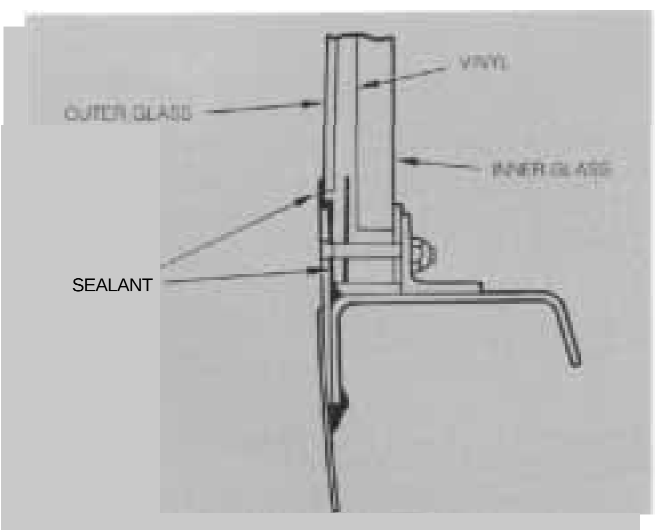


Figure 73. Exterior sealant trim.

Fill the void between windshields that will require spacers for the installation of retainer posts with PR1403G low-adhesion sealant or the equivalent.

Note that spacers are required on the pilot’s, copilot’s and center NESA panels. Refer to the applicable illustrated parts breakdown manual for the correct length of screw and spacer to be used.

To install the spacers, push temporary screws through the skin. windshield flange, and sealant from the outside. Usc a pair of long-nose pliers to place a spacer over each of the screws and seat the spacer onto the windshield flange. Make sure that each screw and spacer is set straight.

Attach an aluminum strap across **the** joining windshield panel edges on two or more of the temporary screws and torque to 20 inch-pounds (Figure 14). The strap may be fabricated from 0.090-to 0.125inch stock about 1% inches by 2% inches. Now remove the masking tape from the outside skin opening and allow the sealant to cure for a minimum of 24 hours.

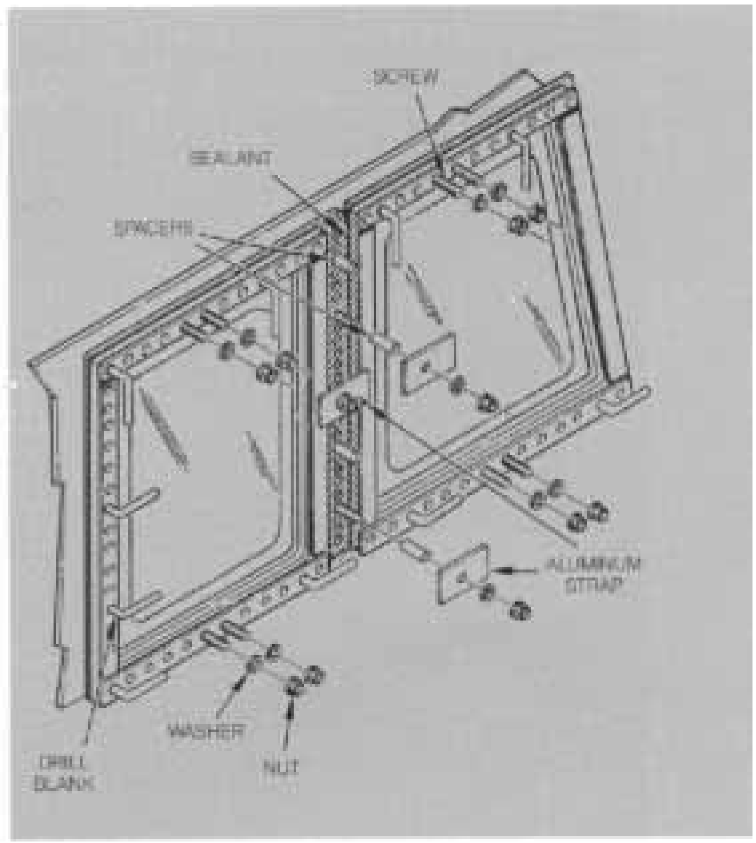


Figure 74. Installation for sealant curing.

After the sealant has cured, remove all the screws and aluminum straps from the windshield. Trim and remove cured sealant from fastener holes which are common between the airframe and the windshield.

Retainer Preparation

Using a scraper, remove and smooth extruded sealant from the edge of the windshield and airframe so that all retainers fit snugly around the windshield. Locate all retainers and clamp them into place (Figure 15).

Ensure that any new retainers to be used are painted with Federal Specification TT-P-1757 zinc chromate primer prior to installation. New retainers may need filing or sanding to get a proper fit.

To install a new retainer, place it in the position it will occupy and tap it lightly with a phenolic block to tighten the fit against the windshield. Enlarge the pilot holes in the retainer which are common with the windshield by drilling them from the outside with a $\frac{7}{32}$-inch drill.

Remove the retainer and drill the holes again with a $\frac{1}{8}$-inch drill and deburr them. The pilot holes in the retainers which are common with those in the airframe sill are drilled after windshield installation. When the holes have been completed, apply the cork gasket, then clamp the retainer into place at the windshield.

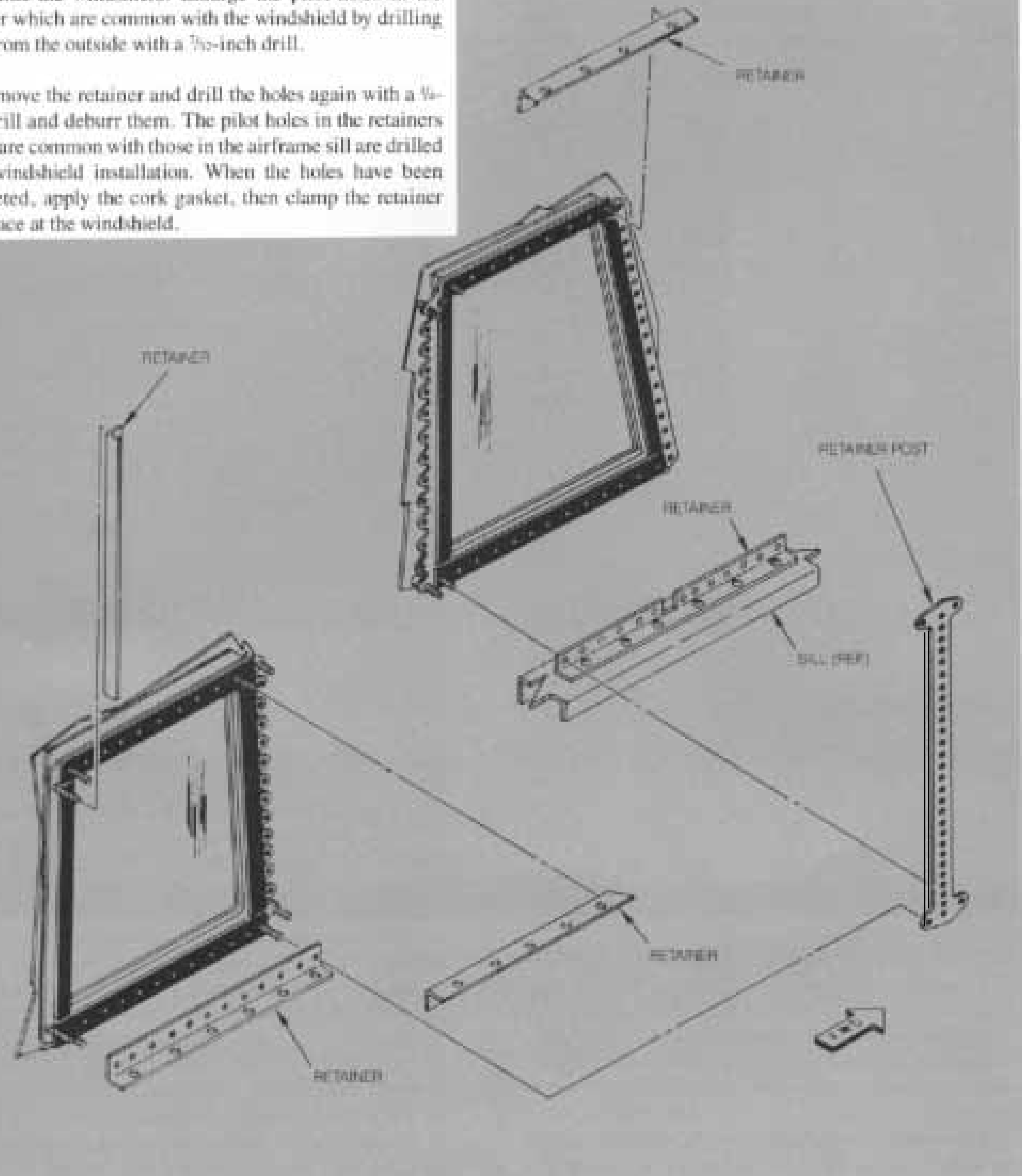


Figure 75. Installing windshield retainers.

Fastener Installation

Clean the windshield fastener holes and countersinks using clean cotton rags and aliphatic naphtha. Then apply PR-1223, Class B1/2, or GC-401, Class B1/2, sealant to the fastener holes with a sealant gun and short nozzle. Fill the holes completely. An assistant will be needed to inform the technician with the sealant gun when the holes are full so that excess sealant can be removed immediately.

Brush-coat each fastener on the shank and under the head with the same sealant. Using a twisting, screwing motion, push sealant-coated screws through the windshields and retainers. Insert one washer and nut on each screw and tighten down.

Torque fasteners on the fixed windshield panels to 18 to 22 inch-pounds. Do not tighten the nuts in a criss-cross pattern in this case. Instead, start at one corner and go around the panel from right to left. Uneven torquing results in point loading and may eventually cause cracking.

Never retorque windshield fasteners once they have been tightened down. Loose nuts which may be discovered later on should be snugged down just enough to seat the fastener.

Windshield screws that interfere with the screws which fasten the retainer to the windshield sill must be omitted. The affected holes in the airframe should be marked and filled with sealant after retainer installation is complete.

If a new retainer is being installed, use a No. 2 drill and drill the pilot holes in the retainer that are common with those in the airframe sill. Note that sealant is not required on these screws.

Once the retainers are installed, the empty windshield fastener holes that were marked for interference must be filled with PRl403G sealant or the equivalent.

Remove the masking tape and the protective paper from both inside and outside the glass panel. Thoroughly clean the windshield after the applied sealant has set. Connect the electrical wiring and perform an operational checkout in accordance with the applicable maintenance manual.

Installing NESA Windows-Clear Vision Panels

Clean the clear-vision panel assembly and aircraft structure, using a phenolic or other nonmetallic scraper and Federal Specification P-D-680 cleaning solvent, or the equivalent. Dry all surfaces with clean, soft cloths.

Be sure shims are installed under the clear-vision handle bracket to permit adjustment of lock clearance for the catch. On the military model it is also necessary to install the safety pin and cable assembly. Commercial models of the Hercules aircraft use a latching mechanism that includes three brackets. Be sure to shim them evenly.

Lift the clear-vision panel assembly into the airframe opening and position it on the mounting surface of the airframe. It is helpful to insert an awl into the top and bottom fastener holes to make it casicr to adjust the clearances between the clear-vision panel and the airframe.

Temporary screws should then be installed from the outside into one of the top, middle, and bottom holes of the hinge assembly and fuselage frames. Place a nut on each temporary screw and tighten.

Close and lock the clear-vision panel. If the panel does not lock or lock smoothly, adjust the height of the bracket or brackets by adding or removing shims. Commercial Hercules aircraft also use shims under the hinges of the clear-vision panels to aid in window alignment.

Loosen the temporary nuts holding the panel and adjust for proper clearance between the clear-vision panel and airframe by pushing on the awls, tapping lightly, or prying so that the clearance is the same on all four sides. After installation, the gap on all sides around the clear-vision panel may vary from 0.03 to 0.12 inches.

Now install the permanent fasteners in the clear-vision windshield hinge, removing the awls and temporary screws as the regular fasteners are secured in place. Use the same general procedure as that described above for fixed NESA windows: clean the fastener holes, fill the holes with sealant, and wet-install the fasteners.

Check the washers on each screw carefully. Make sure that none arc riding on the hinge. If any are found to be interfering with hinge operation, replace them with washers of smaller diameter. The fasteners on clear-vision windshield panels should bc torqued to 25 to 30 inch-pounds.

The next step is to form the gasket that will serve as both weather and pressure seal when the clear-vision window is closed. The following describes the procedure that is used for most military Hercules aircraft.

Close the window and apply 2-inch wide masking tape to the outer surface of the glass about 1/8 inch inside the windshield frame and parallel with the frame edge. Also use the masking tape around the windshield opening to minimize cleanup problems. Now open the window and apply a light, uniform coaling of Dow Corning DC-4 parting agent, or the equivalent, to the rubber seal located on the contact surface of the clear-vision panel frame.

When you really want to find out how to do something, nothing beats going to the experts, and when it comes to installing windshield panels in Hercules airlifters, people like Ft. L. "Dennis" Dennis (left) and Ed Ledford truly are the experts.

Dennis, a 20-year Lockheed veteran who supervises the installation of windshield panels for the C-130 Fuselage Structures Department at Lockheed's Marietta, Georgia, production facility, draws on the experience gained in literally thousands of windshield installations in emphasizing these points on windshield replacement: 1. Make sure that all mating surfaces are clean before applying sealant; the cleaner, the better. 2. Carefully fill in all voids and spaces before the sealant's pot life has expired. 3. Always allow the sealant an adequate amount of time to cure.

Although many contributed to this Service News article, the help of Dennis, Ed, and their team was truly invaluable. We are greatly in their debt.

Next apply a film of MIL-S-8802, Class B-1/2 sealant, or equivalent, about 0.03 to 0.06 inches in thickness, to the clean, contact surface of the airframe.

Close and latch the clear-vision panel, and remove the masking tape from the windshield opening. Note that when the clear-vision panel is closed against the cured sealant, the surface of the glass should be flush with the skin surface. The glass may be up to 0.09 inch below the skin surface on C-130s, up to 0.12 inch below the surface on commercial Hercules models.

Remove all excess extruded sealant, and form the sealant so that it is smooth with the edge of the panel frame. Allow 24 hours for the sealant to cure.

When the sealant has cured, remove the masking tape from the outside surface of the window; then open it and check to be sure that the formed-in-place seal has a smooth and continuous surface. There should also be a small amount of resistance just before the window engages the panel catch or catches, indicating a good seal.

Clean the window thoroughly and connect the heating plugs at the top and the bottom of the panel **in accordance** with the instructions in the applicable maintenance manual.

Matching Resistance Rating

The final step is to make the appropriate electrical connections, and it is important that this be done with care. Premature window failure may result from not properly matching the power source to the electrical resistance of the window.

The electrical resistance of a NESA panel is determined by the stannic oxide coating. Since it is not practical to coat windows with such uniformity that every window will have a standard resistance. there may be a variation of up to 10 percent between the resistance values of individual panels.

NESA windows with lowcrresistance values will tend to warm up faster and become hotter. Those with higher resistance will tend to heat up more slowly and operate at a lower temperature. It is important that such differences be taken into account so that the temperature of all electrically heated windows remains within a safe operating range.

The panels are tested after manufacture to establish into which of three resistance ranges each window falls. The windshield panels arc marked on the basis of the results of this check as RA, RB, or RC.

Since the approximate resistance range of a panel is known before installation, an effective way to control the heating of an individual NESA window is to control the voltage of the input power.

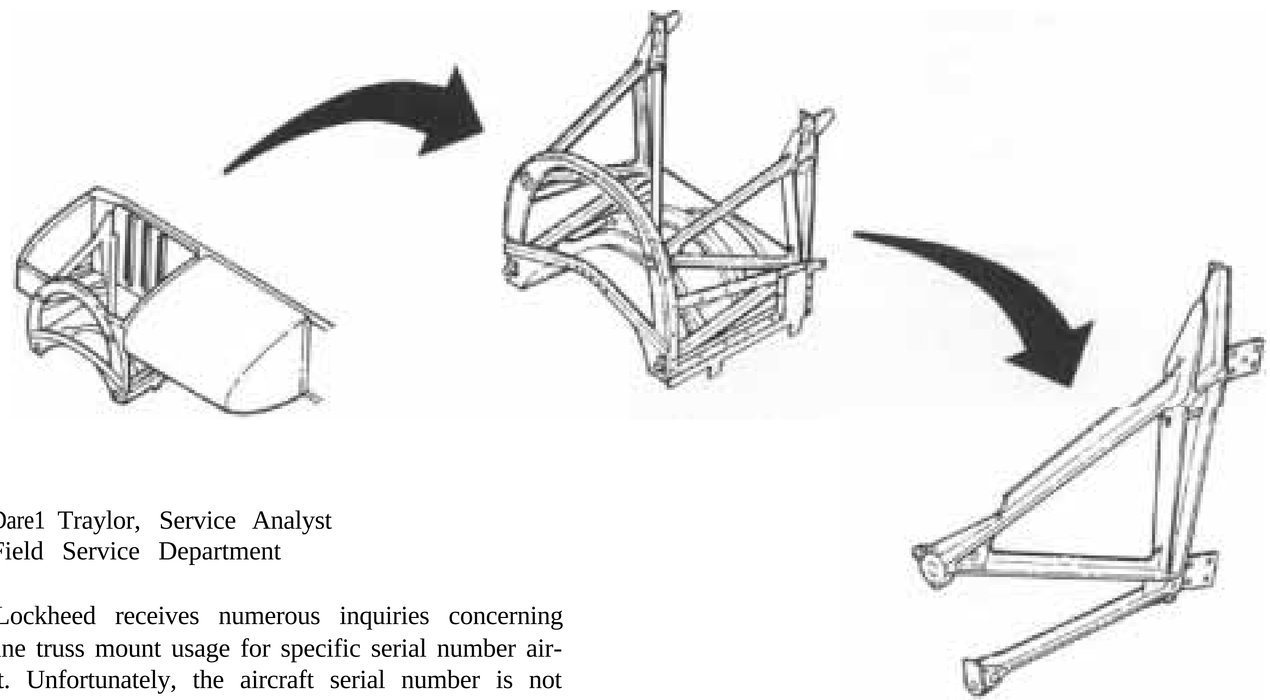
The NESA windshield transformers arc designed to accommodate these variations in window resistance. A choice of three transformer terminals is available for each power lead going to a window. All that is necessary is to connect each window to the correct matching terminal in accordance with the callouts on the applicable aircraft wiring diagram. In the electrical schematic in Figure 7, for example, the RB panel mounted in the center windshield position is shown connected to the B2 terminal of the transformer.

The windshield anti-icing wiring diagrams in the applicable handbooks show how to make the correct wiring connections. Note that if a side windshield, clear-vision window, or the pilot's forward window is being replaced, the resistance rating of the window connected in parallel to the new window must also be considered. Use the chart in the manual provided for this purpose to determine the right transformer terminal.

After the correct terminal has been determined, make sure that power is not applied to the airplane, and open the copilot's distribution panel doors on the right side of the flight station. Locate the proper wire number and make the appropriate terminal connection.

The NESA panels on your Hercules aircraft are built for long, reliable service. With a reasonable amount of care, periodic inspection, and proper removal and installation techniques, NESA windows can offer thousands of hours of trouble-free performance.

ENGINE TRUSS MOUNT USAGE



By Dare1 Traylor, Service Analyst
Field Service Department

Lockheed receives numerous inquiries concerning engine truss mount usage for specific serial number aircraft. Unfortunately, the aircraft serial number is not always as useful in determining truss mount usage as one might think.

Wing replacement and rehabilitation programs have resulted in many changes to parts and materials, and it is difficult for the manuals revisions to keep pace with the resulting variety of aircraft configurations. Unless manuals revision service has been purchased annually, it is possible that your Illustrated Parts Breakdown may not contain the current truss mount replacements available for your aircraft.

The information in the following tables reflects the data contained in the latest engineering drawings, and should help clarify some of the confusion that has arisen concerning engine truss mount differences.

Table 1 offers a guide to engine truss mount usage and interchangeability, and Table 2 shows significant physical differences, such as fabrication materials and lug size, among the various truss mount configurations.

Table 1. Hercules truss mount assembly usage.

LOCATION	MOUNTING LUG SIZE	LEFT-HANDTRUSS	RIGHT-HANDTRUSS
ENG POS NO. 1	0.7 INCH	360013-I /-7 /-27	360014-I /-7 /-27
ENG POS NO. 1	0.9 INCH	360013-I 5 /-19 /-23	360014-15/-19/-23
ENG POS NO. 2	0.7 INCH	360015-1 /-7/-15/-19	360016-I 1-7/-15/-19
ENG POS NO. 3	0.7 INCH	3600151 /-7 /-15 /-19	360016-I /-7 /-1 5 /-1 9
ENG POS NO. 4	0.7 INCH	360017-I /-7 /-27	360018-I /-7 /-27
ENG POS NO. 4	0.9 INCH	360017-15 /-1 9 /-23	360018-I 5 /-1 9 /-23

NOTE: Last dash number shown is the latest configuration for each position depending on the mounting lug size,

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Table 2. Hercules truss mount significant differences.

PART NUMBER	7075-T6 MATERIAL	7175-T736 MATERIAL	0.7-INCH LUG (TANG)	0.9-INCH LUG (TANG)	0.375-INCH CROSS BRACE HOLE	0.500-INCH HOLE W/ BUSHING
360013-1	X		X		X	
360013-7	X		X		X	
360013-15	X			X	X	
360013-19	X			X		X
360013-23		X		X		X
360013-27		X	X			X
360014-1	X		X		X	
360014-7	X		X		X	
360014-15	X			X	X	
360014-19	X			X		X
360014-23		X		X		X
360014-27		X	X			X
360015-1	X		X		X	
360015-7	X		X		X	
360015-15	X		X			X
360015-19		X	X			X
360016-1	X		X		X	
360016-7	X		X		X	
360016-15	X		X			X
360016-19		X	X			X
360017-1	X		X		X	
360017-7	X		X		X	
360017-15	X			X	X	
360017-19	X			X		X
360017-23		X		X		X
360017-27		X	X			X
360018-1	X		X		X	
360018-7	X		X		X	
360018-15	X			X	X	
360018-19	X			X		X
360018-23		X		X		X
360018-27		X	X			X

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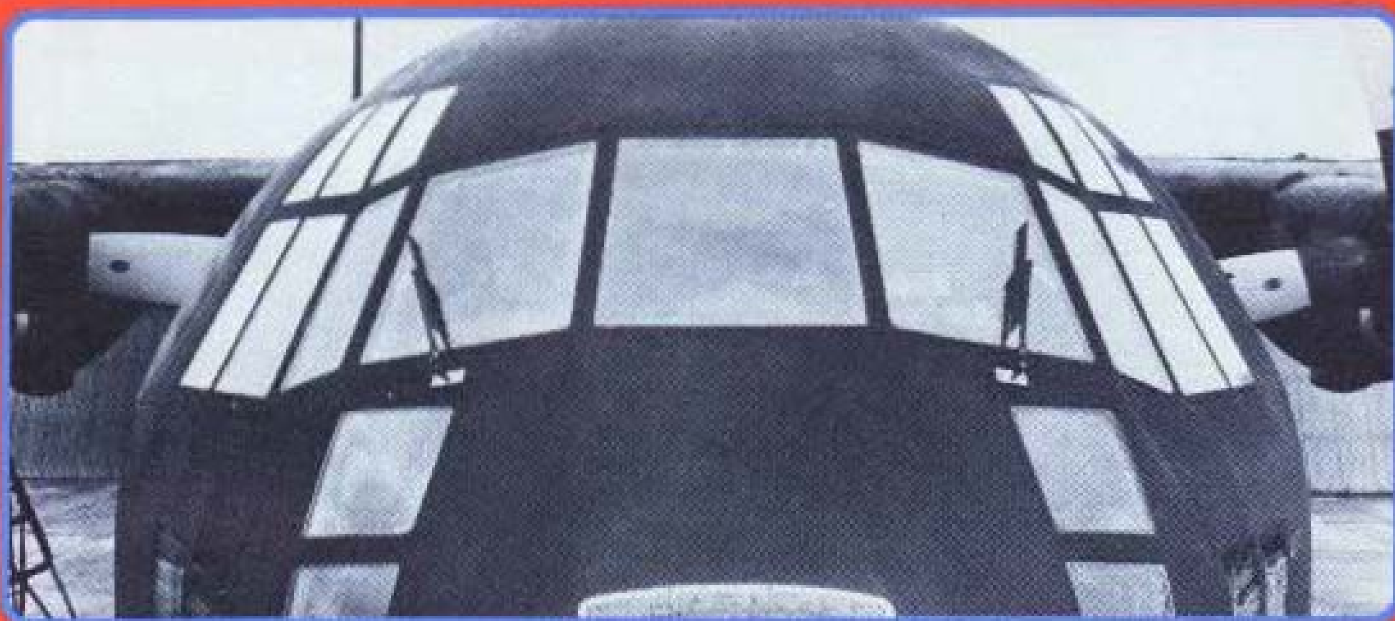

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