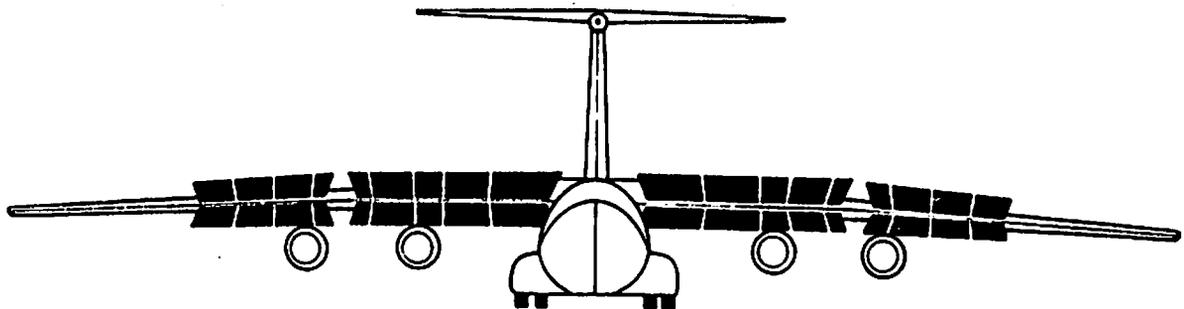


4 JUN

C141A



SPOILER SYSTEM



443d TECHNICAL TRAINING SQUADRON

443d MILITARY AIRLIFT WING, TNG (MAC)

ALTUS AIR FORCE BASE, OKLAHOMA

23 Jun 77

GPO 500

FOR TRAINING PURPOSES ONLY
NOT NECESSARILY CURRENT AFTER DISTRIBUTION

C-141 SPOILER SYSTEM

OBJECTIVES

When you have completed this program, you will be able to:

1. Name the sources of hydraulic pressure during Spoiler operation in flight and on the ground.
2. Identify by name the positions of the Spoiler Lever.
3. Identify the Spoiler warning lights and indicators from a photograph of the various instrument panels.
4. Identify by name the four positions of the Spoiler Select Switch.
5. Identify the conditions which will cause the Spoiler warning lights to illuminate.
6. Define the function of the High Force Detent and Indicator Pin.
7. List the positions of the Spoiler Select Switch and Spoiler Lever for takeoff, inflight and landing operations.
8. List the conditions under which the Spoilers should NOT be deployed in flight.
9. Identify the indications of an asymmetric condition.
10. Define the corrective action after an asymmetric condition occurs.
11. List the positions of the Emergency Retract/Emergency Off Switch.
12. Define the use of the Emergency Retract/Emergency Off Switch.
13. List the conditions which will cause the UNDER SPLR SPEED (Under Spoiler Speed) light to illuminate and define corrective action.

INSTRUCTIONS

The format of this booklet is the same as any other book. It consists of a statement or frame of instruction and if necessary, a question about the information to be answered by you. The correct answer or response is listed on the top of the following page.

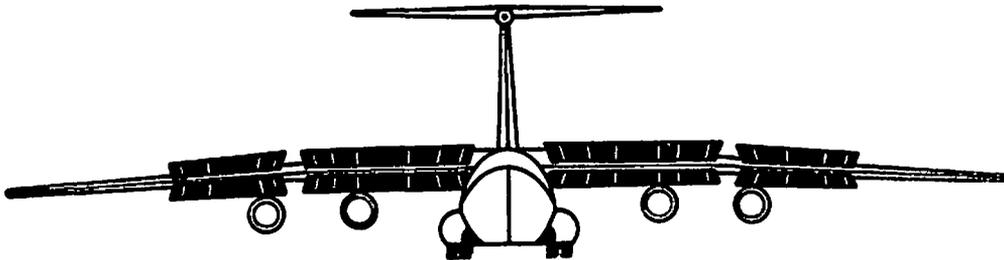
You are required to study the statement or frame of information on each page and if required, answer the question by circling the answer or filling in the blank. You can then check your answer against the correct answer at the top of the next page. If your answer is correct, continue the program, if wrong, correct it before continuing.

Some pages in this text are for information purposes only and do not contain questions, in these cases, continue to the next page after studying the information.

Also included in this text are index pages that list information page numbers that are valuable in locating the subject sought. If at any time you wish to reread or review, feel free to do so.

The Wing Spoilers on the C-141 are ELECTRICALLY CONTROLLED, HYDRAULICALLY OPERATED, HINGED PANELS located just forward of the wing flaps on the UPPER and LOWER surfaces of each wing. The Spoiler panels are divided into INBOARD and OUTBOARD sections located on the UPPER and LOWER surfaces of each wing, with the Spoilers closed, the airflow over and under the wing surface is relatively smooth with a minimum amount of drag. Opening the Spoilers increases drag.

Study the picture and then select the MOST correct statement below.



- A. The Spoiler panels are divided into INBOARD and OUTBOARD sections on the UPPER surface of each wing.
- B. The Spoiler panels consist of single sections located on the UPPER and LOWER surface of each wing.
- C. The Spoiler panels are divided into INBOARD and OUTBOARD sections on the UPPER and LOWER surfaces of each wing.

- C. The Spoiler panels are divided into INBOARD and OUTBOARD sections on the UPPER and LOWER surfaces of each wing.

The purposes of the Spoilers are:

1. In flight.
 - a. To act as a speed brake.
 - b. To allow the pilot to INCREASE the RATE OF DESCENT without exceeding airspeed or Mach limitations.
2. On the ground.
 - a. DECREASE the landing ground roll.
 - b. DECREASE the stopping distance during a Rejected Take-off.

When opened in flight the Spoilers will decrease the rate of descent.

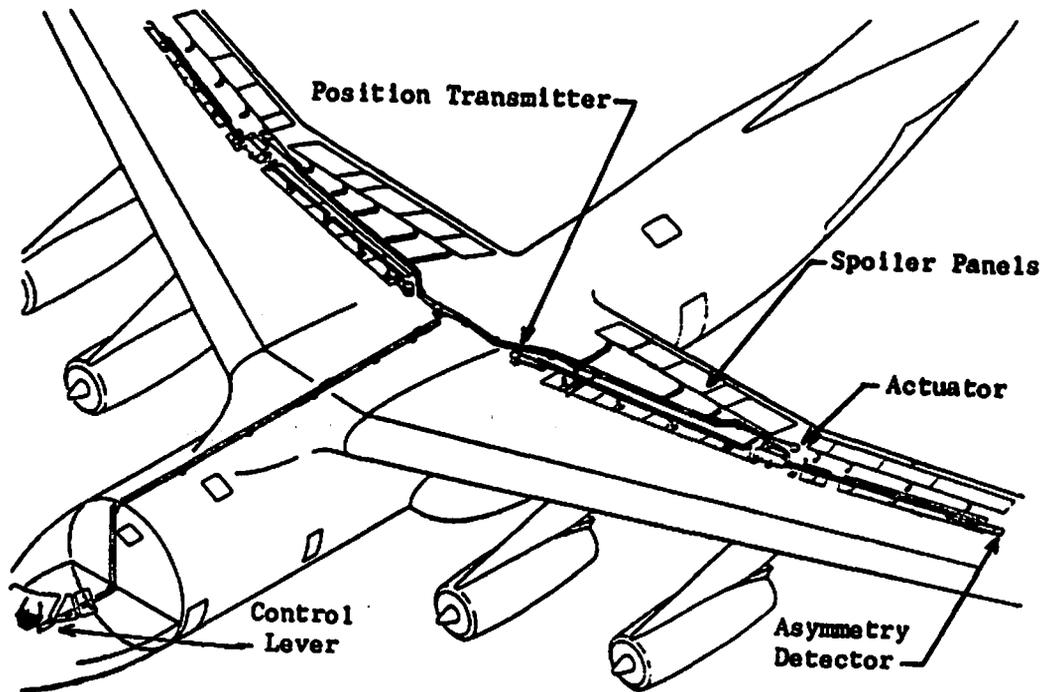
A. TRUE

B. FALSE

B. FALSE

The Spoilers are OPENED to DECREASE the airspeed in flight, to allow the pilot to INCREASE the Rate of Descent (without exceeding airspeed or Mach limitations), DECREASE the Landing Ground Roll, and DECREASE the stopping distance during a Rejected Take-off.

The picture below shows the Spoiler system installation.



Both electrical power and hydraulic pressure are necessary for Spoiler operation. If *either* system is not available, the Spoilers will NOT operate.

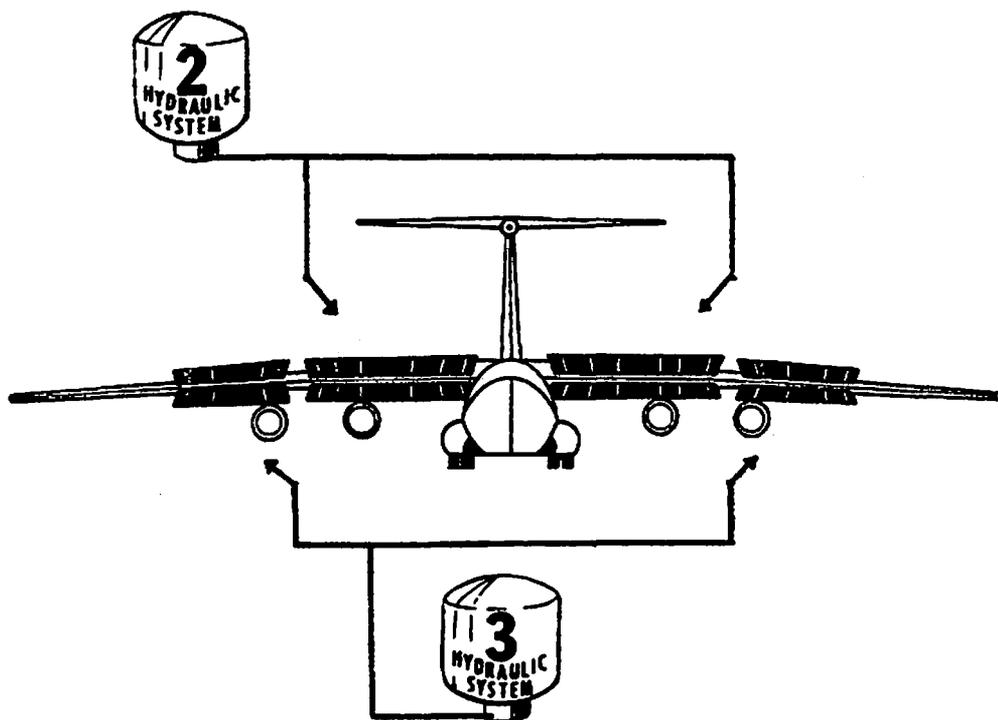
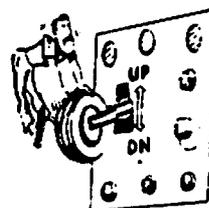
First, let's examine the SOURCES of hydraulic pressure used to operate the Spoilers and how the Landing Gear Lever position influences the source of hydraulic pressure.

Hydraulic Systems Nr 2 and Nr 3 are used to open and close the Spoilers.
But HOW these systems work together to operate the Spoilers depends on the
POSITION of the LANDING GEAR LEVER.

With the Landing Gear Lever in the DOWN position:

1. Hydraulic System Nr 2 operates the INBOARD Spoiler Sections.
2. Hydraulic System Nr 3 operates the OUTBOARD Spoiler Sections.

Study the picture and then answer the statement below.



With the Landing Gear Lever DOWN, does Hydraulic System Nr 2 operate
the INBOARD Spoiler Sections?

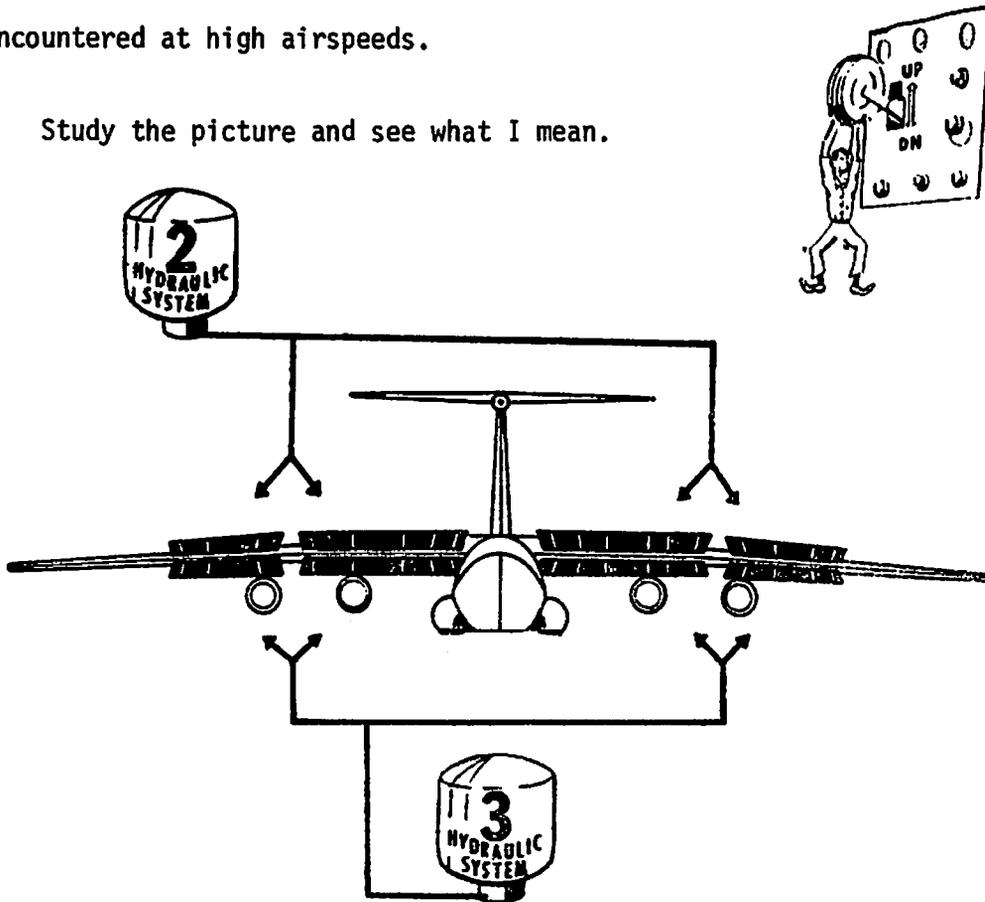
- A. YES
B. NO

A. YES

You're getting the picture. With the Landing Gear Lever down, Hydraulic System Nr 2 operates the inboard sections and Hydraulic System Nr 3 operates the outboard sections.

Let's place the Landing Gear Lever UP. Now BOTH hydraulic systems send pressure to operate ALL SPOILER SECTIONS to overcome the higher air loads encountered at high airspeeds.

Study the picture and see what I mean.



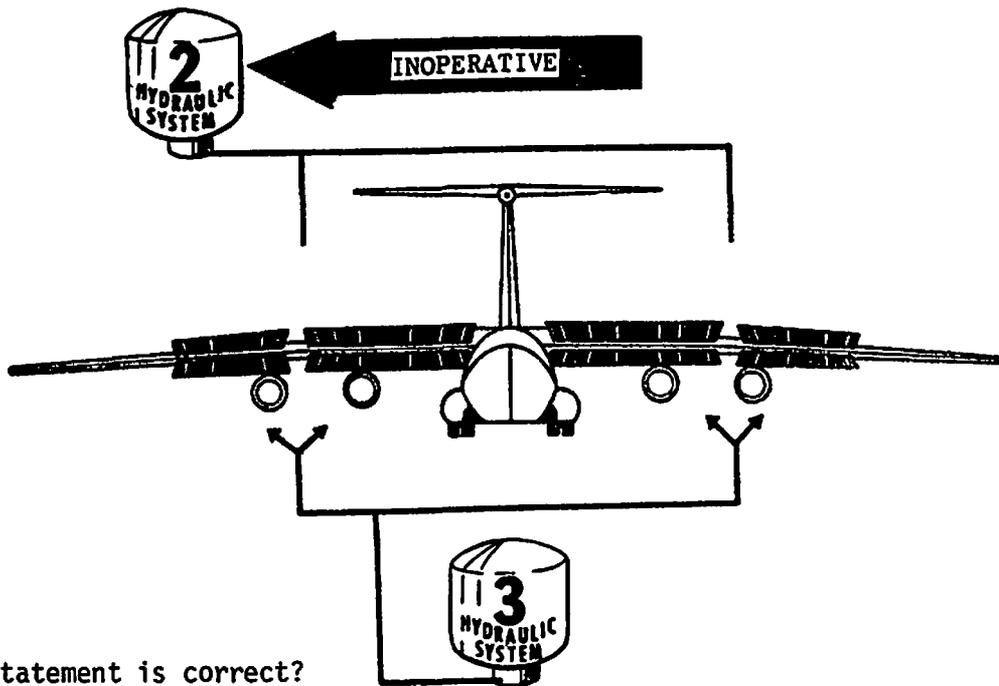
Which of the following is correct?

- A. With the Landing Gear Lever UP, Hydraulic Systems Nr 2 and Nr 3 apply pressure to all Spoiler sections simultaneously to open or close them.
- B. With the Landing Gear Lever UP, Hydraulic System Nr 2 operates the inboard sections and Hydraulic System Nr 3 operates the outboard sections to open and close them.

- A. With the Landing Gear Lever UP, Hydraulic Systems Nr 2 and Nr 3 apply pressure to all Spoiler sections simultaneously to open or close them.

Real good. Now we know, when the Landing Gear Lever is in the UP position, both hydraulic systems work together and operate ALL Spoiler sections and with the Landing Gear Lever in the DOWN position, Hydraulic System Nr. 2 operates the inboard sections while Hydraulic System Nr 3 operates the outboard sections. But -- WHAT happens if either hydraulic system should fail?

No sweat, because the remaining system would then operate ALL Spoiler sections REGARDLESS of which position the Landing Gear Lever was in. Naturally, the Spoilers will not move quite so fast with only one hydraulic system operating, but they will function.



Which statement is correct?

- A. With the Landing Gear Lever DOWN, the inboard Spoiler sections would NOT operate after a Hydraulic System Nr 2 failure.
- B. Should Hydraulic System Nr 2 fail when the Landing Gear Lever is DOWN, Hydraulic System Nr 3 will operate ALL Spoiler sections, but the rate of movement will be slower than normal.

- B. Should Hydraulic System Nr 2 fail when the Landing Gear Lever is DOWN, Hydraulic System Nr 3 will operate ALL Spoiler sections, but the rate of movement will be slower than normal.

How right you are! Should either hydraulic system fail, the other system operates all Spoiler sections regardless of the position of the Landing Gear Lever, but at a slower than normal speed.

As a review, fill in the statements or circle the correct word(s) below: then check your answers on Page 8.

1. The Spoiler sections are divided into inboard and OUT BD sections located on the upper and Lower surfaces of each wing.
2. Opening the Spoilers will:
 - a. Cause the airspeed to (increase) (decrease).
 - b. Allow the pilot to (increase) (decrease) his Rate of Descent without exceeding airspeed or Mach limitations.
 - c. Cause the landing ground roll to (increase) (decrease).
 - d. Decrease stopping distance during a (Short Field) (Rejected) Take-off.
3. With the Landing Gear Lever DOWN, Hydraulic System Nr 2 operates the (inboard) (upper) Spoiler sections and Hydraulic System Nr 3 operates the (outboard) (lower) Spoiler sections.
4. With the Landing Gear Lever UP, Hydraulic Systems Nr 2 and Nr 3 apply pressure to all Spoiler sections simultaneously.
5. If Hydraulic System Nr 2 fails, Hydraulic System Nr 3 operates (all) (only the outboard) Spoiler sections.

ANSWERS TO THE REVIEW

1. outboard lower
2. a. decrease
 b. increase
 c. decrease
 d. rejected
3. inboard outboard
4. 2 3
5. 3 all

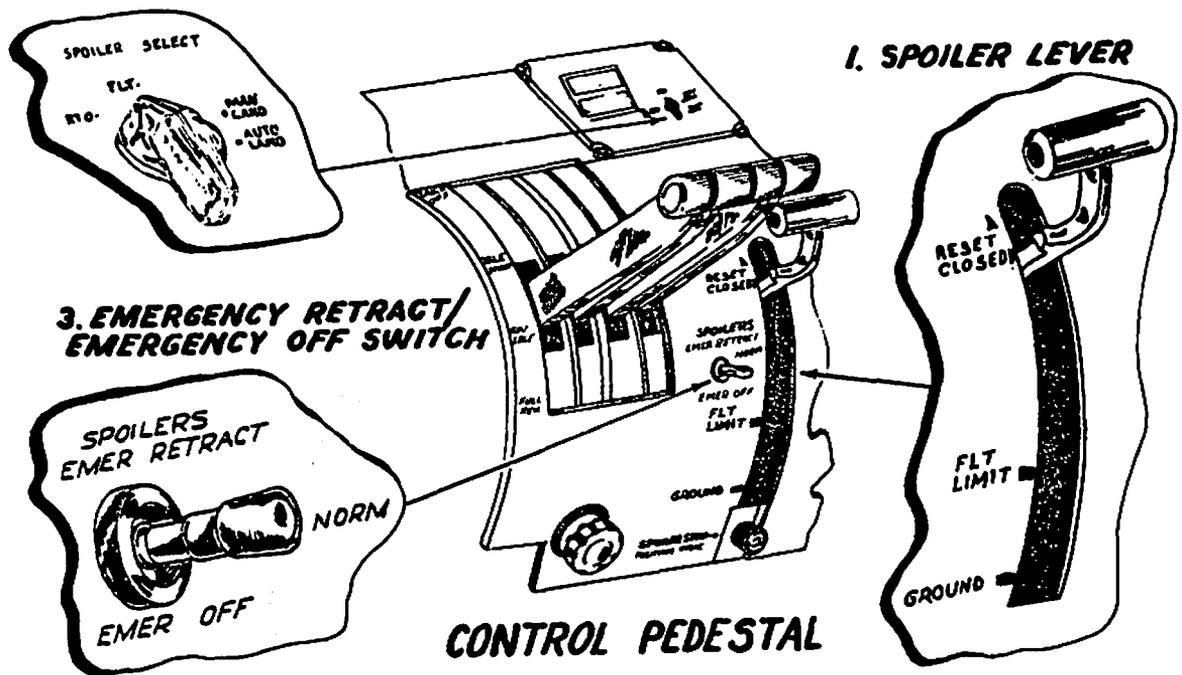
If you missed any questions, review the page listed.

1. Spoiler panel location: Page 1
2. Purposes of Spoilers: Page 2
3. Hydraulic sources with the Landing Gear Lever DOWN: Page 4
4. Hydraulic sources with the Landing Gear Lever UP: Page 5
5. Failure of one hydraulic system: Page 6

Now we are going to be concerned with the three (3) Spoiler Controls located on the Control Pedestal:

1. Spoiler Lever
2. Spoiler Select Switch
3. Emergency Retract/Emergency Off Switch

2. SPOILER SELECT SWITCH



Let's discuss the SPOILER LEVER first. It provides a means of opening and closing the Spoilers.

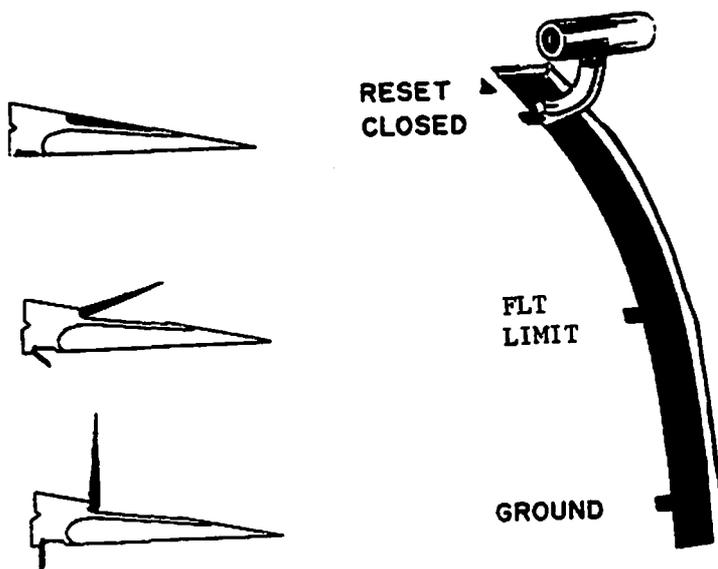
Does this picture show four quadrant markings: RESET, CLOSED, FLT LIMIT, and GROUND?

- A. YES
- B. NO

A. YES

That's right. The four (4) position markings on the Spoiler Lever quadrant are: RESET, CLOSED, FLT LIMIT and GROUND.

Moving the Spoiler Lever to any of the positions except RESET will position the Spoilers to the selected position. The Spoiler Lever is spring loaded from the RESET to the CLOSED position. Moving the Spoiler Lever to any intermediate position between quadrant markings will MOVE the Spoilers to a position relative to the Spoiler Lever position.



By looking at the picture above, can you see that the Spoilers are designed to open further on the ground than in flight?

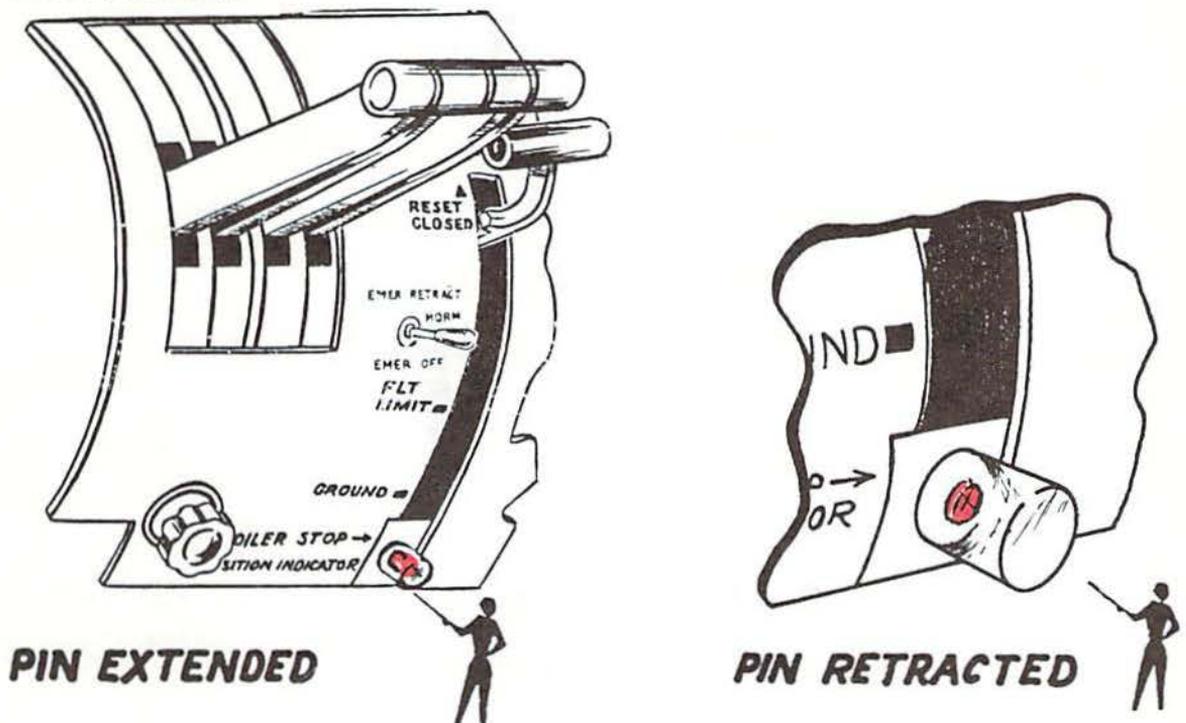
- A. YES
- B. NO

A. YES

The Spoilers are designed to open further on the ground than in flight. The GROUND position is too much for flight operation.

Here is something else you should know about the SPOILER LEVER. It has a solenoid operated HIGH FORCE DETENT at the CLOSED position that serves as a *warning* to prevent the pilot from inadvertently deploying the Spoilers when the Wing Flaps are NOT full up in flight. The High Force Detent -- when engaged -- resists Spoiler Lever movement but *can be overridden* by applying approximately 50 pounds of force to the Spoiler Lever.

When the High Force Detent is engaged, a Spoiler stop position INDICATOR PIN located below the Spoiler Lever slot will extend from the face of the control pedestal.



It is easier to position the Spoiler Lever when the Spoiler Stop position INDICATOR PIN is

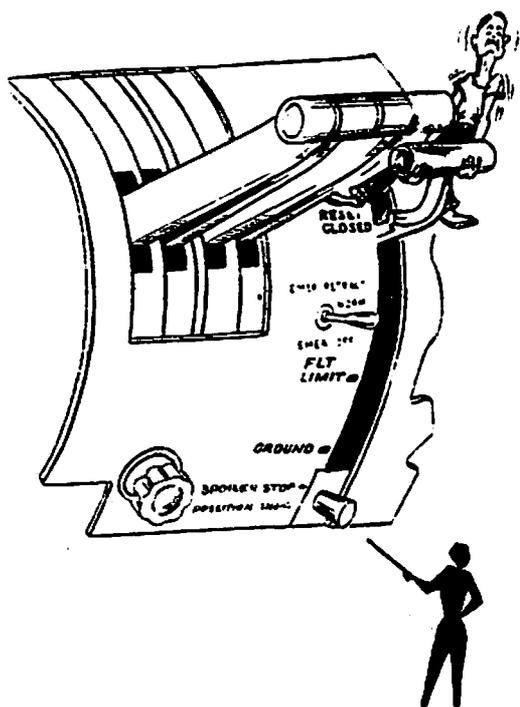
A. Extended from the face of the pedestal.

B. Retracted from the face of the pedestal.

B. Retracted from the face of the pedestal

You are 100% right. It is easier to position the Spoiler Lever when the Spoiler Indicator Pin is *retracted* because the High Force Detent is also *retracted*.

But how can the pilot remove the High Force Detent. Easy, if the wing flaps are full up, he simply LIFTS the Spoiler Lever. This energizes a solenoid to remove the High Force Detent.



When the Spoiler Lever is lifted, what happens to the Indicator Pin?

- A. It retracts from the face of the pedestal.
- B. It extends from the face of the pedestal.

A. It retracts from the face of the pedestal.

That's right. Lifting the Spoiler Lever completes the circuit to the solenoid operated High Force Detent and RETRACTS the Detent and Indicator Pin.

If the Wing Flaps are NOT full up IN FLIGHT, the High Force Detent CANNOT BE REMOVED even if the Spoiler Lever is lifted. This *warns* the pilot when he tries to open the Spoilers. However, the pilot can extend the Spoilers by applying about 50 pounds of force to the Spoiler lever which overrides the High Force Detent.

The pilot CANNOT open the Spoilers in flight when the Wing Flaps are positioned other than full up.



TRUE

FALSE

B. FALSE

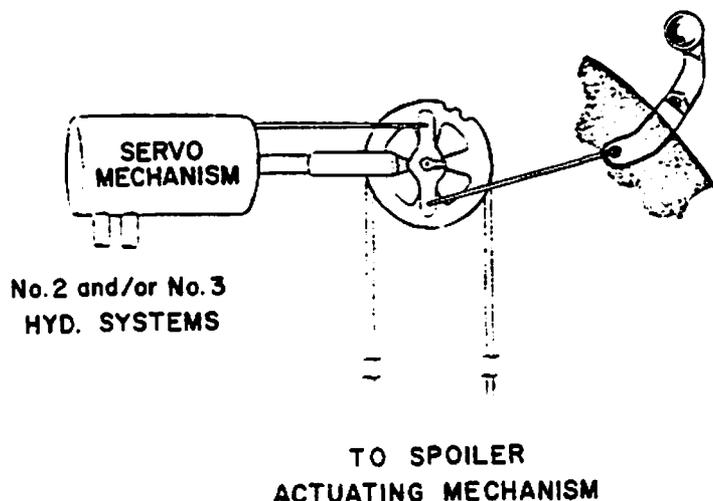
The pilot CAN open the Spoilers in flight when the wing flaps are NOT full up by applying approximately 50 pounds of force to the Spoiler Lever to override the High Force Detent.

However, a WARNING in T.O. 1C-141A-1 tells us:

UNDER NO CIRCUMSTANCES SHOULD THE
SPOILERS BE DEPLOYED IN FLIGHT
UNLESS THE FLAPS ARE FULLY RETRACTED

A Cable SERVO, operated by Hydraulic Systems Nr 2 and Nr 3, is located in the Spoiler Lever Mechanism to provide three primary functions:

1. ASSIST the pilot in moving the Spoiler Lever in EITHER direction.
2. Provide AUTOMATIC Spoiler Lever movement toward the GROUND position during AUTOMATIC Spoiler opening.
3. Act as an irreversible mechanism (within the normal spoiler system blow down limits).



The SERVO is hydraulically operated to move the Spoiler Lever automatically, assist the pilot in moving the Spoiler Lever toward the GROUND position only, and act as an irreversible mechanism.

- A. TRUE
 B. FALSE

B. FALSE

The Spoiler Lever is SERVO operated by Hydraulic Systems Nr 2 and Nr 3 to:

1. Assist the pilot in moving the Spoiler Lever during manual operation, regardless of the direction of movement.
2. Provide automatic Spoiler Lever movement toward the GROUND position during AUTOMATIC Spoiler opening.
3. Act as an irreversible mechanism.

The Servo will operate on one hydraulic system, but two are used as a safety precaution.

Now, let's examine one more function of the Spoiler Lever. Suppose Hydraulic System Nr 3 isn't turned ON, when the Spoilers are to be opened. In this case, moving the Spoiler Lever OUT of the CLOSED position turns Hydraulic System Nr 3 ON.

Select the correct statement below:

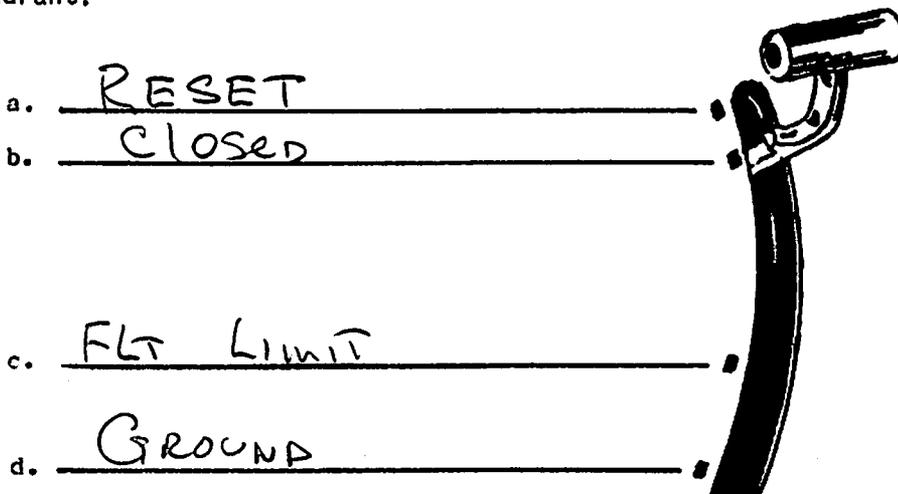
- A. Moving the Spoiler Lever out of the CLOSED position turns ON Hydraulic System Nr 3, if it isn't already on.
- B. Lifting the Spoiler Lever turns ON Hydraulic System Nr 3, if it isn't already on.

- A. Moving the Spoiler Lever out of the CLOSED position turns ON Hydraulic System Nr 3, if it isn't already on.

Moving the Spoiler Lever out of the CLOSED position turns the Hydraulic System Nr 3 ON, if it isn't already ON.

Let's review. Fill in the blanks or circle the correct word(s).

1. The Spoiler Lever is located on the ((control pedestal)) (center instrument panel).
2. Fill in the names of the four markings located on the Spoiler Lever quadrant.



3. The pilot can select any intermediate position of the Spoiler Lever between CLOSED and (FLT LIMIT) ((GROUND)).
4. The unit which warns the pilot if he tries to open the Spoilers in flight when the wing flaps are NOT full up is the High Force ((Detent)) (Stop).
5. The pilot may remove the High Force Detent in flight if the flaps are full up by lifting the Spoiler Lever.

- A. TRUE
 B. FALSE

6. If the High Force Detent is NOT removed, an Indicator PIN protrudes from the face of the console.
7. The pilot may override the High Force Detent by applying approximately (ten) (fifty) pounds of force to the Spoiler Lever.
8. The three primary functions of the Servos in the Spoiler Lever mechanism are to assist the pilot in moving the Spoiler Lever in either direction, provide AUTOMATIC Spoiler Lever movement toward the GROUND position during automatic opening, and act as an irreversible mechanism (within the normal Spoiler System blow down limits.)
- A. TRUE
B. FALSE
9. The Cable Servo is operated by Hydraulic Systems Nr. 2 and Nr. 3.
10. Moving the Spoiler Lever out of the closed detent turns the Hydraulic System Nr. 3 ON if it isn't already ON.
11. Under NO circumstances should the Spoilers be deployed in flight, unless the (wing flaps) (landing gear) are full up.

ANSWERS TO THE REVIEW

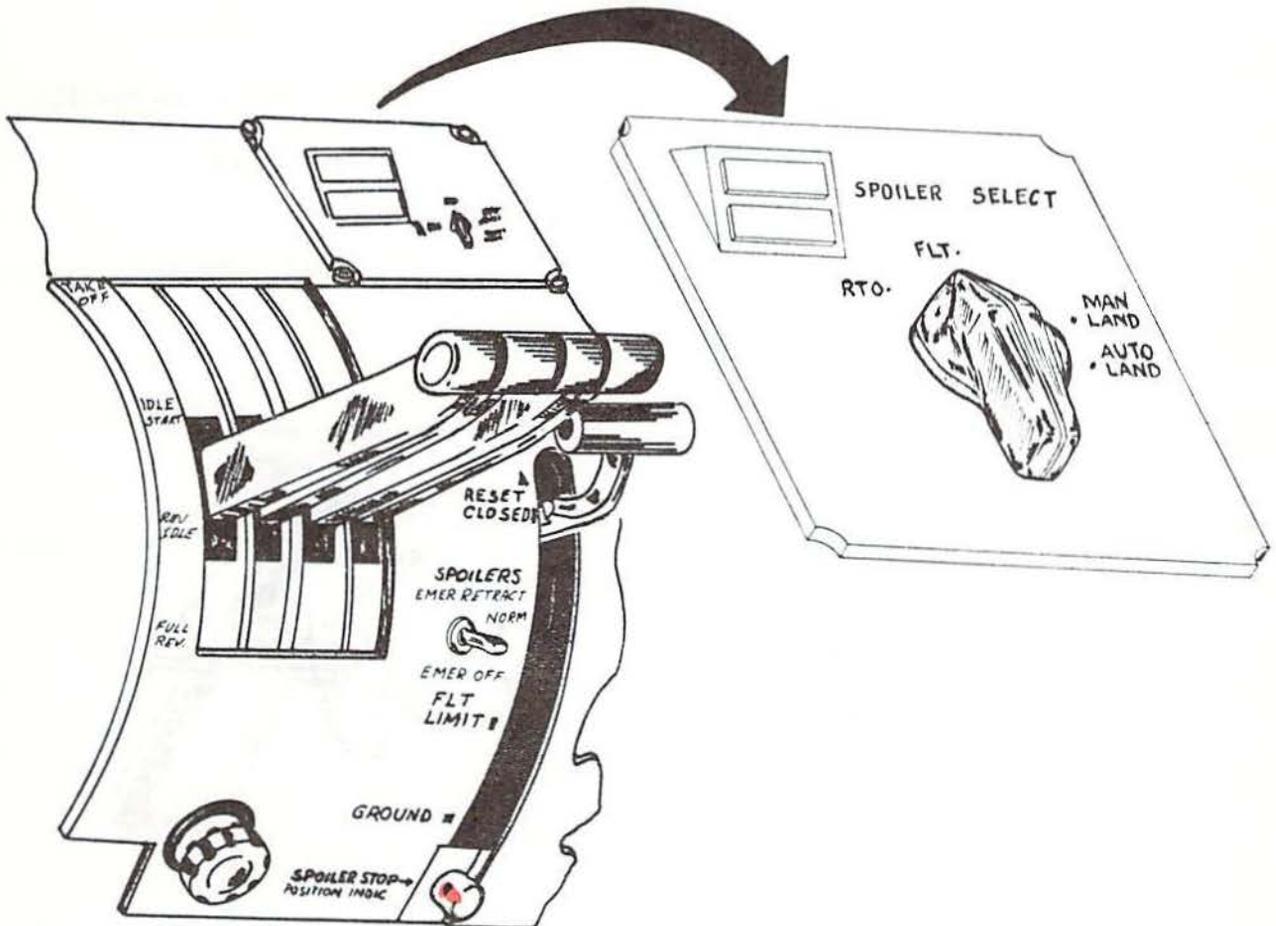
1. Control Pedestal
2. a. RESET b. CLOSED c. FLT LIMIT d. GROUND
3. GROUND
4. Detent
5. True
6. Pin
7. 50
8. True
9. 2 3
10. 3
11. wing flaps

If you missed any questions, review the page listed.

1. Spoiler Lever location: Page 9
2. Spoiler Lever quadrant markings: Page 9
3. Positioning the Spoiler Lever: Page 10
4. High Force Detent purpose: Page 11
5. Removing the High Force Detent: Page 12
6. Indicator Pin: Page 11
7. Overriding the High Force Detent: Page 11
8. Functions of the cable servo: Page 14
9. Hydraulic source to operate the servos: Page 14
10. Turning on Hydraulic System Nr 3: Page 15
11. Spoiler vs Wing Flap operation: Page 14

Okay. Let's proceed with the other units in the system. We will have to refer back to the Spoiler Lever from time to time since it operates in CONJUNCTION WITH the SPOILER SELECT SWITCH.

Notice the LOCATION of the Spoiler Select Switch and the switch position.



From the picture, you can determine that the Spoiler Select Switch is located just forward of the Spoiler Lever on the Control Pedestal. RTO depicts rejected Take-off, FLT is Flight, MAN LAND means Manual Land and AUTO LAND denotes Automated Land.

The four positions are RTO, FLT, MAN LAND, and AUTO LAND.

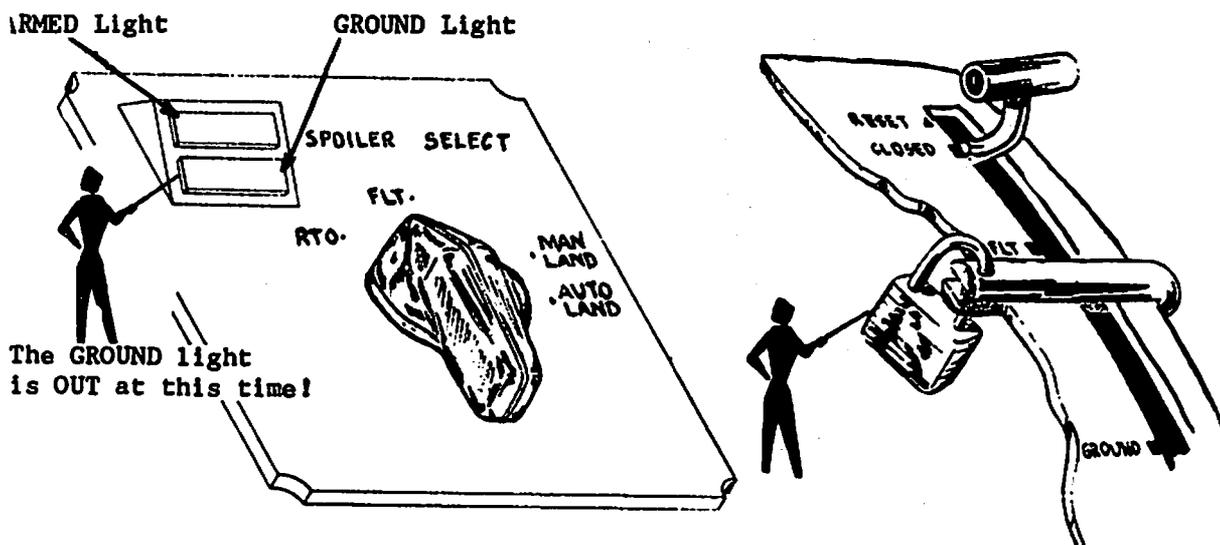
- A. YES
- B. NO

A. YES

You're on the right track. The Spoiler Select Switch is located on the Control Pedestal and has four positions. They are: RTO (Rejected Take-off), FLT, MAN LAND and AUTO LAND. During normal flight, the Spoiler Select Switch should remain in the FLT position.

Let's place the Spoiler Select Switch in the FLT POSITION and see how it affects Spoiler operation. The FLT position does two (2) things:

1. It turns OUT the GROUND LIGHT located on the switch panel.
2. It places a MECHANICAL STOP at the FLT LIMIT position of the Spoiler Lever.



Would you agree that by positioning the Spoiler Select Switch to FLT will accomplish two things:

1. Illuminate the GROUND light.
2. Remove the Mechanical Stop from the FLT LIMIT position of the Spoiler Lever.

A. YES

B. NO

B. NO

The FLT position of the Spoiler Select Switch is the ONLY position which extinguishes the GROUND light and positions the Mechanical Stop. The GROUND light, when illuminated, notifies the pilot he has the switch in ANY ONE of the THREE GROUND OPERATING positions and the Mechanical Stop is removed.

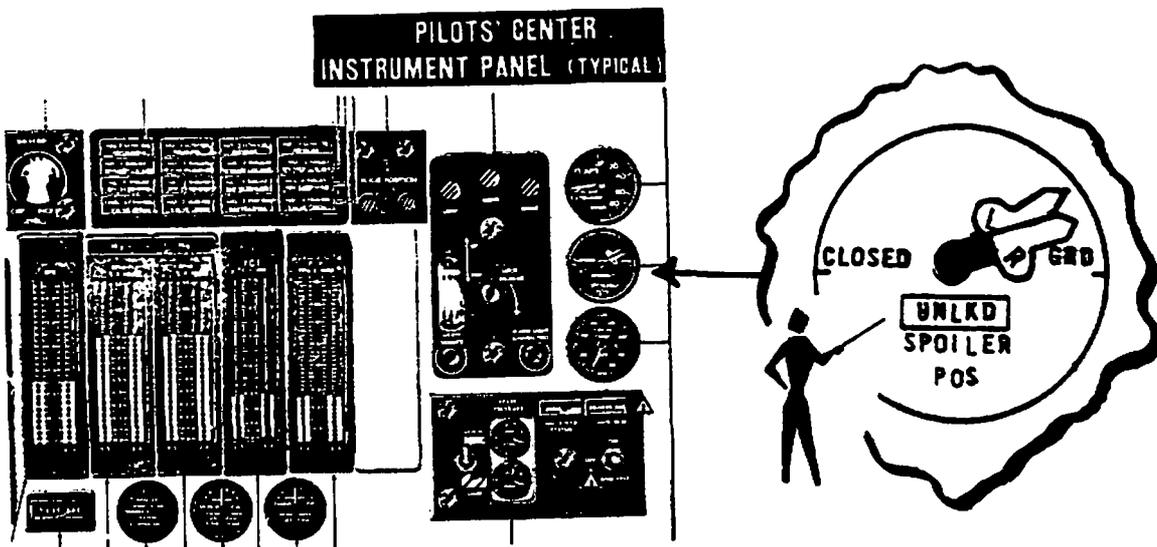
The pilot does three things to open the Spoilers in flight.

1. Positions the SPOILER SELECT SWITCH to FLT.
2. Lifts the SPOILER LEVER.
3. Moves the SPOILER LEVER out of the CLOSED position.

How will he know that the Spoilers have opened? By checking the SPOILER POSITION INDICATOR located on the PILOTS' CENTER INSTRUMENT PANEL.

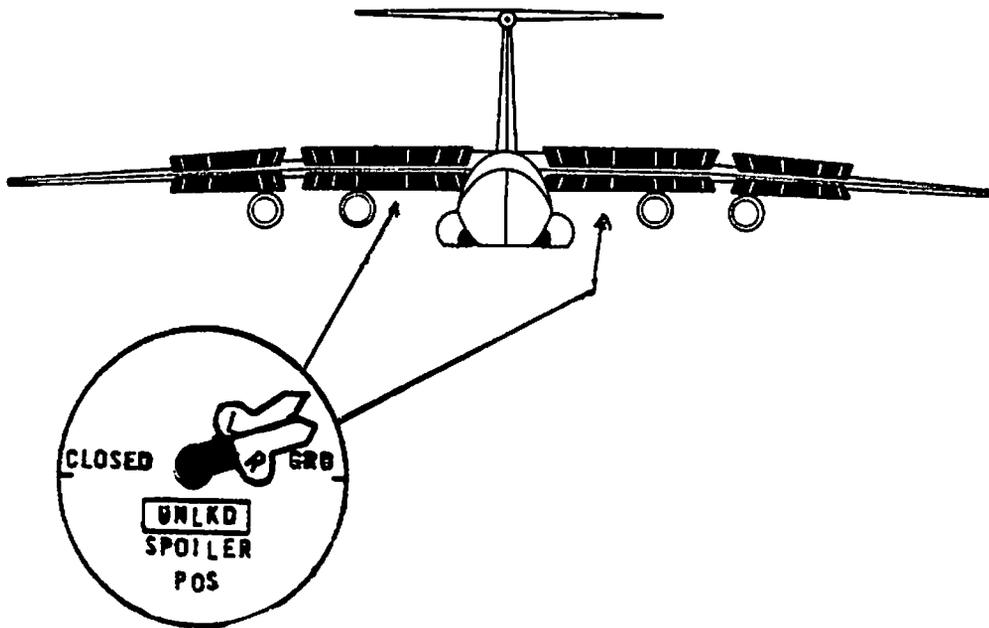
You can determine from the picture below, that the SPOILER POSITION INDICATOR

- A. Has a pointer for each wing labeled "L" and "R".
- B. Has a pointer for each wing labeled "L" and "R", and also has a LOCKED-UNLOCKED flag.



- B. Has a pointer for each wing labeled "L" and "R", and also has a LOCKED-UNLOCKED flag.

You're very observant. You noticed the "L" and "R" pointers AND the LOCKED-UNLOCKED flag located beneath the pointers. The pointers indicate the position of their respective *Inboard* Spoiler Sections - left and right wing. The LOCKED-UNLOCKED flag indicates whether or not all Spoiler sections are LOCKED CLOSED.



Let's assume the pilot opens the Spoilers in flight to decelerate. What happens, if anything, to the Spoilers if the airspeed is high? For one thing, *above* 250 KCAS Spoiler BLOWDOWN occurs. That is, above 250 KCAS the airflow (or pressure) against the Spoiler Section forces them towards the closed position.

Do you believe that Spoiler "blowdown" can be observed on the Spoiler Position Indicator?

- A. YES
- B. NO

A. YES

Sure it can! Spoiler "blowdown" occurs above 250 KCAS and will be indicated on the Spoiler Position Indicator. How far closed they will go depends on the airspeed. As the airspeed decreases, the Spoilers will return to the selected position.

The Spoiler Lever does NOT move during Spoiler "blowdown." This is because the Cable Servo Mechanism contains an irreversible feature to prevent Spoiler Lever movement within the normal "blowdown" limits.

One more Spoiler operating limitation. The Spoilers are placarded *against operation above 350 KCAS OR MACH 0.75.*

We now have two limitations placed on Spoiler operation in flight. They should not be opened in flight above:

- A. 250 KCAS OR when the wing flaps are NOT full up.
- B. 350 KCAS OR when the wing flaps are NOT full up.

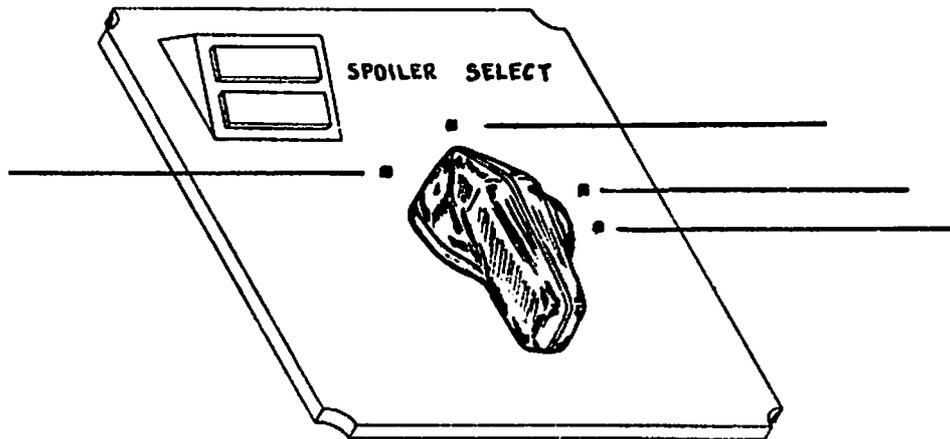
B. 350 KCAS OR when the wing flaps are NOT full up.

Sure. The Spoilers should not be opened in flight above 350 KCAS or Mach 0.75, and they should NOT be opened in flight unless the wing flaps are full UP.

This completes the explanation of NORMAL Spoiler operation IN FLIGHT. Now let's review. Circle the correct word(s) below and fill in the blanks.

1. During flight, Hydraulic Systems Nr 2 and 3 apply pressure to the in-board and outboard Spoiler sections (together) (independently) to open and close them.
2. If one hydraulic system fails, the other will operate the Spoilers, but at a (reduced) (faster) rate of speed.
3. With the wing flaps full up, lifting the Spoiler Lever removes the High Force (Detent) (Stop) located at the (CLOSED) (GROUND) position of the Spoiler Lever.
4. Movement of the Spoiler Lever out of the CLOSED position is aided by th (Servo) (Tabs) operated by Hydraulic Systems Nr 2 and Nr 3.
5. The Spoilers should not be opened in flight if the wing flaps are NOT full (down) (up).
6. If Hydraulic System Nr 3 is not already turned on, moving the Spoiler Lever out of the (CLOSED) (GROUND) position turns it on.
7. A Spoiler Position Indicator located on the pilots' (left) (center) Instrument panel indicates Spoiler position and also indicates when the Spoilers are (LOCKED - UNLOCKED) or (OPEN - CLOSED).

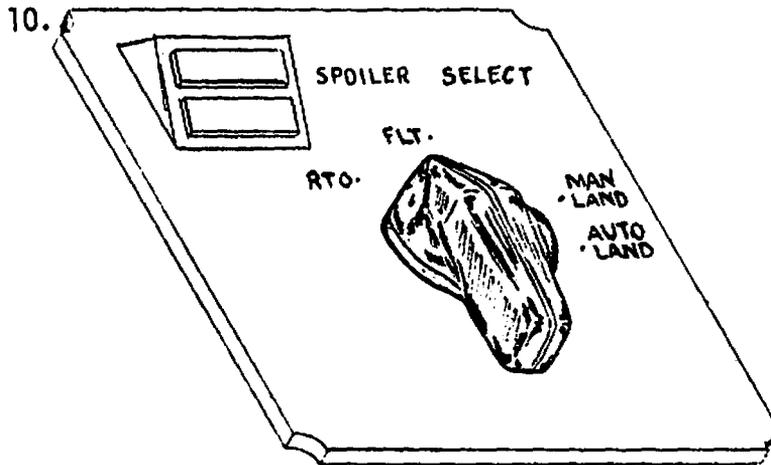
8. Spoiler "blow-down" occurs above (250) (200) KCAS.
9. The Spoilers should not be opened above (300) (350) KCAS or Mach (1.1) (0.75).
10. Insert the names of the Spoiler Select Switch positions.



11. Moving the Spoiler Select Switch to FLT turns OUT the (GROUND) (ARMED) light and places a Mechanical (Detent) (Stop) at the FLT LIMIT position of the Spoiler Lever.
12. If the Spoiler Select Switch is in any position other than FLT, the GROUND light will illuminate and the Mechanical Stop will be (in place at) (removed from) the FLT LIMIT position of the Spoiler Lever.

ANSWERS to the REVIEW.

1. together
2. reduced
3. Detent CLOSED
4. Servos
5. up
6. CLOSED
7. center LOCKED - UNLOCKED
8. 250
9. 350 0.75



11. GROUND Stop
12. removed from

How is the High Force Detent removed when the wing flaps are NOT full up? It's accomplished through the Main Landing Gear TOUCHDOWN Switches. With the Main Landing Gear Struts compressed, the High Force Detent can be removed even if the wing flaps are NOT full up.

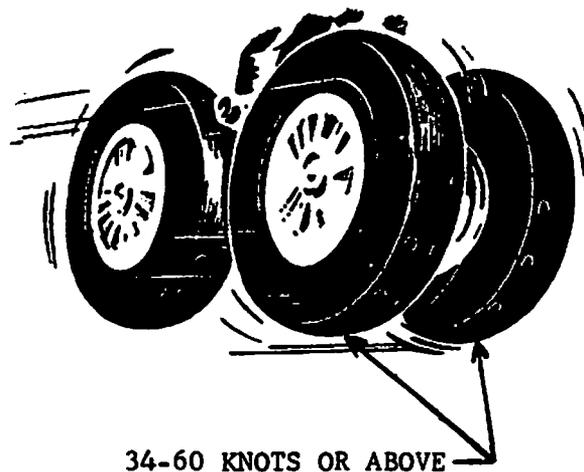
During MAN LAND operation, how can the pilot remove the High Force Detent after touchdown if the wing flaps are NOT full up?

- A. Lift the Spoiler Lever.
- B. He cannot remove the High Force Detent during MAN LAND if the wing flaps are NOT full up.

A. Lift the Spoiler Lever.

You're right! The pilot must lift the Spoiler Lever to remove the High Force Detent. Compressing the Main Landing Gear Struts simply allows the High Force Detent *to be removed* when the wing flaps are not full up.

During the initial touchdown and landing ground roll, not much weight is placed on the landing gear to compress the struts. To compensate for this, WHEEL SPIN-UP DETECTORS are installed on the Four (4) FORWARD MAIN WHEELS ONLY. These SPIN-UP DETECTORS allow the pilot to remove the High Force Detent when the main gear is rotating at 34-60 knots and above, even if the struts are NOT compressed.



During landing, either the Landing Gear TOUCHDOWN switches OR the Landing Gear SPIN-UP detectors on the Four (4) Forward Main Wheels will allow the pilot to remove the High Force Detent by lifting the Spoiler Lever.

- A. TRUE
- B. FALSE

A. TRUE

It's true. During landing either the Landing Gear Touchdown Switches or the Landing Gear Spin-Up Detectors will allow the pilot to remove the High Force Detent by lifting the Spoiler Lever. Now how about another short review.

Circle the correct word(s) or fill in the appropriate blank spaces.

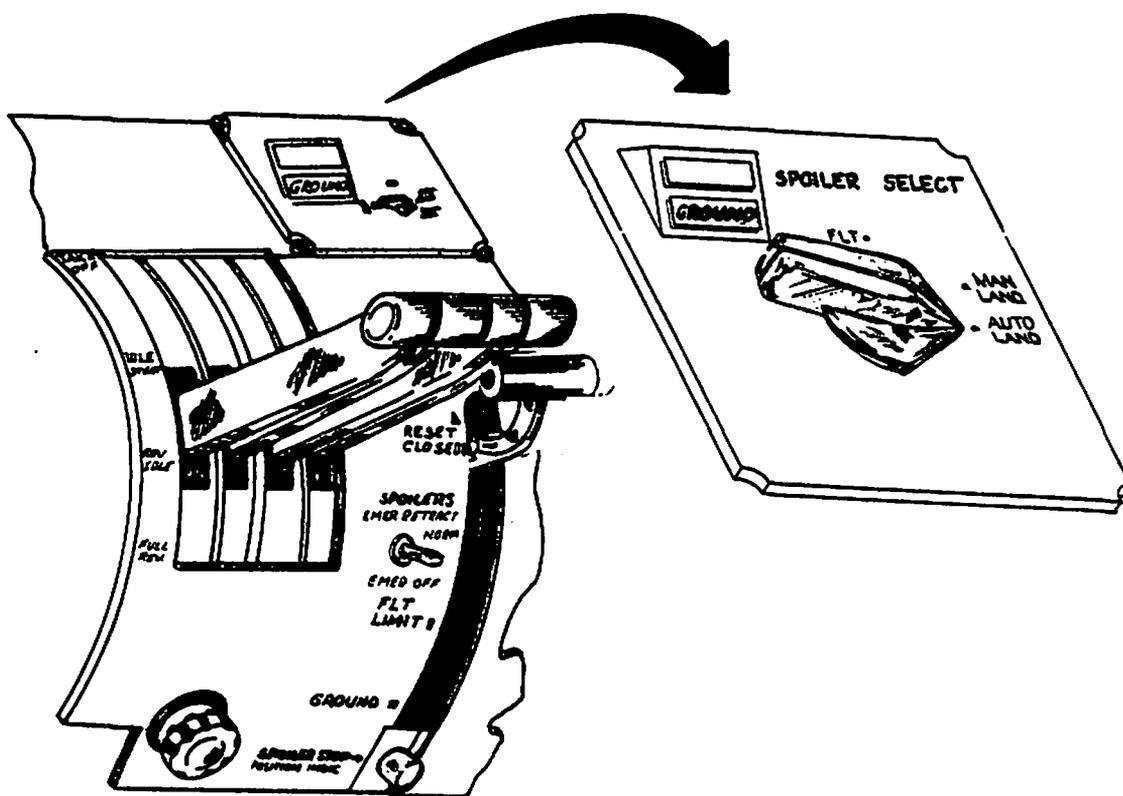
1. Moving the Spoiler Select Switch out of the FLT position will illuminate the (ARMED) (GROUND) light and removes the Mechanical (Detent) (Stop) from the FLT LIMIT position of the Spoiler Lever.
2. After the Touchdown Switches or Wheel Spin-Up Detectors are actuated, lifting the Spoiler Lever will remove the High Force Detent and Indicator Pin and allow the Lever to be moved to the (FLT LIMIT) (GROUND) position.

CHECK your answers with those listed below and make any necessary corrections.

1. GROUND Stop
2. GROUND

The AUTO LAND feature provides AUTOMATIC SPOILER OPENING after touch-down. When the Spoiler Select Switch and Spoiler Lever are properly set, the Spoiler Lever will AUTOMATICALLY move to the GROUND position as soon as Main Landing Gear WHEEL SPIN-UP occurs.

This is how it operates. FIRST the Spoiler Select Switch is positioned to AUTO LAND. This REMOVES the MECHANICAL STOP from the FLT LIMIT position of the Spoiler Lever and ILLUMINATES the GROUND light.



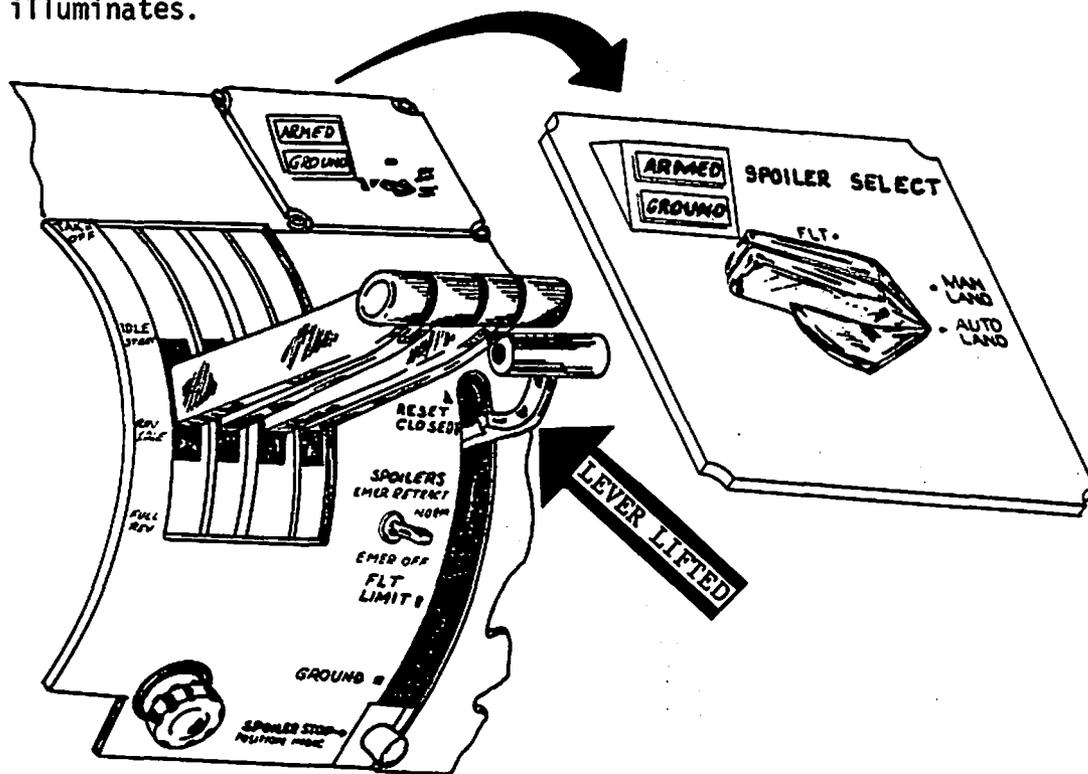
Are these two actions (mechanical stop removal and GROUND light illumination) different from those which occur when the Spoiler Select Switch is in MAN LAND?

- A. YES
- B. NO

B. NO

Good! No difference. Any position of the Spoiler Select Switch, other than FLT illuminates the GROUND light and removes the Mechanical Stop.

Next, LIFT the Spoiler Lever. This removes the HIGH FORCE DETENT and ARMS the system for automatic Spoiler opening. How do we know that the Spoiler system is armed? The ARMED LIGHT located just forward of the GROUND light illuminates.



Study the picture, then select the MOST correct statement below.

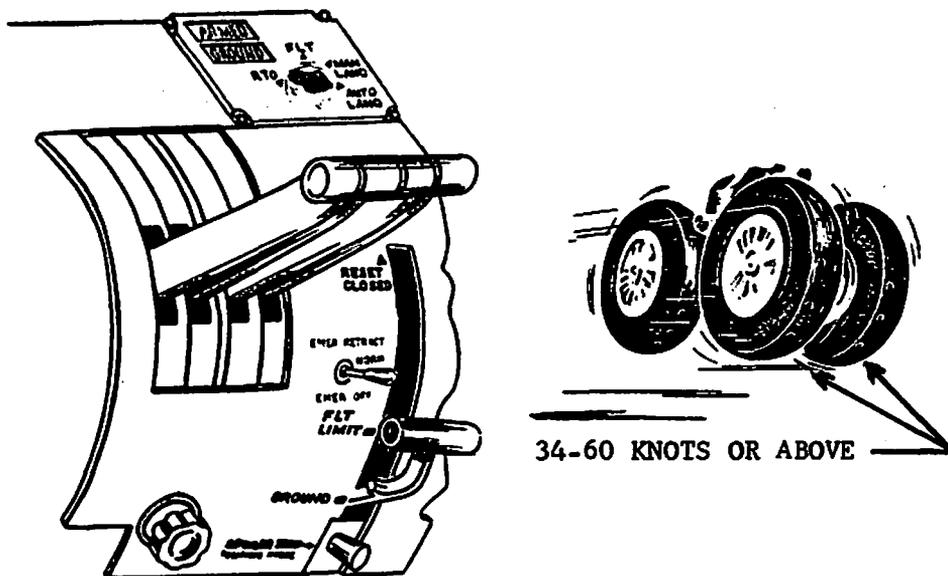
- A. The ARMED and GROUND lights are ILLUMINATED because the Spoiler Select Switch is in AUTO LAND.
- B. The ARMED and GROUND lights are ILLUMINATED because the Spoiler Select Switch is in AUTO LAND and the Spoiler Lever is LIFTED.
- C. Statement "B" is correct and the High Force Detent Indicator Pin is RETRACTED.

C. Statement "B" is correct and the High Force Detent Indicator Pin is RETRACTED.

How right you are! Setting the Spoiler Select Switch to AUTO LAND illuminates the GROUND light and removes the Mechanical Stop. With the Spoiler Select Switch in AUTO LAND, LIFTING the Spoiler Lever:

1. Arms the system.
2. Illuminates the ARMED light
3. Removes the High Force Detent.
4. Retracts the Indicator Pin.

The next step is the landing. As soon as WHEEL SPIN-UP is achieved on the 4 forward main wheels after touchdown (34-60 knots or above), the Spoiler Lever automatically moves to the GROUND position by action of the CABLE SERVO MECHANISM. This action opens the Spoilers.



Automatic Spoiler opening will be achieved during AUTO LAND Operation, when the Main Landing Gear struts compress and actuate the touchdown switches.

- A. TRUE
- B. FALSE

B. FALSE

The Main Landing Gear struts do NOT need to be compressed. The wheel SPIN-UP detectors cause automatic Spoiler opening during AUTO LAND operation. The touchdown switches have nothing to do with automatic Spoiler deployment. However, the touchdown switches turn out the ARMED light after touchdown, but that's all they do as far as Spoiler operation using AUTO LAND is concerned.

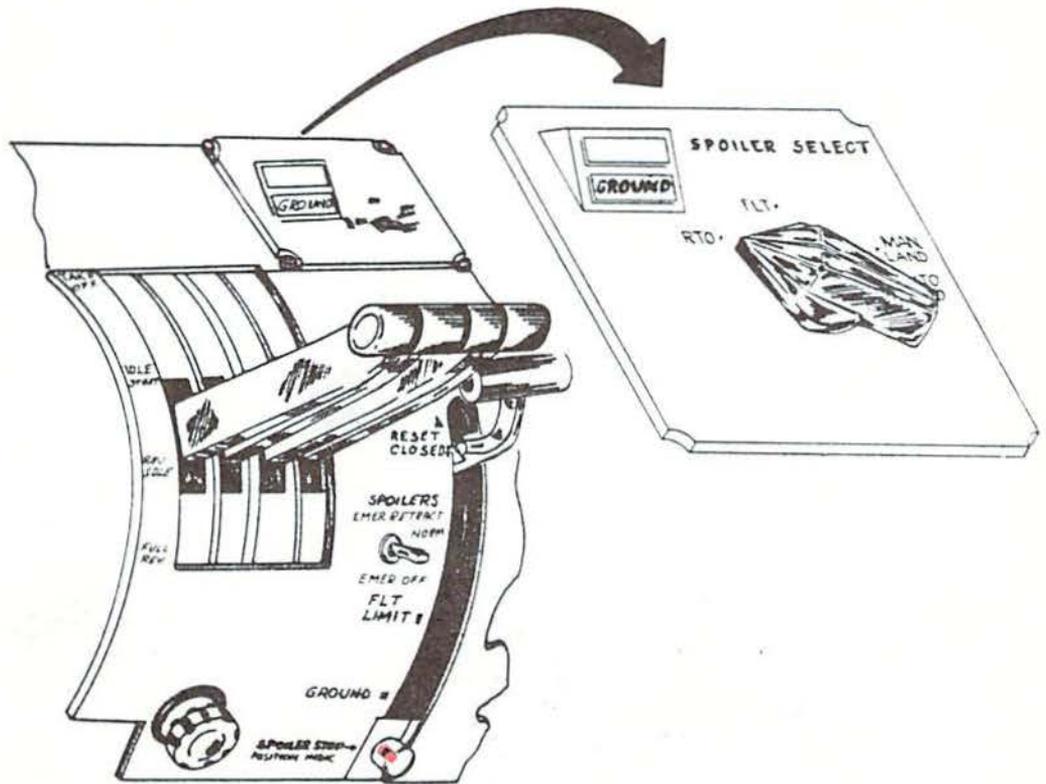
We have one *very important* precaution to observe when landing. A WARNING in T.O. 1C-141A-1 tells us:

THE SPOILER HANDLE WILL NOT BE ARMED
UNTIL AFTER THE LANDING GEAR IS SAFELY
ON THE RUNWAY.

If the Spoilers are armed with the Spoiler Select Switch in AUTO LAND, the Spoilers will open to the full ground position in flight provided the forward main gear is rotating above auto Spoiler deployment speed. Thus, the reason for the WARNING stated above.

We have one more position on the Spoiler Select Switch: RTO (Rejected Take-Off). RTO provides automatic Spoiler opening if the pilot decides to reject during the take-off roll.

First, turn the Spoiler Select Switch to RTO. This illuminates the GROUND light and removes the MECHANICAL STOP from the FLT LIMIT position of the Spoiler Lever.



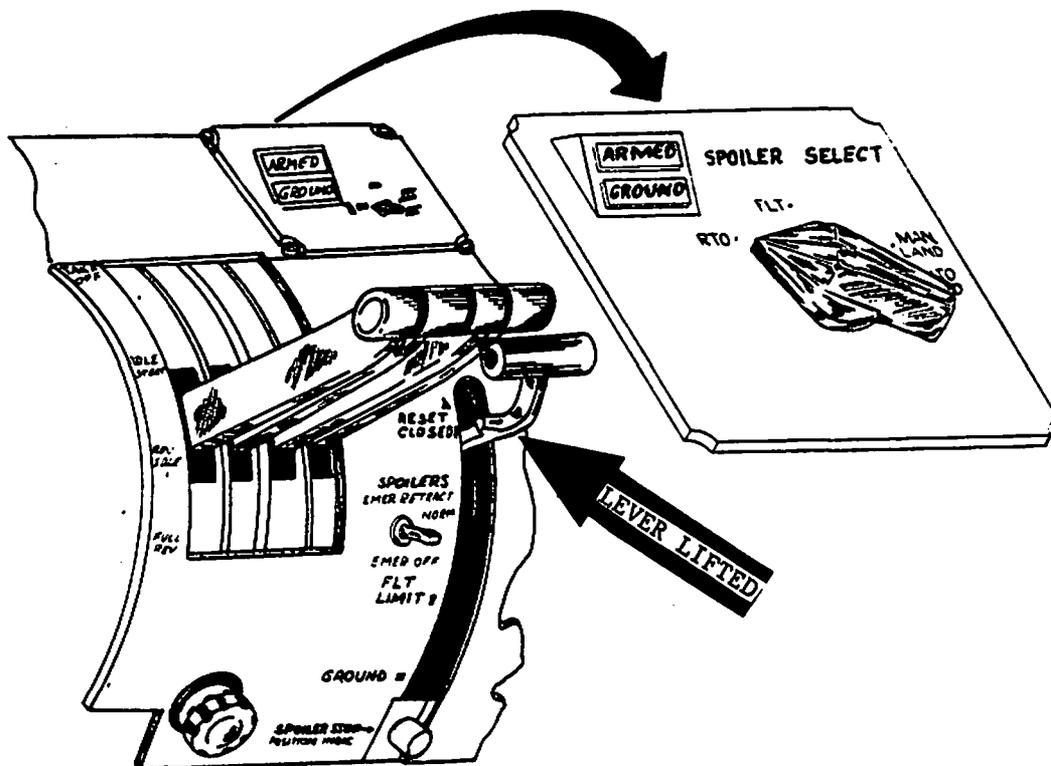
These two actions are the same as those which occur when the Spoiler Select Switch is in AUTO LAND or MAN LAND.

- A. TRUE
- B. FALSE

A. TRUE

You are right! Three of the four positions of the Spoiler Select Switch (MAN LAND, AUTO LAND and RTO) will illuminate the GROUND light and remove the Mechanical Stop.

Next, LIFT the Spoiler Lever. This removes the High Force Detent and retracts the Indicator Pin. It also ARMS the system for Automatic Spoiler deployment when desired. Study the picture.



From the picture, you can determine that

- A. only the GROUND light is illuminated.
- B. both the ARMED and GROUND lights are illuminated.

B. Both the ARMED and GROUND lights are illuminated.

Both the ARMED and GROUND lights are ILLUMINATED. Moving the Spoiler Select Switch out of the FLT position illuminates the GROUND light. Placing the Spoiler Select Switch in RTO and "lifting" the Spoiler Lever illuminates the ARMED light. The ARMED light notifies you when the system is set for AUTOMATIC Spoiler deployment should you initiate a Rejected Takeoff.

(The ARMED light will NOT illuminate *in flight* with the system set for RTO, due to the action of the Landing Gear TOUCHDOWN Switches.)

If everything is set up for an RTO, how do we achieve AUTOMATIC Spoiler deployment? Well, two more operations must occur. First, the Main Landing Gear WHEEL SPIN-UP Detectors must be actuated (34-60 knots and above); second, *any two symmetric throttles must be moved to the reverse idle range or beyond.*

By saying *any two symmetric throttles must be reversed*, means Nr 1 and Nr 4 throttles or Nr 2 and Nr 3 throttles.

A. TRUE

B. FALSE

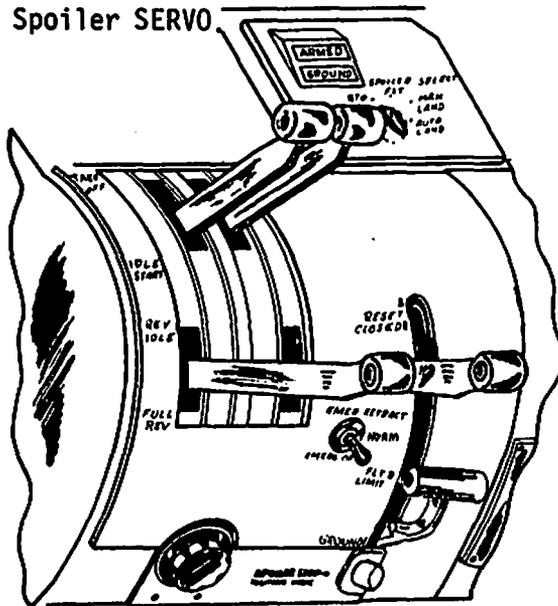
A. TRUE

Excellent! Reversing either the INBOARD throttles or the OUTBOARD throttles during a Rejected Take-off will cause Spoiler deployment if:

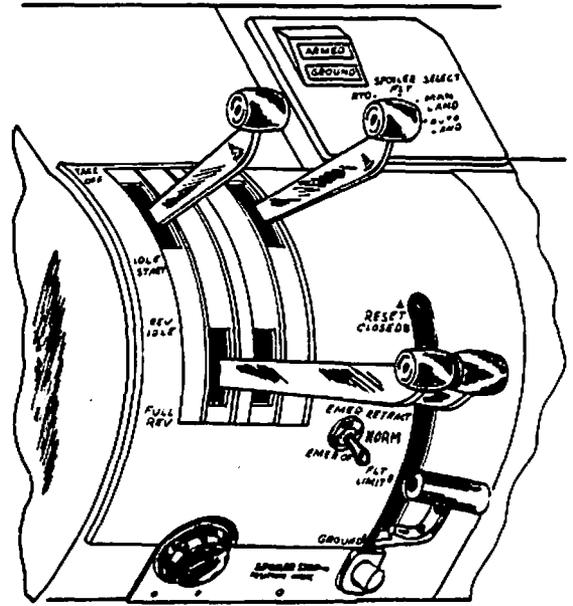
1. The Spoiler Select Switch is set to RTO.
2. The Spoiler Lever is ARMED (lifted).
3. Main Landing Gear Wheel Spin-up has occurred. (34 to 60 KTS)

How does reversing the throttles accomplish AUTOMATIC Spoiler opening during a Rejected Take-off?

Automatic Spoiler deployment during a Rejected Takeoff is accomplished through the Spoiler Cable Servo Mechanism. When the Spoiler Select Switch and Spoiler Lever are properly set for a Rejected Takeoff, reversing both OUTBOARD throttles allows Hydraulic System Nr 2 to actuate the Spoiler SERVO which AUTOMATICALLY moves the Spoiler Lever to the GROUND position. Reversing both INBOARD throttles causes Hydraulic System Nr 3 to actuate the Spoiler SERVO



Hydraulic System Nr 2 actuates the Spoiler Servo.



Hydraulic System Nr 3 actuates the Spoiler Servo.

If Hydraulic System Nr 2 fails during a Rejected Takeoff and ONLY the OUTBOARD throttles are reversed, the Spoilers will NOT automatically open because the SERVO is *not* actuated. Now answer this.

Do you believe the Spoiler Lever can be *manually* moved to the GROUND position to open the Spoilers under these conditions?

- A. YES
- B. NO

A. YES

I'll buy that. In this case (Hydraulic System Nr 2 failure and OUTBOARD throttle reversal), the Spoilers can be *manually* opened if they do not automatically open during a Rejected Takeoff. The Cable Servo Mechanism will still operate from Hydraulic System Nr 3, and the Spoilers will also operate.

Is the opposite true? That is, if the Hydraulic System Nr 3 fails and only the INBOARD throttles are reversed, can we manually open the Spoilers?

A. YES

B. NO

A. YES

You've got the point. Of course, if *both* hydraulic systems fail during a Rejected Takeoff, "you are in deep trouble" as far as Spoiler operation is concerned. Now let's review AUTO LAND and RTO operation. Fill in the blank spaces or circle the correct word(s) in the statements below.

1. With the Spoiler Select Switch in AUTO LAND or RTO, lifting the Spoiler Lever will:
 - a. Turn on the (ARMED) (GROUND) light indicating that the system is armed.
 - b. Remove the High Force (Stop) (Detent).
 - c. Retract the High Force Detent Indicator (Pin) (Stop).
2. During AUTO LAND operation with the Spoilers armed, they will open as soon as Main Landing Gear Wheel _____ occurs.
3. The Spoilers are opened during AUTO LAND and RTO by action of the Spoiler (Servo) (Reversing) Mechanism.
4. During Rejected Takeoff operation, the Spoilers will NOT OPEN until Main Landing Gear Wheel Spin-Up occurs and _____ throttles are moved to REVERSE IDLE or beyond.
5. If Hydraulic System Nr 3 has failed during a Rejected Takeoff, the Spoilers will NOT automatically open unless the outboard throttles are reversed or the Spoiler Lever is (manually) (automatically) moved to the GROUND position.

Check your answers on Page 42, make any necessary corrections.

ANSWERS to the REVIEW

1. a. ARMED
b. Detent
c. Pin
2. Spin-Up
3. Servo
4. symmetric
5. Manually

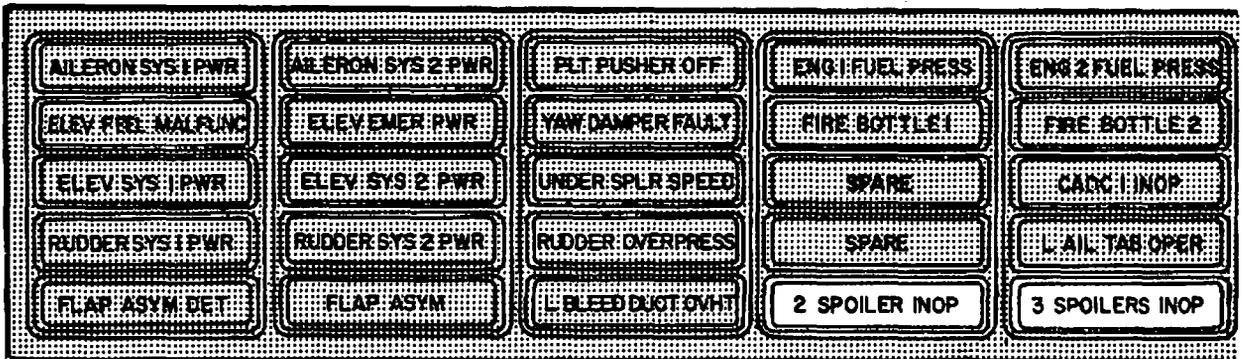
If you missed any questions review the page listed.

1. Lifting the Spoiler Lever during AUTO LAND and RTO operation:
Pages 32 & 36.
2. Main Landing Gear Wheel Spin-Up during AUTO LAND: Page 34.
3. Spoiler Servo operation: Pages 33, 39.
4. Throttle reversal during RTO: Page 37.
5. Hydraulic system failure during RTO: Page 39.

What would happen if the Spoilers on one wing were to open and those on the other did not open? The answer is obvious, isn't it? The aircraft would tend to roll. To prevent this from happening, an ASYMMETRY PROTECTION SYSTEM is installed on the Spoilers.

This ASYMMETRY PROTECTION SYSTEM detects uneven OUTBOARD Spoiler opening during approximately the first 2½ inches of Spoiler Drive Tube extension. The asymmetry detectors are located on the *outboard end of each OUTBOARD Spoiler Drive Tube*. If one OUTBOARD Spoiler Actuator moves 2½ inches while the other OUTBOARD actuator moves less than 3/4 inch during the initial operation, TWO things happen.

1. Hydraulic Systems Nr 2 and Nr 3 *drive the Spoilers closed*.
2. Nr 2 SPOILER INOP and Nr 3 SPOILER INOP lights ILLUMINATE.



ANNUNCIATOR PANEL-LEFT SIDE

If the Nr 2 SPOILER INOP and the Nr 3 SPOILER INOP lights illuminate, the instrument to check would be the

- A. Hydraulic Pressure Gage
- B. Spoiler Position Indicator

B. Spoiler Position Indicator

Sure. The Spoiler Position Indicator should indicate that the Spoilers have closed. If the Nr 2 SPOILER INOP and the Nr 3 SPOILER INOP lights illuminate and the *Spoilers go closed*, we know that an asymmetric condition has existed. Remember! Asymmetry protection is available on OUTBOARD sections only, and then only during the first 2 1/2 inches of Spoiler Drive Tube extension.

So far all Spoiler operation has been accomplished through the action of the cable SERVO Mechanism. It operates differently during an asymmetric condition.

When the Spoilers go closed during an asymmetric condition, the Spoiler Lever *remains in position*. For example, if the Spoiler Lever was placed to the FLT LIMIT position and an asymmetric condition occurred, it would remain there and Hydraulic Systems Nr 2 and Nr 3 would apply pressure to the Spoiler Actuating Mechanisms located in the wings.

The corrective action for an asymmetric condition is to move the Spoiler Lever forward to the RESET position. This RESETS the Asymmetry Protection System.



When the Spoiler Lever is moved to RESET, do you believe the Nr 2 SPOILER INOP and the Nr 3 SPOILER INOP lights will go out?

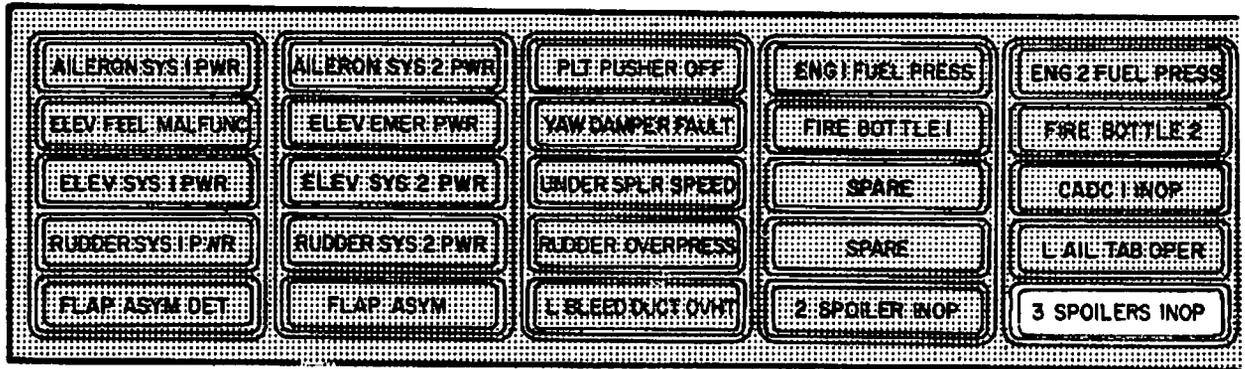
- A. YES
- B. NO

A. YES

Real good. Moving the Spoiler Lever to RESET after an asymmetric condition RESETS the system for operation and turns the Nr 2 SPOILER INOP and the Nr 3 SPOILER INOP lights out.

NOTE: The Spoiler Lever is spring loaded from the RESET to the CLOSED position.

An electrical malfunction exists if only one SPOILER INOP light illuminates. In this case, the Spoilers will remain fully operational.



ANNUNCIATOR PANEL-LEFT SIDE

Is the following statement TRUE or FALSE?

If the Spoiler Lever is moved to the FLT LIMIT position and only Nr 3 SPOILER INOP light illuminates, the Spoiler Position Indicator will indicate the Spoilers are closed.

- A. TRUE
- B. FALSE

B. FALSE

You're right! One SPOILER INOP light does NOT affect Spoiler operation; therefore, the Spoiler Position Indicator will indicate that the Spoilers are open to the FLT LIMIT position.

Should the left wing Spoilers stop approximately half way open, and the right wing Spoilers continue to open, would the Asymmetry Protection System function?

A. YES

B. NO

B. NO

You're *really* getting the point now. The Asymmetry Protection System will NOT function unless it is initiated during the first two and one half (2½) inches of Spoiler operation.

One last but very important item about the Asymmetry Protection System before we proceed on to something else.

Let's assume that the LEFT INBOARD Spoiler Section DID NOT open during Spoiler operation and the others DID open. Would the Asymmetry Protection System function under this condition?

A. YES

B. NO

B. NO

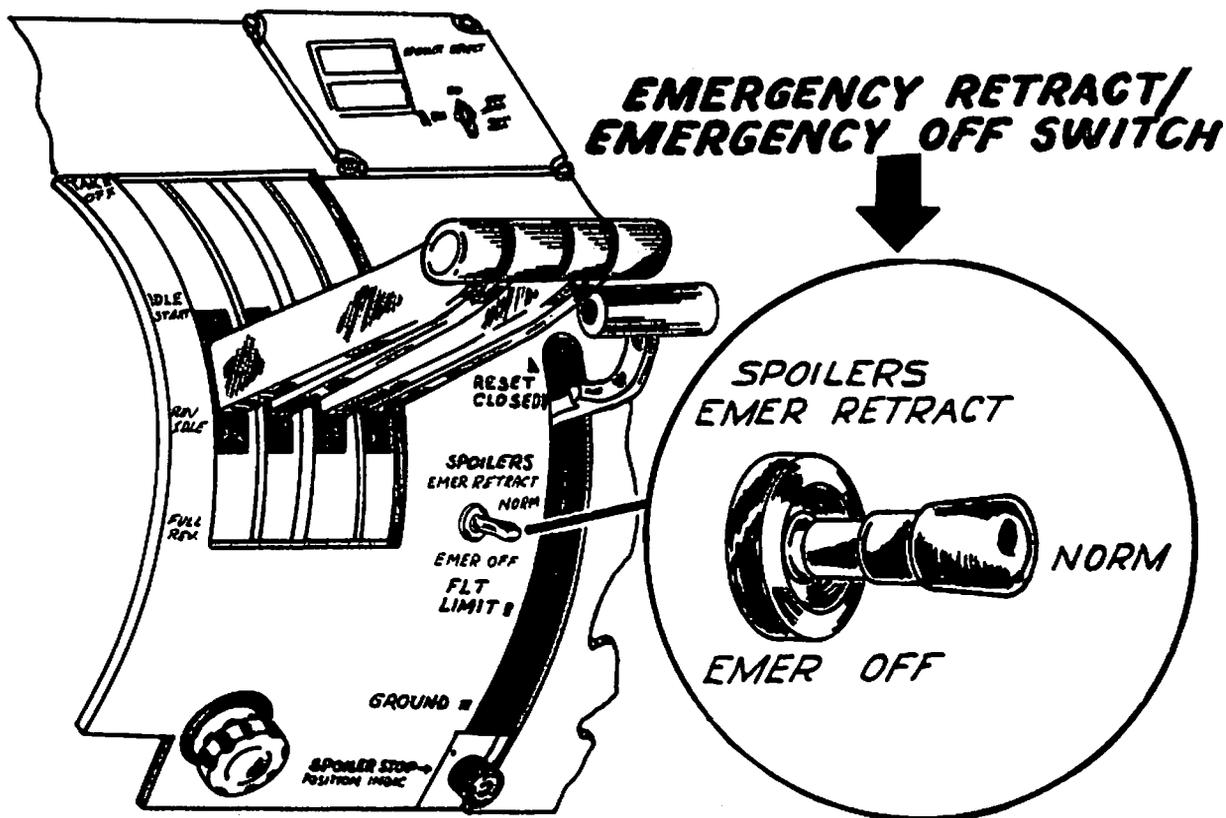
Excellent! You remembered that the asymmetry detectors are located on the OUTBOARD Spoilers only.

If an asymmetric condition exists on the INBOARD Spoiler Sections, the aircraft will tend to roll. The Spoiler Position Indicator TRANSMITTERS are located on the INBOARD Spoiler Sections. Therefore, the Spoiler Position Indicator will *also* tell us if one inboard Spoiler is open more than the other. Of course, the corrective action in this situation is to close the Spoilers.

The next unit to discuss in this book is the EMERGENCY RETRACT/
EMERGENCY OFF Switch.

The Emergency Retract/Emergency Off Switch (hereafter referred to as the EREO Switch) is used to bypass the Normal Control System, CLOSE the Spoilers and DEACTIVATE the Spoiler System in the event of a MALFUNCTION.

Look at the picture and then select the correct statement below.

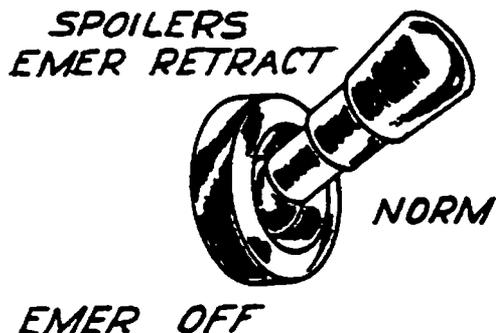


- A. The EREO Switch is located on the Pilots' Center Instrument Panel and has three positions marked: EMER RETRACT - NORM - EMER OFF.
- B. The EREO Switch is located by the Spoiler Lever and has three positions marked: EMER RETRACT - NORM - EMER OFF.

B. The EREO Switch is located by the Spoiler Lever and has three positions marked: EMER RETRACT - NORM - EMER OFF.

That's it. The EREO Switch is located by the Spoiler Lever and has three positions: EMER RETRACT - NORM - EMER OFF.

The EREO Switch is normally left in the NORM position. EMER RETRACT is a momentary position that is SPRING LOADED back to NORM. EMER RETRACT position SIMULATES an ASYMMETRICAL CONDITION.



Since moving the EREO Switch to EMER RETRACT simulates an asymmetrical condition, is the following statement correct?

When the EREO Switch is momentarily placed to EMER RETRACT, Hydraulic Systems Nr 2 and Nr 3 drive the Spoilers CLOSED and Nr 2 SPOILER INOP and Nr 3 SPOILER INOP lights illuminate.

- A. YES
- B. NO

A. YES

CORRECT. The EMER RETRACT position causes Hydraulic Systems Nr 2 and Nr 3 to drive the Spoilers CLOSED and turns on the Nr 2 SPOILER INOP and the Nr 3 SPOILER INOP lights.

Is this statement correct?

Since EMER RETRACT simulates an assymetrical condition, moving the Spoiler Lever to RESET will turn *out* the SPOILER INOP lights and *reset* the system.

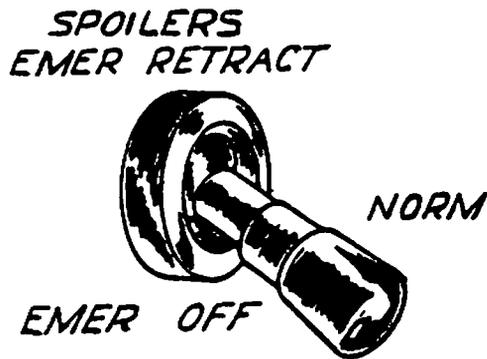
A. YES

B. NO

A. YES

Right again. The system can be RESET and SPOILER INOP lights can be extinguished by moving the Spoiler Lever to RESET. Then the system is back in operation.

When the EREO Switch is placed to EMER OFF, it will *stay in position* and the Spoilers cannot be opened.



If the Spoilers are already OPEN when the EREO Switch is placed to EMER OFF, several events occur.

1. Nr 2 hydraulic pressure is *shut off* at the Spoiler Actuating Mechanisms.
2. Hydraulic System Nr 3 drives the Spoilers CLOSED and then automatically *shuts off* at the Spoiler Actuating Mechanisms.
3. Nr 2 SPOILER INOP and Nr 3 SPOILER INOP lights illuminate.

Is this statement correct?

Before the Nr 3 hydraulic PUMPS will stop operating, the Spoiler Lever will have to be moved to the CLOSED position.

- A. YES
B. NO

A. YES

How true. You recall that Hydraulic System Nr 3 will be turned ON any time the Spoiler Lever is moved *out* of the CLOSED position. Shutting off the pressure at the Spoiler Actuating Mechanism does NOT shut off the entire system. Before the Nr 3 hydraulic PUMPS can be turned OFF, the Spoiler Lever *must* be placed in the CLOSED position.

Which of the following statements do you believe is correct?

- A. Before the Spoilers can be used after the EREO Switch is placed in EMER OFF, the Spoiler Lever must be moved to RESET.

- B. Before the Spoilers can be used after the EREO Switch is placed in EMER OFF, the EREO Switch must be returned to NORM and the Spoiler Lever moved to RESET.

- B. Before the Spoilers can be used after the EREO Switch is placed in EMER OFF, the EREO Switch must be returned to NORM and the Spoiler Lever moved to RESET.

Absolutely right! When the EREO Switch is placed to EMER OFF, it will stay there. Before the Spoiler Lever is moved to RESET, the EREO Switch must be moved to NORM. If it is not, the system can not be RESET.

A switch has been added 5° pass the FLT POSITION to protect you from overdeployment of the Spoilers in flight. It's called the INFLIGHT SPOILER EXTENSION LOCKOUT. With the Landing Gear Lever in the "UP" position Spoiler retraction will occur regardless of the position of the Spoiler Select Switch, whenever the Wing Spoiler Lever is moved 5 degrees or more aft of the FLT LIMIT position.

With the Landing Gear Lever in the "UP" position, Spoiler retraction will occur whenever the Wing Spoiler Lever is moved 5 degrees or more aft of the FLT LIMIT position and the Spoiler Select Switch is in

- A. the FLT position only
- B. any position

B. any position

Any position is correct. With the Landing Gear Lever in the "UP" position, Spoiler retraction will occur regardless of the position of the Spoiler Select Switch if the Wing Spoiler Lever is moved 5 degrees or more aft of the FLT LIMIT position.

Throttle switches have been added for automatic Spoiler retraction if a Go-Around is needed. These are called SPOILER GO-AROUND RETRACT switches.

With the Landing Gear Lever in the "DOWN" position, when any two throttles (one for each wing) are advanced beyond the 54 degree throttle position, the Spoilers will automatically retract.

Which of the following conditions will cause the Spoilers to automatically retract?

- A. The Landing Gear Lever must be in the "DOWN" position.
- B. One throttle for each wing advanced beyond the 54 degree throttle position.
- C. Both of the above conditions must be accomplished.

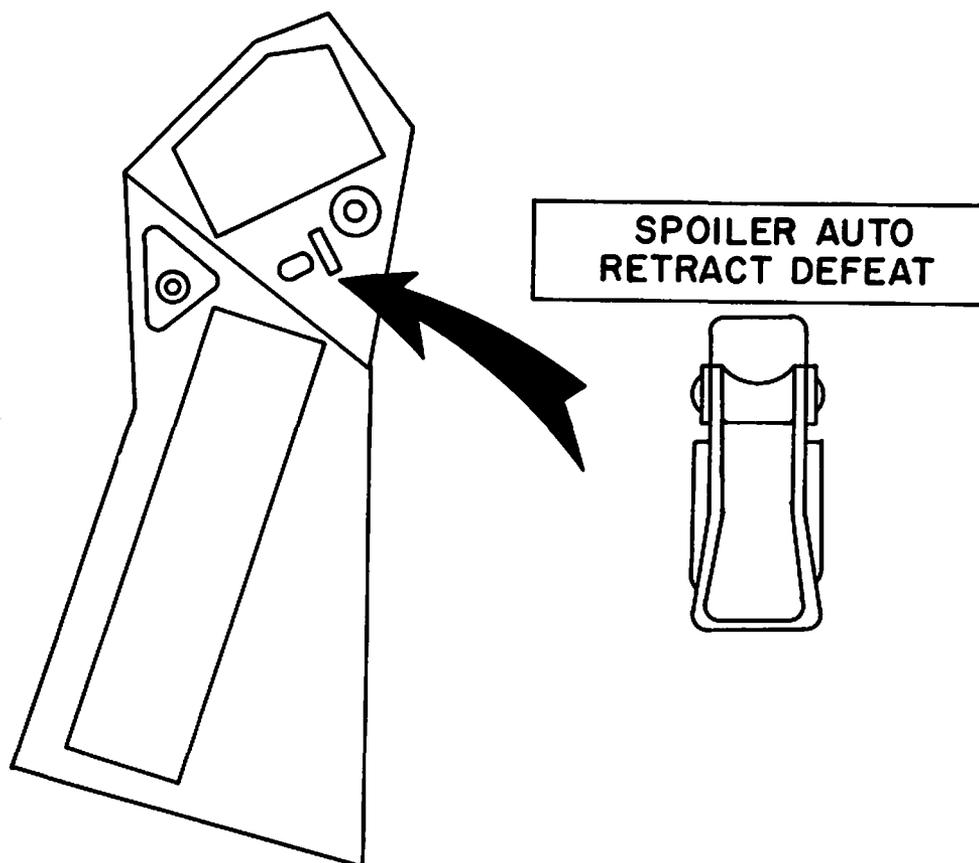
C. Both of the above must be accomplished

It's true. In order for the Spoilers to automatically retract, the Landing Gear Lever must be in the "DOWN" position AND one throttle for each wing must be advanced beyond the 54 degree position.

Suppose a condition arises where we need to advance the throttle beyond the 54 degree position with the Landing Gear Lever in the "DOWN" position. There is a switch provided that will allow us to defeat the automatic retract feature. It's called the "SPOILERS AUTO RETRACT DEFEAT" switch.

For a look at this switch TURN to Page 57.

The SPOILERS AUTO RETRACT DEFEAT switch is located on the forward end of the copilot's side console. Take a look at the picture.



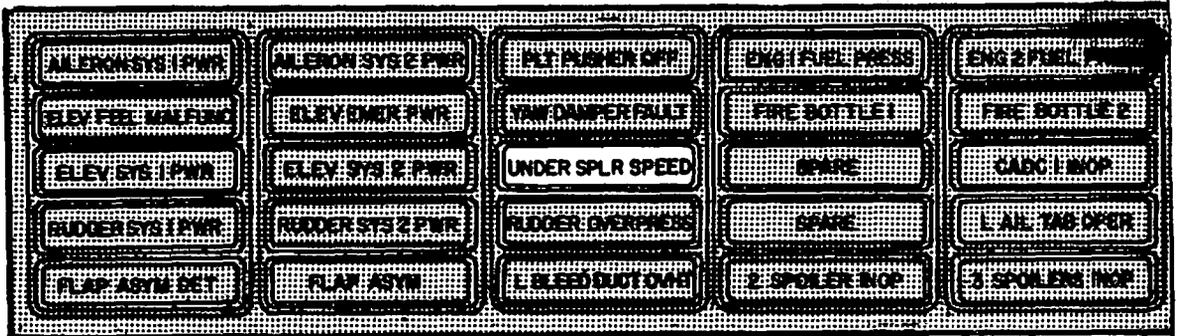
The purpose of the SPOILERS AUTO RETRACT DEFEAT switch is to prevent the Spoilers from retracting when one throttle for each wing is advanced beyond the 54 degree throttle position with the Landing Gear Lever in

- A. any position
- B. the "DOWN" position

B. the "DOWN" position

In the "DOWN" position. That's correct. The purpose of the SPOILERS AUTO RETRACT DEFEAT switch is to prevent the Spoilers from retracting when one throttle for each wing is advanced beyond the 54 degree throttle position with the Landing Gear Lever in the "DOWN" position.

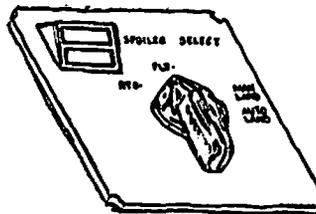
The last unit we will discuss in this book is the UNDER SPLR SPEED (UNDER SPOILER SPEED) light located on the Annunciator Panel-Left Side. The UNDER SPLR SPEED light WARNS the pilot if Spoiler operation is attempted at an airspeed and aircraft attitude bordering on STALL conditions.



ANNUNCIATOR PANEL-LEFT SIDE

The UNDER SPLR SPEED light will illuminate and an Audible Warning Horn will sound when the following conditions exist.

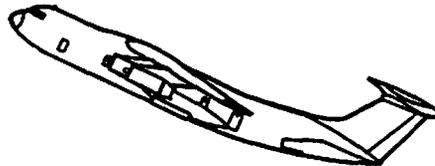
1. The Spoiler Select Switch is positioned to FLT.



2. The Spoiler Lever is LIFTED.



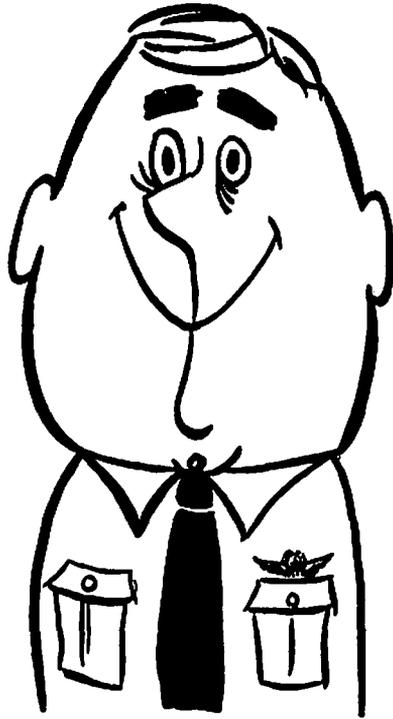
3. The aircraft approaches a stall attitude.



Do you think the UNDER SPLR SPEED light will illuminate and the Audible Warning Horn sound if the above conditions were met and the Spoilers are already set to the FLT LIMIT position?

- A. YES
- B. NO

A. YES



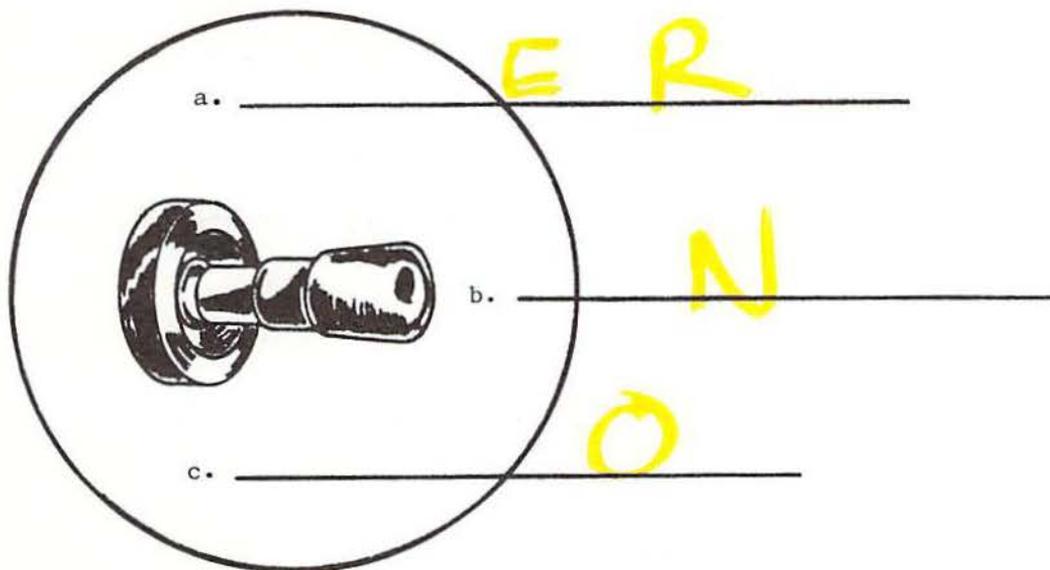
Excellent! When the Spoilers are already open and a stall is approached, the UNDER SPLR SPEED light will illuminate and the Audible Warning Horn will sound if the Spoiler Select Switch is positioned to FLT. This notifies the pilot to close the Spoilers.

Thus, we have three (3) conditions under which we should NOT open the Spoilers in flight.

1. Any time the wing flaps are NOT full up.
2. Above 350 KCAS or Mach 0.75.
3. When approaching a stall.

Fill in the blank spaces or circle the correct word(s) below.

1. The Asymmetry Protection System detects uneven (inboard) (outboard) Spoiler operation during the first 2½ inches of Spoiler (operation) (closing).
2. If only one SPOILER INOP light illuminates, the spoiler system will remain operational.
 - a. True
 - b. False
3. The Asymmetry Protection System will NOT detect an asymmetric condition on the (inboard) (outboard) Spoiler sections.
4. The EREO Switch is used to bypass Normal Control System, close the Spoilers and deactivate the system in the event of a _____ during Spoiler operation.
5. List the three positions of the EREO Switch.



EMERGENCY RETRACT OPERATION

6. EMER RETRACT, a momentary position that is spring loaded back to NORMAL, simulates an asymmetrical condition which, in turn, causes:
 - a. Hydraulic Systems Nr 2 and Nr 3 to drive the Spoilers (closed) (open).
 - b. Nr 2 and Nr 3 SPOILER INOP lights to ILLUM.
7. Moving the Spoiler Lever to RESET will (illuminate)(extinguish) the SPOILER INOP lights and RESET the system for operation.

EMERGENCY OFF OPERATION

8. With the EREO Switch in EMER OFF, the Spoilers cannot be (opened) (closed).
9. If the Spoilers are already open, placing the EREO Switch to EMER OFF will cause:
 - a. Hydraulic pressure Nr 2 to be shut off at the Spoiler (Lever) (Actuating) Mechanisms.
 - b. Hydraulic System Nr 3 to drive the Spoilers Closed by applying pressure to the Spoiler Actuating Mechanisms.
 - c. Hydraulic System Nr 3 (pressure) (pumps) to be shut off at the Spoiler Actuating Mechanism as soon as the Spoilers reach the closed position.
 - d. Nr 2 and Nr 3 SPOILER INOP lights to (go out) (illuminate).
10. The Spoiler Lever must be moved to CLOSED before the Hydraulic System Nr 3 (pressure) (pumps) can be shut off.