



AIR FORCE TACTICS, TECHNIQUES, AND PROCEDURES 3-32.12

28 MARCH 2016

MINIMUM AIRFIELD OPERATING SURFACE (MAOS) SELECTION AND REPAIR QUALITY CRITERIAL (RQC)



DEPARTMENT OF THE AIR FORCE

This page intentionally left blank.



28 MARCH 2016

Tactical Doctrine

***MINIMUM AIRFIELD OPERATING SURFACE (MAOS)
SELECTION AND REPAIR QUALITY CRITERIA (RQC)***

ACCESSIBILITY: Publications and forms are available on the e-Publishing web site at www.e-Publishing.af.mil for downloading or ordering.

RELEASABILITY: There are no releasability restrictions on this publication.

OPR: AFCEC/CXX

Certified By: AF/A4C
(Maj Gen Timothy S. Green)

Pages: 121

PURPOSE: To provide tactics, techniques and procedures (TTP) to accurately and expeditiously select minimum airfield operating surfaces (MAOS) and determine repair quality criteria (RQC) immediately after an attack. This publication supports Air Force Instruction (AFI) 10-209, *RED HORSE Program*; AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, Air Force Pamphlet (AFPAM) 10-219, Volume 4, *Airfield Damage Repair Operations*, and Air Force Doctrine Annex 3-34, *Engineer Operations*. Ensure all records created as a result of processes prescribed in this publication are maintained in accordance with (IAW) Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of IAW the Air Force Records Disposition Schedule (RDS) in the Air Force Records Information Management System (AFRIMS). Refer recommended changes and questions about this publication to the Office of Primary Responsibility (OPR) using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command.

APPLICATION: This publication applies to all Air Force active duty, Air National Guard (ANG), and Air Force Reserve Command (AFRC) Prime Base Engineer Emergency Force (BEEF) and RED HORSE engineers performing MAOS and RQC immediately after an attack. This document is authoritative but not directive. The MAOS selection TTPs found in this publication take precedence over those found in other nondirective publications. The applicable Air Force Instruction (AFI) will take precedence in cases where this publication and AFIs conflict.

SCOPE: This publication provides guidance for selecting an MAOS and determining RQC after an attack. It describes the tools necessary to create a Geospatial Expeditionary Planning Tool (GeoExPT) scenario, plotting and managing airfield damage, selecting a minimum operating strip (MOS) and MAOS, and to print and plot operations. The GeoExPT application is constantly being upgraded and modified; users should refer to the Users' Manual for the latest procedures.

Chapter 1—INTRODUCTION	4
1.1. Background	4
1.2. Overview	4
Chapter 2—CONCEPT OF OPERATIONS	5
2.1. Sequence of Events	5
2.2. MAOS Selection Team	5
Table 2.1. Team Composition	6
2.3. MOS Selection Kit	7
Table 2.2. MAOS Selection Team Supplies	7
2.4. MAOS Characteristics	8
Table 2.3. MOS Launch or Recovery (LoR) Capability	9
Chapter 3—GeoExPT	11
3.1. Introduction	11
3.2. Acquiring the GeoExPT Training Manual	11

Chapter 4—LEGACY – MANUAL MAOS SELECTION	12
4.1. Purpose	12
4.2. Chart Description	12
Figure 4.1. Sample Aircraft MOS Requirements Chart	12
4.3. Assumptions	13
4.4. Step-by-Step Directions for Determining MOS Lengths	13
Table 4.1. Instructional Guidelines for Determining MOS Lengths	14
Figure 4.2. Example Density Ratio Table	17
Table 4.2. RQC Chart/Figure Number	18
Figure 4.3. Worksheet 1 Example	21
Figure 4.4. Determining Operational Lengths	22
Figure 4.5. Operational Lengths Entered on Worksheet 1	23
Figure 4.6. Determining Arrested Landing Operational Length	24
Figure 4.7. Determining Takeoff Operational Length	25
Figure 4.8. Takeoff or Landing (ToL) Map	27
Table 4.3. MOS Designation Identifier Explained	26
Figure 4.9. Worksheet 2 Example	28
Figure 4.10. Finding Uncorrected RQC on Chart D1	29
Figure 4.11. RQC Values Recorded on Worksheet 2	30
Figure 4.12. RQC Summary (Worksheet 3)	32
4.5. Presenting MAOS Candidates to Wing Commander	33
Figure 4.13. Summary RQC Presentation Format	33
Attachment 1—GLOSSARY OF REFERENCES & SUPPORTING INFO	35
Attachment 2—BLANK FORMS FOR REPRODUCTION	41
Attachment 3—AIRCRAFT MOS REQUIREMENT CHARTS	45

Chapter 1

INTRODUCTION

1.1. Background. A wing commander's number one priority after an attack is to launch and recover mission aircraft. However, if the takeoff or landing (ToL) surface is damaged during the attack, repairs are likely required before launching and recovering aircraft. In most instances repairing the entire airfield is not an option; it would take too long to meet the commander's air tasking order (ATO). Initially, only repairing the minimum pavement necessary to launch and recover aircraft expedites the reopening of the airfield.

1.1.1. Engineers, with close coordination from Airfield Management, must recommend the most appropriate airfield surfaces to repair—those that require the least repair time, including unexploded explosive ordnance (UXO) mitigation, but still provide adequate launch or recovery (LoR) surfaces for mission aircraft. The ToL surface selected for repair is called the minimum operating strip (MOS). The MOS is the area where aircraft actually takeoff or land and its dimensions are determined by the installation Crisis Action Team (CAT). The MOS dimensions vary with aircraft type, operation, and weights, as well as environmental conditions.

1.1.2. A suitable MOS cannot be selected without a full appreciation of the damage throughout the entire airfield. For example, if an ideal MOS is identified that involves minimum repair effort, finding acceptable access routes from aircraft parking areas to the MOS must also be considered. These combined surfaces (MOS, minimum taxiways, and minimum aircraft parking areas) are known as the minimum airfield operating surface (MAOS).

1.2. Overview. This publication serves as a guide to select suitable MAOS candidates. It explains the MAOS selection process, to include concept of operations, team organization and resources, sequence of the selection steps, characteristics of a good MOS, and determining repair quality criteria (RQC). An illustrated example of MOS selection is also presented.

Note: RQC calculations are only required for legacy repair methods (e.g., crushed stone with or without FOD cover). The new rapid airfield damage repair (RADR) capping methods (e.g., rapid-setting concrete or asphalt) are considered semi-permanent repairs and repaired flush with the surrounding pavement.

Chapter 2

CONCEPT OF OPERATIONS

2.1. Sequence of Events. Before repairs begin, airfield damage must be assessed, reported, and plotted; a MAOS selected; and UXO safed and removed.

2.1.1. Damage Assessment. Airfield damage assessment teams (ADAT), described in AFTTP 3-32.11, *Airfield Damage Assessment after Attack*, provide MAOS selection personnel information about the type and location of damage and UXO on the airfield surfaces. The CAT provides additional information on operational requirements and expected operating conditions following the attack.

2.1.2. MAOS Selection. Using information provided by the airfield damage assessment teams (ADATs) and the CAT, the MAOS Selection Cell identifies potential MAOS candidates within 30 minutes after the attack and briefs the candidates to the wing commander. The commander selects the most desirable candidate to meet the ATO.

2.1.3. UXO Mitigation. Once the MAOS is selected, Explosive Ordnance Disposal (EOD) operators begin rendering safe and removing UXO that impact MAOS recovery (described in AFTTP 3-32.5V6, *Explosive Ordnance Disposal (EOD) Unexploded Explosive Ordnance (UXO) Operations*).

2.1.4. MAOS Repair. As EOD clears repair areas, recovery teams begin pavement repairs, airfield marking and striping, airfield lighting installation, aircraft arresting system installation, and final sweeping of the MAOS.

2.1.5. Airfield Restrictions and Closures. Civil Engineers coordinate with the Airfield Manager or designated representative throughout all phase of the repair process (i.e. pre-, on-going, and post-) to ensure appropriate airfield restrictions and/or closures are imposed and applicable Notices to Airmen (NOTAMs) issued.

2.2. MAOS Selection Team. The MAOS Selection Team receives, records, and plots damage and UXO reports from ADATs, along with pertinent operational information received from the CAT, such as expected weather conditions, runway conditions, aircraft loads, minimum MOS width, and arresting system requirements, and uses the relayed information to identify acceptable MOAS candidates to be selected by the wing commander.

2.2.1. Airfield damage and UXO data are entered into GeoExPT or manually plotted on the MOS selection map when GeoExPT is unavailable. The backup MAOS Selection Team, typically in the Civil Engineer Unit Control Center (CE-UCC), performs the same actions to ensure the data is still available if the Primary Emergency Operations Center (EOC) is destroyed during subsequent attacks. GeoExPT generates three suggested MAOS candidates (verified by the selection team), or selected manually by the MAOS Selection Team when GeoExPT is not available, and are presented to the wing commander for final selection.

2.2.2. **Location.** The primary and alternate EOCs will have a MAOS selection team assigned. In addition, individuals in the CE-UCC will perform MAOS selection. Information regarding MAOS selection is promptly passed to the Alternate EOC and Alternate CE-UCC. This provides redundancy for damage recording, a triple check on proposed MAOS candidates, and continuity of operations in the event the Primary EOC and/or Primary CE-UCC is damaged.

2.2.3. **Team Composition.** At a minimum, the MAOS Selection Team is composed of two engineering technicians (AFS 3E5X1) and an augmentee (Table 2.1.). The engineering technicians input data into GeoExPT or plots damage on the airfield map, select at least three candidate MAOSs, and brief the wing commander on the candidates. The augmentee serves as a radio operator and data recorder.

Table 2.1. Team Composition.

Position	AFSC	Responsibilities
Team Chief	3E5X1	- Oversee MAOS Selection activities - Brief wing commander on MAOS candidates
Damage Plotter	3E5X1	- Plot damage and UXO data - Select candidate MAOSs - Calculate RQC
Radio Operator/Recorder	Any	- Receive/record damage and UXO data - Assist with MAOS selection - Track ADAT progress/movement
¹ EOD Technician	3E8X1	- Receive/record UXO damage - Provide technical advice on UXO effects - Track ADAT progress/movement

Position	AFSC	Responsibilities
² Airfield Management Representative	1C7XX	<ul style="list-style-type: none"> - Provide technical advice on aircraft characteristics - Provide technical advice regarding airfield planning and design criteria - Coordinates airfield restrictions and/or closures with Airfield Management Operations - Provide technical advice on priority of pavement repairs in order to expedite takeoffs and landings
¹ Member of EOC staff (ESF-5)		
² If vacant, required information is requested from the CAT		

2.2.3.1. An EOD representative (AFS 3E8X1) in the EOC may support the MAOS Selection Team by receiving and recording EOD related data from the ADATs. They also provide technical expertise on UXO stand-off distances and estimate UXO mitigation times.

2.2.3.2. Installations often support a variety of aircraft with different MAOS requirements and must be considered during MOAS selection. Therefore, consider adding an Airfield Management representative who understands aircraft characteristics and airfield design criteria should to the MAOS Selection Team.

2.3. MOS Selection Kit. Engineers should posture a MOS selection kit at installations with flying missions. As a minimum, the kit should include items listed in [Table 2.2](#).

Table 2.2. MAOS Selection Team Supplies.

Item
• Laptop Computer w/GeoExPT software loaded
• Transparent MOS overlay and crater templates (e.g., clear acetate, Plexiglas, etc.)
• Plotting board
• Critical resource charts
• Straight edge, engineer scale, and transparent circle templates with decimal units matching the airfield map scale
• AFTTP 3-32.12, <i>Minimum Airfield Operating Surface Selection</i>

• Markers, pens, and pencils
• Damage reporting/recording forms
• Base grid map – 1:4800 (1-inch = 400-foot) scale
• Airfield map – 1:1200 (1-inch = 100-foot) scale with Pavement Reference Marking System (ToL map) Note: Ideally, the runway portion of the airfield map should be lightly partitioned in 10-foot increments to ease and expedite plotting.
• Airfield Suitability Analysis (See AMCI 11-211)
• Applicable Air Tasking Orders or sortie requirements
• Base Support Plan

2.4. MAOS Characteristics. Simply stated, the goal of MAOS candidate selection is to locate the best available MOS that can be repaired in the least amount of time. A good MOS has many characteristics, the ranking of which will depend upon the situation at a particular installation. Consequently, the MAOS selection process must be flexible to identify the best option under a wide variety of circumstances. Generally, a good MAOS will allow rapid restoration of launch and recovery capability. Crater repair is a lengthy process; thus, it is important to initially repair no more damage than necessary. That is why it is imperative to wait for completion of airfield damage assessment before finalizing MAOS selection. The MAOS selection procedure is designed to choose a takeoff and landing area that is comparatively low in crater and spall damage. Repair time, therefore, is saved at the cost of initial delay caused by accurately identifying and plotting damage and selecting a MOS. Selecting a MAOS is a balance of identifying candidates with the least amount of damage, maximum utilization of existing markings, lighting, and aircraft arresting systems, and a high LoR rating.

2.4.1. Resource Limitations. An ADR team's capability may be hampered by resource shortages and equipment deficiencies. The MAOS selection team should consider any noticeable limitations when determining candidates. As damage reports are received, the selection team must make a conscious decision to monitor ADR equipment and materials status during the MOS selection process. Engineer personnel in the alternate EOC and CE-UCC should also monitor equipment and material status as a crosscheck for accuracy. As airfield damage assessment nears completion, a quick verification of equipment and material between all control centers should be accomplished to ensure the most current information is considered.

2.4.2. Sortie Capability. Aircraft should be able to get to and from the MOS quickly. If a MAOS is selected without regard to sortie generation capability, aircraft operations could be restricted after MOS repair. The LoR status of an airfield measures sortie generation capability, independent of variables such as mission time, aircraft attrition, and origin of aircraft (aircraft may launch at one air base and be recovered at another). A few examples of how various restrictions can reduce LoR capabilities are shown in **Table 2.3**. For example, a MOS with two access taxiways that requires an aircraft to backtrack more than 2,000 feet will have an LoR capability of only 50%. Additional explanations of other common LoR restrictions are described below.

Table 2.3. MOS LoR Capability.

2 Access Taxiways	One Access Taxiway	Taxi Backtrack > 1K Ft.	Taxi Backtrack > 2K Ft.	Arrestment of Each Aircraft	ATC Eqpt. Not Functional	Relative LoR Capability
X						100%
X				X		34%
X				X	X	25%
X		X				60%
X			X			50%
	X					40%
	X			X		27%
	X			X	X	19%

2.4.2.1. LoR Status. The LoR status of a MOS is the total number of launches and recoveries the surface can handle per unit time compared to the number that could be handled by the same undamaged airfield. An LoR status of 100 percent simply means the MOS and its access route(s) are not restricting sortie capacity. Even if its LoR status is substantially less than 100 percent, it does not necessarily mean that the MOS is limiting sortie capability. Normal operations may not use the entire capability, and other factors in the base status after an attack may be even more limiting.

2.4.2.2. MOS Location. A MOS may be located on the main runway parallel to the centerline, on a parallel taxiway, or even on an alternate LoR surface on or off base that has the proper structural capacity. The MOS location affects LoR status in various ways by limiting access and egress, by limiting air traffic control, or by restricting the flight approach of aircraft.

2.5. Pre-Attack Actions. When an attack is imminent the primary MAOS Selection Team reports to the EOC, while the backup MAOS selection teams report to the Alternate EOC, CE-UCC, and Alternate CE-UCC. The primary MAOS Selection Team performs the following actions and passes information to the backup MAOS Selection Teams:

2.5.1. If time permits, gather the following information and pass the information to the backup MAOS Selection Teams.

2.5.1.1. Contact the Mission Director within the CAT for:

2.5.1.1.1. Expected mission aircraft operations (e.g., landing, takeoff, evacuation).

2.5.1.1.2. Gross weights of mission aircraft expected to use the MOS.

2.5.1.1.3. Unidirectional or bidirectional MOS.

2.5.1.2. Contact Base Weather for current and forecasted weather conditions.

2.5.1.3. Determine operational lengths for mission aircraft.

2.5.2. Conduct communications checks with EOC, CE-UCC, and ADATs.

Chapter 3

GEOSPATIAL EXPEDITIONARY PLANNING TOOL (GeoExPT)

3.1. Introduction. Users should refer to the GeoExPT User Manual when performing MAOS selection with GeoExPT. The application is constantly being upgraded and modified and therefore users should ensure they are using the most current manual for the latest updates and procedures.

3.2. Acquiring the GeoExPT Training Manual. Contact the Air Force Civil Engineer Center Reach Back Center (AFCEC RBC), 888-232-3721 (toll free), DSN 523-6995, or via email at afcec.rbc@us.af.mil to acquire the current application and user manual.

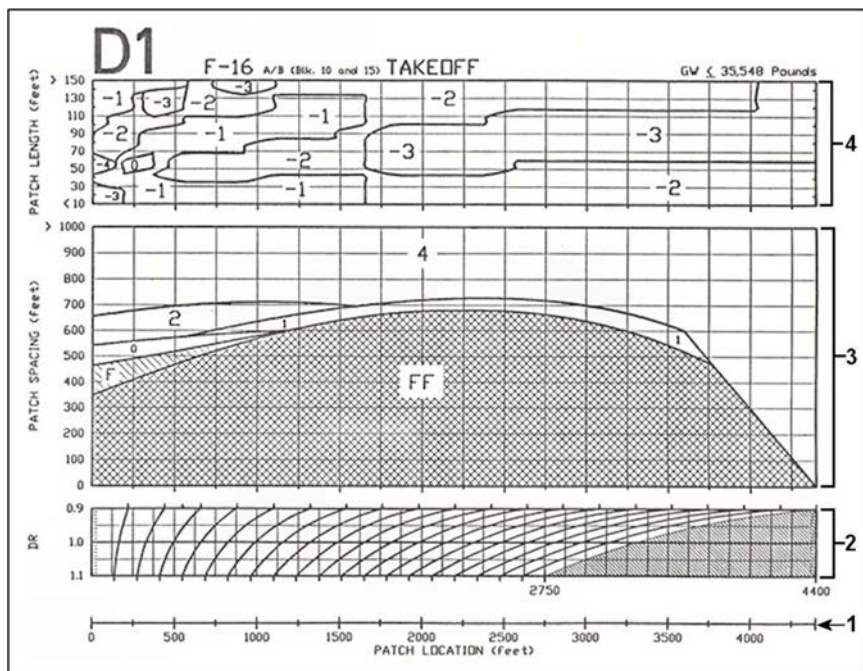
Chapter 4

LEGACY – MANUAL MAOS SELECTION

4.1 Purpose. Manual MAOS selection is used when GeoExPT is unavailable.

4.2. Chart Description. **Figure 4.1** is an example of charts used to determine the MOS requirement for a given aircraft and aircraft operation. The chart has four areas: 1) the location baseline shift area; 2) the environmental shift area; 3) the uncorrected RQC area; and 4) correction factor area as shown in **Figure 4.1**.

Figure 4.1. Sample RQC Chart.



4.2.1. Location Base Line. The location baseline is the starting point for calculations. This area is used to determine the MOS requirement, as well as mark the repair patch locations when determining the RQC requirement.

4.2.2. Environmental Shift. This area compensates for aircraft performance variations due to weather and runway conditions. These include the Density

Ratio (DR) and the Runway Surface Condition (RSC). **Note:** Some charts may not have an RSC section.

4.2.3. **Uncorrected RQC.** This area determines initial RQC for individual repairs.

4.2.4. **Correction Factor.** This area provides RQC correction factors based on the repair location on the MOS and its proximity to other repairs.

4.3. Assumptions. The following assumptions apply when performing the manual MAOS selection method.

4.3.1. Users are familiar with the functions of damage assessment and MAOS selection, including reporting of airfield damage nomenclature.

4.3.2. RQC represents the maximum allowable repair height, in inches, for all values except flush (F) and a flush repair followed by a flush repair (FF).

4.3.3. Allowable sag depth is 2.0 inches for all RQC, except “F” and “FF.”

4.3.4. Allowable repair slope is 5.0% for all RQC, except in a landing touchdown zone. Allowable repair slope is 3.4% in landing touchdown zones.

4.3.5. Aircraft contact the entire length of each repair on the MOS. Lateral repair location does not affect RQC.

4.3.6. All spalls are repaired to flush criteria.

4.3.7. Aircraft operation lengths are defined as takeoff or landing distance in the aircraft performance manual. Since the MOS length may be specified by the CAT and the wing commander, it may be longer than the longest operation length. Any repair in a section of the MOS beyond the longest operation length has an RQC equal to flush “F.”

4.3.8. Aircraft are maintained in accordance with relevant technical orders and service manuals.

4.3.9. Relay the following caution to the CAT and Airfield Management for taxiway repairs: “All operations on taxiway repairs are limited to 5 knots. Taxiway repairs may have up to 6 inches of upheaval and up to 2 inches of sag. Braking in vicinity of repairs on taxiway surfaces must be avoided.”

4.4. Step-by-Step Directions for Determining MOS Lengths. **Table 4.1** provides a step-by-step checklist for determining MOS lengths. It is recommended the user follow these steps to ensure accuracy and quality of the

process. Steps 1 and 2 may be performed during pre-attack actions to save time when selecting MAOS candidates after the attack. Information in the following paragraphs expound upon **Table 4.1**.

Table 4.1. Instructional Guidelines for Determining MOS Lengths.

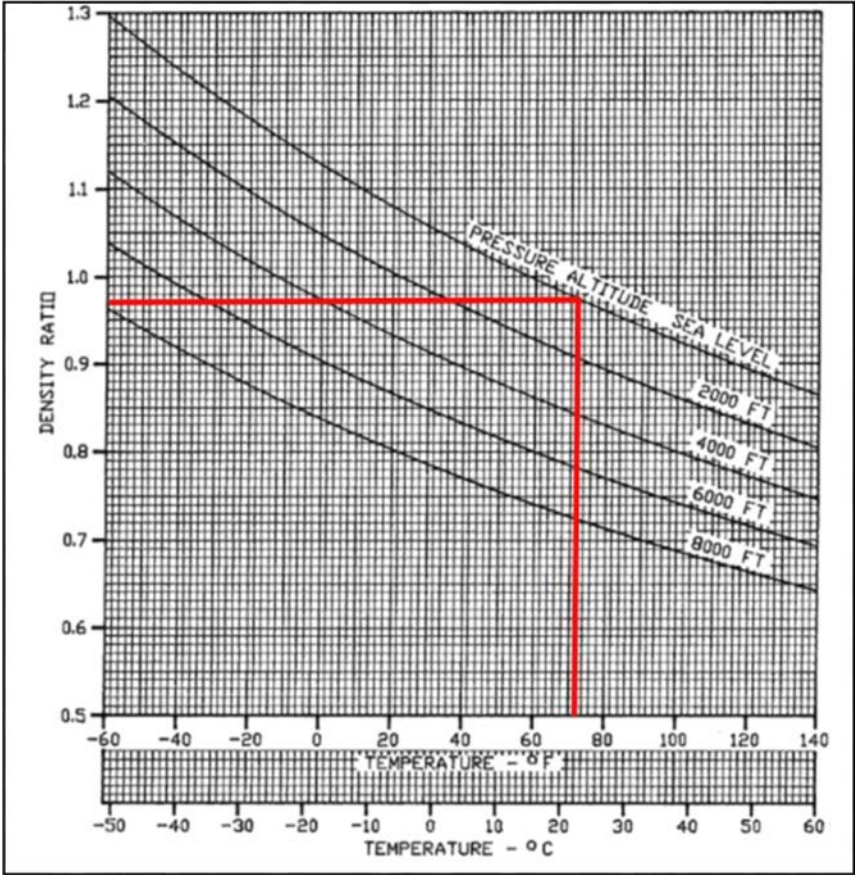
Step	Process Action	
1	Collect Aircraft and Environmental Data – Record on Worksheet 1	
	1.1	Record data for aircraft operation expected on the MOS
		1.1.1 Aircraft model
		1.1.2 Gross weight (pounds)
		1.1.3 Operation (takeoff, landing, or evacuation)
		1.1.4 Special landing operations (aero braking; wheel braking; short field arrestment, with chute, without chute, or normal)
		1.1.5 Direction of operations (from MOS threshold or departure end)
	1.2	Record the RQC chart number for each operation
	1.3	Record <i>highest</i> expected temperature, pressure altitude, and <i>lowest</i> Density Ratio (DR) expected for that day. If DR is unavailable, use DR Chart (Figure 4.2 & Attachment 2) by drawing a vertical line from the temperature axis until intersecting with the pressure altitude and then draw a horizontal line to the DR axis.
	1.4	If applicable, record condition or greatest expected depth of condition (i.e. average depth of water, slush, loose snow, packed snow, or ice on runway surface to nearest tenth of an inch).
2	Determine Operational Lengths (See <i>Figure 4.4</i>)	
	2.1	Draw a horizontal line, corresponding to the DR (0.97), across the DR section.
	2.2	Draw horizontal line in condition-type section (Chart D2) corresponding to worst type of condition expected in that section of MOS in next 12 hours.
	2.3	From the intersection of the DR line and the shaded section, draw a vertical line to the bottom of the RSC section. Follow guideline until line intersects with RSC. From this intersection, draw a vertical line downward to location baseline to determine operational length (4,400) and record on Worksheet 1.

Step	Process Action	
	2.4	If no RSC section (Chart D1), locate intersection of DR line with shaded section. From this point, draw a vertical line downward to location baseline to determine operational length (3,525) and record on Worksheet 1.
3	Define Repair Patches on the ToL Map	
	3.1	Draw lines, perpendicular to sides of MOS, at beginning and end of each crater on, or partially on, MOS.
	3.2	Shade area between lines for each crater
	3.3	If two shaded areas are within 25 feet of each other, shade area between them
	3.4	From MOS threshold, number each shaded area as a patch
4	For each Operation, Determine Patch Locations, Lengths, and Spacing	
	4.1	Draw double lines, perpendicular to sides of MOS, marking operation threshold and operation length
	4.2	For each patch within two sets of double lines, record operation number and patch number on Worksheet 2 (e.g., for Operations 2 – Patch 3, enter “2/3”)
	4.3	For each patch, measure distance from operation threshold to center of the patch, and record “Patch Location” on Worksheet 2. If distance is greater than operation length, record operation length.
	4.4	Measure length of each patch and record on Worksheet 2.
	4.5	For each patch, measure distance from center of patch to center of next patch (in operational direction) and record this distance as “Patch Spacing” on Worksheet 2. For last patch, record maximum spacing value from RQC chart.
	4.6	Repeat step 4 for each operation using MOS.
5	Determine Uncorrected RQC and Correction Factor	
	5.1	Mark location of each patch on location baseline
	5.2	Mark spacing and length for each patch on their respective axes
	5.3	Draw a horizontal line, corresponding to the current DR, across the DR section. If there is an RSC section, draw a horizontal line, corresponding to current RSC, across that section.

Step	Process Action
	5.4 For each patch, draw a vertical line from location baseline to intersect with current DR. Then follow guidelines to top of DR section. From this point, draw a vertical line to intersect with current RSC. Then follow guidelines to top of the section. From this point, draw a vertical line to top of DR section to top of RQC chart.
	5.5 For each patch, draw a horizontal line corresponding to spacing for that patch until line intersects with vertical line from step 5.4. Determine uncorrected RQC from region of intersection and record on Worksheet 2. If intersection falls within a shaded region, a correction factor is not required.
	5.6 For each patch, draw a horizontal line corresponding to length of that patch until line intersects with vertical line from step 5.4. Determine correction factor from region of intersection and record on Worksheet 2.
	5.7 Perform step 5 for each operation.
6	Determine RQC for Each Repair Patch
	6.1 Add correction factor to uncorrected RQC and record on Worksheet 2. If result is a negative number, record an "F." If uncorrected RQC for a repair is "FF," record an "F" for both that patch and patch immediately following it.
	6.2 Calculate RQC for each patch for each operation
7	Summarize RQC for Entire MOS
	7.1 List each MOS threshold operation on top half of Worksheet 3.
	7.2 List each operation from MOS departure end on bottom half of Worksheet 3.
	7.3 Mark each patch number from MOS on both top and bottom of Worksheet 3.
	7.4 For each operation and patch number, record RQC from Worksheet 2 onto Worksheet 3. For patches on MOS but not within length of any operation, record an "F."
	7.5 For each repair patch and each operation direction, record the lowest RQC in the summary lines on Worksheet 3
	7.6 For each repair patch, record lower summary value in combined line on Worksheet 3

Step	Process Action	
	7.7	Transfer combined RQC to ToL map, and brief Base Civil Engineer and/or wing commander.
Note: See Attachment 2 for blank worksheets.		

Figure 4.2. Example Density Ratio Table.



4.4.1. **Collect Aircraft Operational and Environmental Data.** Contact the CAT and Airfield Management to gather information on aircraft operations and

environmental data (contact Base Weather if the CAT does not have the environmental data). Record each operation and corresponding chart number from **Table 4.2** on a separate line of Worksheet 1 (**Figure 4.3**). If uncertain as to procedures used during aircraft operations, select charts for all possible operations (charts may be found in **Attachment 3**). **Note:** If possible, perform this step during pre-attack actions to save time during actual MAOS selection.

Note: Some aircraft models found in these RQC charts have been retired by the US, but ally nations may still fly them; therefore, the charts remain. If there is no chart for an aircraft or a particular aircraft operation, plan for a 10,000-ft by 150-ft MOS unless the Senior Airfield Authority provides specific MOS dimensions. Projects are scheduled to develop charts for new aircraft models not listed and will be added when available.

Table 4.2. RQC Chart/Figure Number.

Aircraft MOS Requirement Charts/Figure Numbers			
Aircraft	RQC Chart	Operation	Figure #
F-4 C/D	A1	Takeoff	A3.1
	A2	Landing – Arrestment	A3.2
	A3	Landing – w / Chute	A3.3
	A4	Landing – w/o Chute	A3.4
	A5	Evacuation	A3.5
F-4 E	B1	Takeoff	A3.6
	B2	Landing – Arrestment	A3.7
	B3	Landing – w / Chute	A3.8
	B4	Landing – w/o Chute	A3.9
	B5	Evacuation	A3.10
F-15 A/B	C1	Takeoff	A3.11
	C2	Landing – Aero Braking	A3.12
	C3	Landing – Wheel Braking	A3.13
	C4	Landing – Arrestment	A3.14
	C5	Evacuation	A3.15
F-15 C/D	C6	Takeoff	A3.16
	C7	Landing – Aero Braking	A3.17
	C8	Landing – Wheel Braking	A3.18
	C9	Landing – Arrestment	A3.19
	C10	Evacuation	A3.20

Aircraft MOS Requirement Charts/Figure Numbers			
Aircraft	RQC Chart	Operation	Figure #
F-15 E	C11	Takeoff	A3.21
	C12	Landing	A3.22
	C13	Landing – Arrestment	A3.23
	C14	Evacuation	A3.24
F-16 A/B Block 10/15	D1	Takeoff	A3.25
	D2	Landing	A3.26
	D3	Landing – Arrestment	A3.27
	D4	Evacuation	A3.28
F-16 C/D Block 25/30/32	D5	Takeoff	A3.29
	D6	Landing	A3.30
	D7	Landing – Arrestment	A3.31
	D8	Evacuation	A3.32
F-16 C/D Block 40/42	D9	Takeoff	A3.33
	D10	Landing	A3.34
	D11	Landing – Arrestment	A3.35
	D12	Evacuation	A3.36
F-111 A/E	E1	Takeoff	A3.37
	E2	Landing	A3.38
	E3	Landing – Short Field	A3.39
	E4	Landing – Arrestment	A3.40
	E5	Evacuation	A3.41
C-5 B	F1	Takeoff	A3.42
	F2	Landing	A3.43
C-130 E/H	G1	Takeoff	A3.44
	G2	Landing	A3.45
C-141 A/B Heavy	H1	Heavy Weight Takeoff	A3.46
	H2	Heavy Weight Landing	A3.47
C-141 A/B Medium	I1	Medium Weight Takeoff	A3.48
	I2	Medium Weight Landing	A3.49
A-7D	J1	Takeoff	A3.50
	J2	Landing	A3.51
	J3	Landing – Arrestment	A3.52
	J4	Evacuation	A3.53

Aircraft MOS Requirement Charts/Figure Numbers			
Aircraft	RQC Chart	Operation	Figure #
A-10 A	K1	Takeoff	A3.54
	K2	Landing	A3.55
KC-135 R	L1	Heavy Weight Takeoff	A3.56
	L2	Normal Weight Takeoff	A3.57
	L3	Landing	A3.58
KC-10	M1	Heavy Weight Takeoff	A3.59
	M2	Normal Weight Takeoff	A3.60
	M3	Landing	A3.61
C-9	N1	Heavy Weight Takeoff	A3.62
	N2	Normal Weight Takeoff	A3.63
	N3	Landing	A3.64
C-17	O1	Disclaimer	A3.65
	O2	Heavy Weight Takeoff	A3.66
	O3	Normal Weight Takeoff	A3.67
	O4	Heavy Weight Landing Steep Approach	A3.68
	O5	Heavy Weight Landing Normal Approach	A3.69
	O6	Normal Weight Landing Normal Approach	A3.70
F-117	P2	Heavy Weight Takeoff	A3.71
	P3	Normal Weight Takeoff	A3.72
	P4	Light Weight Takeoff	A3.73
	P5	Normal Weight Landing – No Chute	A3.74
	P6	Normal Weight Landing – Chute	A3.75
	P7	Heavy Weight Landing – No Chute	A3.76
	P8	Heavy Weight Landing – Chute	A3.77
Note: Charts reflect legacy 990 ft maximum runout for arrestment landings; current maximum runout is 1,200 ft. See note at bottom of each arrestment landing chart for operational length correction to reflect 1,200 ft maximum runout.			

Figure 4.3. Worksheet 1 Example.

WORKSHEET 1 - REPAIR QUALITY CRITERIA (RQC) ENVIRONMENTAL DATA							
TEMPERATURE (°F)		MOS THRESHOLD (Feet)		RUNWAY SURFACE CONDITION (RSC)			
ALTITUDE (Feet)		DEPARTURE END (Feet)		Condition (Choose One)	DRY <input type="checkbox"/>	WR <input type="checkbox"/>	SLR/LSR/PSR/IR <input type="checkbox"/>
DENSITY RATIO		MOS LENGTH (Feet)		Condition Depth (Estimated to Nearest Tenth) _____ Inch			
OPERATION NUMBER	AIRCRAFT MODEL	GROSS WEIGHT (Lbs)	OPERATION	SPECIAL LANDING PROCEDURES	DIRECTION (Choose One)	CHART	OPERATION LENGTH (Feet)
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MOS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		

RSC: WR=WET RUNWAY SLR=SLUSH ON RUNWAY LSR=LOOSE SNOW ON RUNWAY PSR=PACKED SNOW ON RUNWAY IR=ICE ON RUNWAY

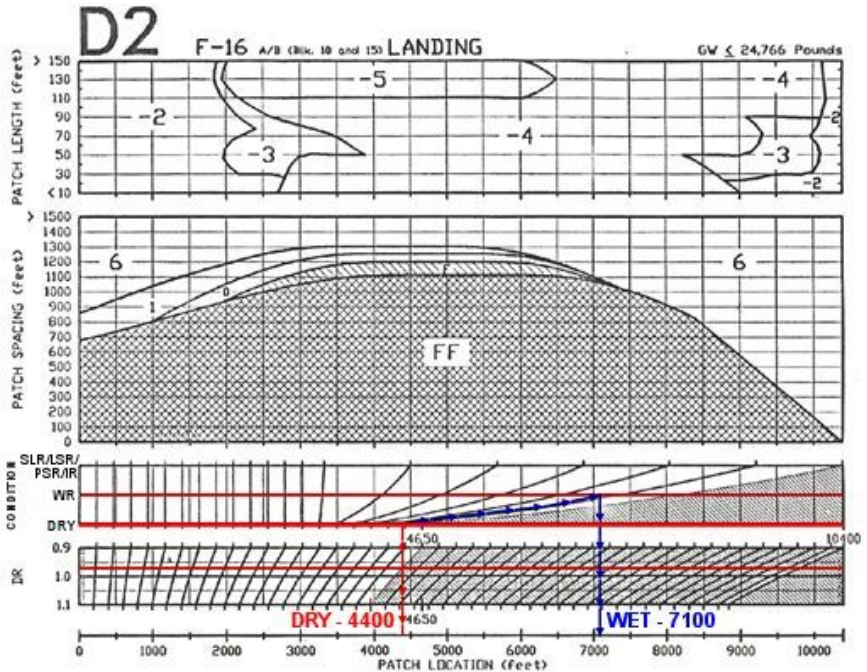
4.4.2. Determining Operational Lengths. Once proper charts are selected, determine operation length for each combination of aircraft configuration and operation. The longest calculated length for aircraft operations to be performed is the minimum overall length of the MOS. **Note:** If there is no chart for an aircraft or a particular aircraft operation, plan for 10,000-feet by 150-foot MOS unless the Senior Airfield Authority (SAA) provides other MOS dimensions.

4.4.2.1. RQC Charts with RSC. Figure 4.4. provides an example of determining operational lengths for F-16 landing operations with a DR = 0.97, Condition = DRY, and Condition Depth = 0.0. **Note:** See Table 4.1., Step 1.3, for instructions to determine DR when unavailable from the CAT. **Note:** For illustration purposes, landing operation with condition of WR (7,100) is also shown in Figure 4.4.

4.4.2.1.1. Draw a horizontal line across the DR section corresponding to the DR recorded on Worksheet 1 (0.97).

4.4.2.1.2. Draw a horizontal line across the RSC section corresponding to the condition recorded on Worksheet 1 (DRY).

Figure 4.4. Determining Operational Lengths.



4.4.2.1.3. From the intersection of the DR line with the shaded section, draw a vertical line down to the location baseline (4,400).

4.4.2.1.4. If the RSC were *Wet* (WR) or *Slush/Loose Snow/Packed Snow/Ice* (SLR/LSR/PSR/IR), follow the horizontal DR line to the shaded area. Draw a vertical line up to the bottom of the RSC section and follow guidelines until the line intersects with current RSC. Stay between guidelines in proportion to starting location (e.g., WR/SLR/LSR = 7,100).

4.4.2.1.5. Record length (4,400) in space provided on Worksheet 1 ([Figure 4.5](#)).

4.4.2.1.6. Perform the above steps for each operation on Worksheet 1.

4.4.2.2. **RQC Charts without RSC.** Operational length determination using charts with no RSC is simply accomplished by eliminating the shift in the RSC area.

Figure 4.5. Operational Lengths Entered on Worksheet 1.

WORKSHEET 1 -- REPAIR QUALITY CRITERIA (RQC) ENVIRONMENTAL DATA							
TEMPERATURE (°F)		72	MDS THRESHOLD (Feet)		RUNWAY SURFACE CONDITION (RSC)		
ALTITUDE (Feet)		Sea Level	DEPARTURE END (Feet)		Condition (Choose One)	DRY <input checked="" type="checkbox"/> WR <input type="checkbox"/>	SLR/LSR/PSR/IR <input type="checkbox"/>
DENSITY RATIO		.97	MDS LENGTH (Feet)		Condition Depth (Estimated to Nearest Foot)		
OPERATION NUMBER	AIRCRAFT MODEL	GROSS WEIGHT (Lbs)	OPERATION	SPECIAL LANDING PROCEDURES	DIRECTION (Choose One)	CHART	OPERATION LENGTH (Feet)
1	F-16B	33,000	Takeoff		<input checked="" type="checkbox"/> FROM MDS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END	D1	3,525
2	F-16B	22,800	Landing		<input checked="" type="checkbox"/> FROM MDS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END	D2	4,400
3	F-16B	22,800	Landing	Arrestment	<input checked="" type="checkbox"/> FROM MDS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END	D3	2,034
4	F-16B	33,000	Takeoff		<input type="checkbox"/> FROM MDS THRESHOLD <input checked="" type="checkbox"/> FROM DEPARTURE END	D1	3,525
5	F-16B	22,800	Landing		<input type="checkbox"/> FROM MDS THRESHOLD <input checked="" type="checkbox"/> FROM DEPARTURE END	D2	4,400
					<input type="checkbox"/> FROM MDS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MDS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		
					<input type="checkbox"/> FROM MDS THRESHOLD <input type="checkbox"/> FROM DEPARTURE END		

RSC= WR=WET RUNWAY SLR=SLUSH ON RUNWAY LSR=LOOSE SNOW ON RUNWAY PSR=PACKED SNOW ON RUNWAY IR=ICE ON RUNWAY

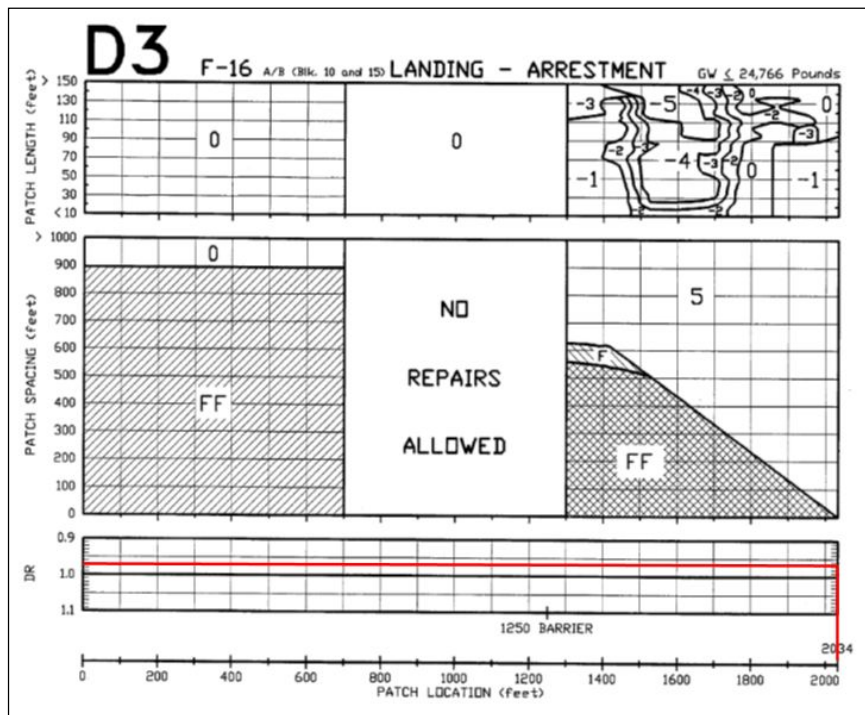
4.4.2.2.1. Continuing with the example above, if the RSC were WR, the landing operation length would be 7,100 feet; this would require a MOS of at least that length. In this case, determine if the MOS length could be decreased by calculating the arrested landing operational length using RQC Chart D3 (Figure 4.6.), which does not have an RSC section. **Note:** Using arrested landing operational lengths may result in fewer pavement repairs, but may also lower the MOS LoR capability (Table 2.3.).

4.4.2.2.2. Draw a horizontal line across the DR section corresponding to the DR recorded on Worksheet 1 (0.97).

4.4.2.2.3. There is no shaded area in the DR section; therefore, draw a vertical line from the far right side of the DR section down to the location baseline and record the value (2,034) on Worksheet 1 (Figure 4.5).

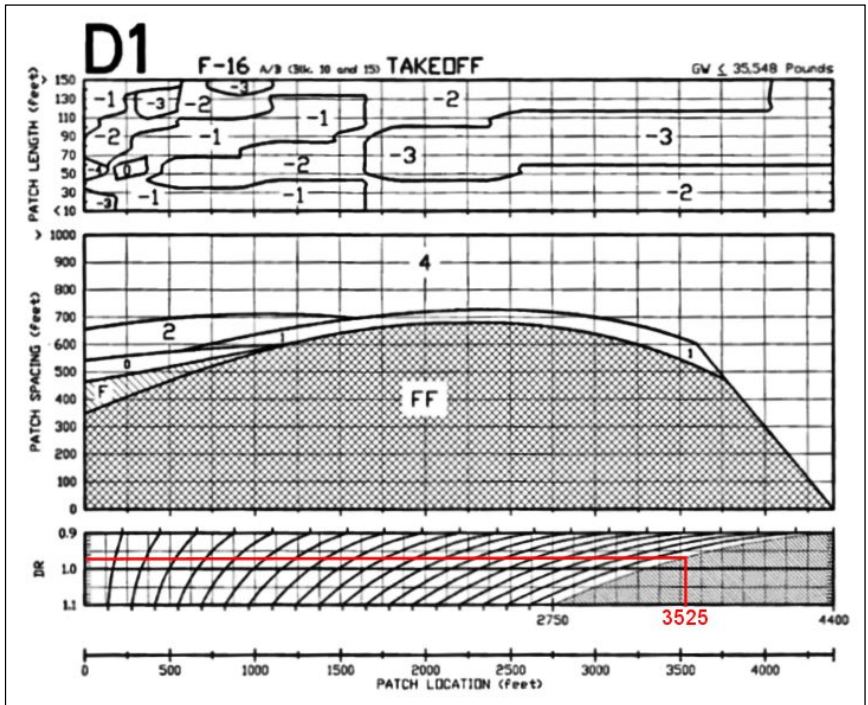
4.4.2.2.4. Use Chart D1 (**Figure 4.7**) to determine takeoff operational length. Where DR line intersects shaded area, draw vertical line to location baseline since there is no RSC section and add results to Worksheet 1 (**Figure 4.5**).

Figure 4.6. Determining Arrested Landing Operational Length.



4.4.3. **Damage Plotting.** Runway damage is plotted on a 1:1200 scale (1 inch equals 100 feet) ToL map as reported by the ADATs. The ToL map should utilize the same Pavement Reference Marking System (PRMS) as the grid overlay. The MOS selection team uses the ToL map (located in the EOC when possible) to select MOS candidates. Damage is initially plotted on the ToL map with estimated repair diameters (double the apparent diameter). Utilize the 1:4800 (1 inch equals 400 feet) Crash Grid Map for all damage items not located on the runway. This map should utilize the Military Grid Reference System (MGRS) as the grid overlay. Following completion of runway repairs, RQC must be recalculated using the actual repair lengths.

Figure 4.7. Determining Takeoff Operational Length.



4.4.4. Initial MAOS Selection. Choose several potential launch and recovery strips with support areas (e.g., refueling area, munition loading area, arm/de-arm area, parking, maintenance). Consider all suitable pavement surfaces that can be used for ToL surfaces (e.g., parallel taxiways and access roads). Keep limiting factors and shortfalls in mind. Slide MOS template across the ToL map until a suitable MOS is found. Bracket ([]) the MOS ends and list using the MOS identifier as explained in [paragraph 4.4.5.1](#). Continue this same procedure until two alternatives are located. [Table 4.3](#) lists positive and negative MAOS attributes.

4.4.5. Other factors that may influence MAOS selection:

4.4.5.1. In most cases a unidirectional MOS results in less stringent RQC values which may permit greater latitude in repair quality.

Table 4.3. MAOS Attributes.

Positive	Negative
• Minimal number of craters	• Damage unrepairable within 6.5 hours
• Aligned with existing centerline	• Dense clusters of craters
• Use existing thresholds and departures	• Craters within 1,000 feet of threshold & departure
• Craters not located close together	• MOS without potential for expansion
• Access/Egress routes at both ends	• Crater within 550 feet of arresting system
• Use existing aircraft arresting systems	• Damage in first & last 1K feet pavement
• Use existing airfield lighting	• Only one access route
• Close to material stockpiles	• Damaged utility lines (e.g., water/fuel)
• Longer and wider dimensions	• Dense clusters of UXO

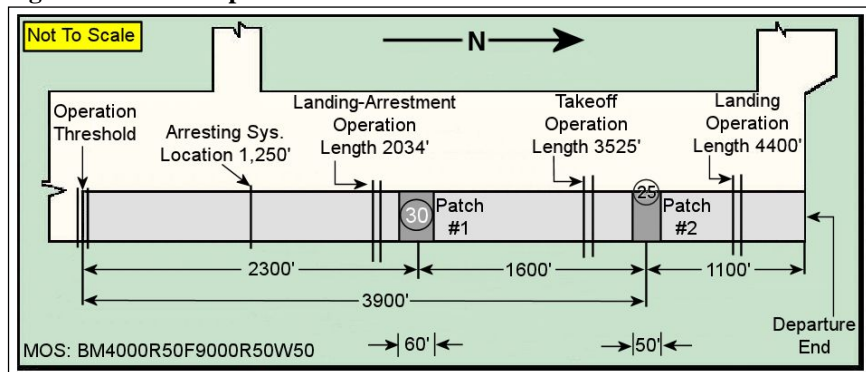
4.4.5.2. In most situations landing operations require more pavement length than takeoff operations, especially in wet or icy conditions. If an aircraft arresting system (AAS) is available the landing length can be shortened with an accompanying decrease in the repair efforts. Ensure sufficient undamaged pavement exists before recommending an AAS.

4.4.5.3. There may be occasions, particularly with bidirectional operations, when moving an operational threshold could decrease the RQC value for a repair patch. Look for the takeoff or landing operation that drives the lowest RQC value for a particular patch and if moving the applicable threshold results in a less restrictive RQC value. Chances are the need for the repair patch will not be eliminated, but the degree of required quality will be lessened.

4.4.5.4. After repairs are completed and accurate dimensions are obtained, it is critical to repeat the RQC process to ensure safe aircraft operations.

4.4.6. Define Repair Patches on the ToL Map.

4.4.6.1. After selection, determine MOS coordinates using the same method as locating damage/UXO as explained in AFTTP 3-32.11. For example, the 50-foot by 5,000-foot MOS in **Figure 4.8** is selected on a 150-foot wide by 9,000-foot long runway. The MOS would be identified as: BM4000R50F9000R50W50 as explained in **Table 4.4**.

Figure 4.8. ToL Map.**Table 4.4. MOS Designation Identifier Explained (BM4000R50F9000R50W50).**

Identifier	Explanation
BM	Bidirectional MOS (UM – Unidirectional MOS)
4000	Distance from 0 point of PRMS to leading edge (threshold) of MOS
R	Denotes left or right of centerline to center of leading edge of MOS
50	Numerical distance left or right of centerline expressed in feet
F	Field Identifier
9000	Distance from PRMS 0-point to center of field's trailing edge (departure)
R	Denotes left/right of centerline to center of field's trailing edge
50	Numerical distance left or right of centerline expressed in feet
W	Width of field (MOS)
50	Numerical width of field (MOS)

4.4.6.2. Draw lines perpendicular to the MOS edges at the beginning and end of each crater on (or partially on) the MOS (**Figure 4.8**).

4.4.6.3. Shade areas on the MOS between the lines for each repair. If two or more shaded areas overlap, or are within 25 feet of each other, shade the area or areas between them.

4.4.6.4. From the MOS operational threshold, number each shaded area as a repair patch. For operations on bidirectional MOSs, do not renumber the patches

when the operation direction changes. Once a patch is numbered, it should not be changed.

4.4.7. Finding Repair Patch Location, Length, and Spacing.

4.4.7.1. Once repair patches have been numbered, determine location, length, and spacing for each. **Figure 4.8** shows examples of patch locations, lengths and spacing. **Figure 4.9** provides an example of results recorded on Worksheet 2.

Figure 4.9. Worksheet 2 Example.

WORKSHEET 2 - REPAIR QUALITY CRITERIA (RQC) VALUES WORKSHEET									
MOS THRESHOLD (Feet)	4,000	OPERATION #		1	2	3	4	5	
DEPARTURE END (Feet)	9,000	DIRECTION	FROM MOS THR FROM DEP END	X	X	X		X	X
MOS LENGTH (Feet)	5,000	OPERATION LENGTH		3525	4400	2034	3525	4400	
CHART #	OPERATION # PATCH #	PATCH LOCATION (Feet)	PATCH LENGTH (Feet)	PATCH SPACING (Feet)	UNCORRECTED RQC	CORRECTION FACTOR	RQC		
D1	1/1	2,300	60	1,000					
D2	2/1	2,300	60	1,600					
D2	2/2	3,900	50	1,500					
D3	3/--	2,034	----	----					

4.4.7.2. Draw double lines on the ToL map perpendicular to the sides of the MOS to mark the operations threshold and operation length.

4.4.7.3. For each patch within the two sets of double lines, record the operation number and patch number on Worksheet 2.

4.4.7.4. Find the center of each repair patch. Measure the distance (in feet) from this point back to the operational threshold. If the distance is greater than the operation length, use the operation length. If the patch center is in front of the operation threshold, use zero. Record these repair locations in the “Patch Location” column of Worksheet 2.

4.4.7.5. Measure each patch length parallel to the side of the MOS (in feet). Record the results in the “Patch Length” column of Worksheet 2.

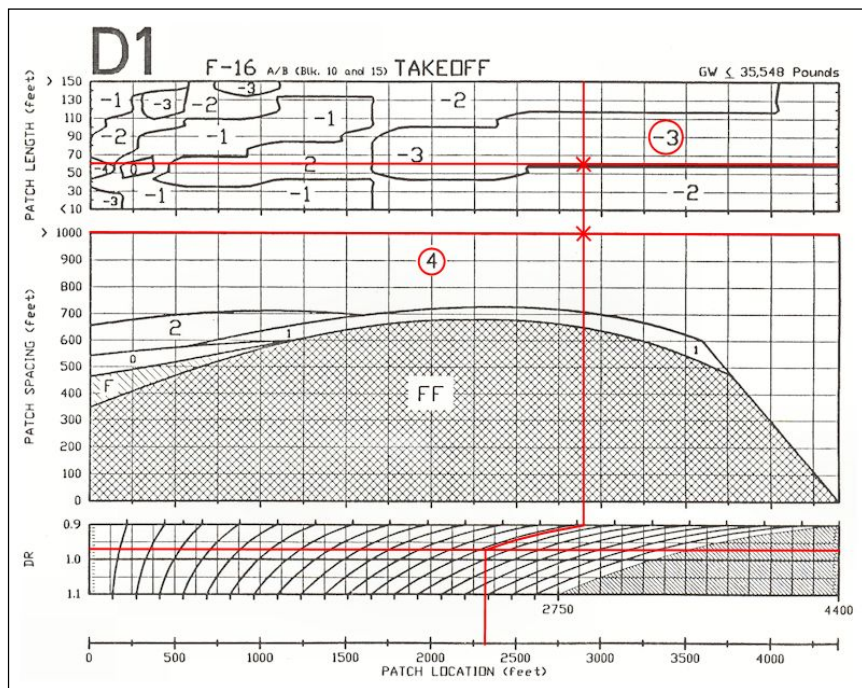
4.4.7.6. Measure, in the direction of operation, the distance (in feet) from the center of each patch to the center of the next patch. If there is not a “next” patch

(i.e., the patch is the last one), use the maximum value on the spacing axis of the RQC chart. Record the results in the “Patch Spacing” column of Worksheet 2.

4.4.7.7. Mark the repair patch locations, lengths, and spacing on applicable RQC charts. If the value for any length or spacing is greater than the maximum or less than the minimum shown on the RQC chart, mark the maximum or minimum.

4.4.8. **Finding Repair Quality Criteria (RQC).** Incorrect RQC calculations may result in aircraft damage, aircrew injury, and/or death of the aircrew. Uncertainty of any value (RQC, uncorrected RQC, or correction factor) shall be resolved by using the most conservative value (i.e., the lowest value). An intersection on a boundary line between two regions in the uncorrected RQC or correction factor areas must be treated as though it falls in the region with the lowest value. **Figure 4.10** illustrates the procedure to find RQC.

Figure 4.10. Finding Uncorrected RQC on Chart D1.



4.4.8.1. Finding Uncorrected RQC.

4.4.8.1.1. Draw a horizontal line across the DR section corresponding to the DR recorded on Worksheet 1 (0.97). If there is an RSC section, draw a horizontal line across that section corresponding to the RSC recorded on Worksheet 1.

4.4.8.1.2. Draw vertical lines from the patch locations (2,300) on the location baseline until they intersect with the current DR.

4.4.8.1.3. From each intersection, follow the guidelines to the top of the DR section. Stay between the guidelines in proportion to the starting location.

4.4.8.1.4. If applicable, from the top of the DR section, draw a vertical line until it intersects with the current RSC, then follow the guidelines to the top of that section. From this point, draw a vertical line to the top of the RQC chart. If there is no RSC section, draw a vertical line from the top of the DR section to the top of the RQC chart.

4.4.8.1.5. Draw a horizontal line from each repair patch spacing on the vertical axis to the uncorrected RQC area. Continue each line until it intersects the vertical line for that patch.

4.4.8.1.6. The intersections are in the various regions of the uncorrected RQC area. The number in each region indicates the uncorrected RQC for intersections in that region. Record the uncorrected RQC values (4) for each repair patch on Worksheet 2 ([Figure 4.11](#)).

Figure 4.11. RQC Values Recorded on Worksheet 2.

WORKSHEET 2 - REPAIR QUALITY CRITERIA (RQC) VALUES WORKSHEET									
MDS THRESHOLD (Feet)	4,000	OPERATION #		1	2	3	4	5	
DEPARTURE END (Feet)	9,000	DIRECTION	FROM MOS THR	X	X	X			
			FROM DEP END				X	X	
MDS LENGTH (Feet)	5,000	OPERATION LENGTH		3525	4400	2034	3525	4400	
CHART #	OPERATION # PATCH #	PATCH LOCATION (Feet)	PATCH LENGTH (Feet)	PATCH SPACING (Feet)	UNCORRECTED RQC	CORRECTION FACTOR		RQC	
D1	1/1	2,300	60	1,000	4	-3		1	
D2	2/1	2,300	60	1,600					
D2	2/2	3,900	50	1,500					
D3	3/--	2,034	----	----					

4.4.8.1.7. A value of “F” indicates a flush repair. A value of “FF” indicates a flush repair that must be followed by another flush repair.

4.4.8.2. **Finding Correction Factor.** Correction factor is always negative or zero.

4.4.8.2.1. If uncorrected RQC is in a region shaded with diagonal lines, corrected RQC equals the uncorrected RQC. All “F” and “FF” regions are shaded with diagonal lines. “FF” regions are crosshatched to contrast with “F” regions.

4.4.8.2.2. In the Corrected RQC area, draw a horizontal line from each patch length to intersect the appropriate vertical line.

4.4.8.2.3. The intersections of these lines are in the various regions of the correction factor. The number in each region indicates the correction factor for intersections in that region.

4.4.8.2.4. Record the correction factor(s) (-3) on Worksheet 2 (**Figure 4.11**).

4.4.9. **Calculating RQC.** A patch with an uncorrected RQC of “F” or “FF” has an RQC of “F.” The patch following a patch with an uncorrected RQC of “FF” also has an RQC of “F.”

4.4.9.1. Add the uncorrected RQC (4) and correction factor (-3). RQC (1) is always less than or equal to the uncorrected RQC.

4.4.9.2. If the uncorrected RQC plus the correction factor results in a negative number, the RQC for that repair patch is “F.”

4.4.9.3. Record the RQC values on Worksheet 2 (**Figure 4.11**) and in the spaced provided on Worksheet 3 (**Figure 4.12**).

Note: Arrested landing from the departure end is not listed as an operation due to the fact that if a second arresting system was installed 1,250 feet from the departure end, patch 2 would fall within the “NO REPAIRS ALLOWED” section of the RQC chart. An arresting system could not be installed at midfield due to the fact that patch 1 would be within the “NO REPAIRS ALLOWED” section of the RQC chart. Therefore, in-flight emergency landings requiring arrestment would only be performed when landing from the threshold end. When landing in the opposite direction the SAA may authorize use of the departure end (threshold end in this scenario) AAS for aircraft experiencing braking problems and for aborted take-offs.

Figure 4.12. RQC Summary (Worksheet 3).

WORKSHEET 3 - R						
OPERATION DIRECTION		FROM MOS THRESHOLD				
OPERATION #	PATCH 1	PATCH 2	PATCH 3	PATCH 4	PATCH 5	PATCH 6
1 - TAKEOFF	1	---				
2 - LANDING	3	2				
3 - LANDING ARRESTMENT	---	---				
SUMMARY	1	2				

OPERATION DIRECTION		FROM DEPARTURE END				
OPERATION #	PATCH 1	PATCH 2	PATCH 3	PATCH 4	PATCH 5	PATCH 6
4 - TAKEOFF	1	2				
5 - LANDING	3	4				
SUMMARY	1	2				
COMBINED	1	2				

4.4.8.4. Repeat instructions in [paragraph 4.4.5](#) for every operation in the same direction. Patch numbering and patch spacing remain constant.

4.4.8.5. If bidirectional operations are required, repeat the instructions for [paragraph 4.4.5](#) for each operation in the opposite direction. Patch numbering and patch lengths remain constant. Remember the operational threshold is now at the departure end.

4.4.9. **RQC Summary.** Summarize RQC for the entire MOS on Worksheet 3 ([Figure 4.12](#)).

4.4.9.1. List each operation from the MOS threshold on the top half of Worksheet 3.

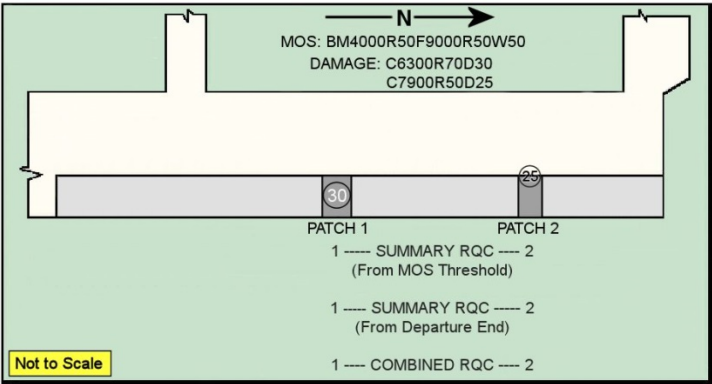
4.4.9.2. List each operation from MOS departure end on the bottom half of Worksheet 3.

4.4.9.3. For each operation and patch number, record the RQC from Worksheet 2 onto Worksheet 3. For patches that are on the MOS but are not within the length of *any* operation, record an “F”.

4.5. Presenting MAOS Candidates to Wing Commander. It is recommended that the MAOS Selection Team brief the EOC staff for feedback before briefing the wing commander. Provide the following information when briefing the wing commander:

- 4.5.1. Pros and cons of each candidate.
- 4.5.2. Estimated time to complete repairs.
- 4.5.3. Repair priority recommendations.
- 4.5.4. Any actions concerning sortie generation to include RQC data.
- 4.5.5. Monitor repair and update appropriate maps to indicate status and provide updates to the EOC to keep the wing commander abreast of recovery progress.
- 4.5.6. An example of presenting this data using a MOS map is presented in **Figure 4.13**. The RQC values for both MOS threshold and departure end operations are shown along with the combined values for each repair patch. This summary permits a quick method of informing the CE-UCC of RQC requirements so they may rapidly forward them to repair crews.

Figure 4.13. Summary RQC Presentation Format.



**JOHN B. COOPER, Lieutenant General, USAF
DCS/Logistics, Engineering & Force Protection**

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

Air Force Doctrine Annex 3-34, *Engineer Operations*, 19 Sep 2011

AFI 10-209, *RED HORSE Program*, 8 May 2012

AFI 10-210, *Prime Base Engineer Emergency Force (BEEF) Program*, 6 Sep 2012

AFI 13-204, Volume 3, *Airfield Operations Procedures and Programs*, 1 Sep 2010

AFMAN 33-363, *Management of Records*, 1 Mar 2008

AFPAM 10-219, Volume 3, *Civil Engineer Disaster & Attack Recovery Procedures*, 9 Jun 2008

AFPAM 10-219, Volume 4, *Airfield Damage Repair Operations*, 28 May 2008

AFTTP 3-32.5V6, *Explosive Ordnance Disposal (EOD) Unexploded Explosive Ordnance (UXO) Operations*, 28 Apr 2015

AFTTP 3-32.11, *Airfield Damage Assessment after Major Attack*, 1 Feb 2016

AMCI 11-211, *Destination Airfield Suitability Analysis*, 21 Dec 2012

T.O. 33-1-23, *Equipment and Procedures for Obtaining Runway Condition Readings*, 16 Sep 2011

GeoExPT User Manual

Adopted Forms

AF Form 847, *Recommendation for Change of Publication*, 22 September 2009

Note: The acronyms and terms shown below may not always agree with Joint Publication 1-02, *DoD Dictionary of Military and Associated Terms*, or the *Air Force Glossary Doctrine Annex*, but are common to the engineering community as a whole.

Abbreviations and Acronyms

ADAT—Airfield Damage Assessment Team

ADR—Airfield Damage Repair

AFCEC—Air Force Civil Engineer Center

AFI—Air Force Instruction

AFMAN—Air Force Manual

AFPAM—Air Force Pamphlet

AFRC—Air Force Reserve Component

AFRIMS—Air Force Records Information Management System

AFS—Air Force Specialty

ANG—Air National Guard

ATO—Air Tasking Order

BEEF—Base Engineer Emergency Force

CAT—Crisis Action Team

CE—Civil Engineer

DR—Density Ratio

GeoExPT—Geospatial Expeditionary Planning Tool

EOC—Emergency Operations Center

EOD—Explosive Ordnance Disposal

ESF—Emergency Support Function

FOD—Foreign Object Damage

GeoExPT—Geospatial Expeditionary Planning Tool

IR—Ice on runway

LoR—Launch or Recovery

LSR—Loose snow on runway

MAOS—Minimum Airfield Operating Surface

MGRS—Military Grid Reference System

MOS—Minimum Operating Strip

NOTAM—Notice to Airmen

OPR—Office of Primary Responsibility

PRMS—Pavement Reference Marking System

PSR—Packed snow on runway

RDS—Records Disposition Schedule

RQC—Repair Quality Criteria

RSC—Runway Surface Condition

SAA—Senior Airfield Authority

SLR—Slush on runway

ToL—Takeoff or Landing

TTP—Tactics, Techniques, and Procedures

UCC—Unit Control Center

UFC—Unified Facilities Criteria

UXO—Unexploded Ordnance; Unexploded Explosive Ordnance

WR—Wet runway

Terms

Airfield—An area prepared for the accommodation (including any buildings, installations, and equipment), landing, and takeoff of aircraft.

Air Tasking Order (ATO)—A method used to task and disseminate to components, subordinate units, and command and control agencies projected sorties, capabilities and/or forces to targets and specific missions. Normally provides specific instructions to include call signs, targets, controlling agencies, etc., as well as general instructions. Source: JP 3-30.

Airfield Damage Assessment—Locating, classifying, and measuring the damage (camouflet, crater, spall, and UXO) on the airfield operating surfaces.

Airfield Damage Assessment Team (ADAT)—An airfield recovery team, typically located in or near the EOC and directed by the ESF 3, used to identify and locate airfield damage and UXO following an attack. Their initial efforts are normally targeted towards the airfield proper; but can also be employed elsewhere as deemed necessary. The ADAT usually consists of one engineering technician and two EOD technicians. A CE member trained as an EOD assistant may replace one of the EOD technicians when two are unavailable for ADAT. The ADAT should be equipped with an armored vehicle and communications enabling them to report their observations to the MAOS Selection Cell. The ADAT damage reports must be accurate as this information is used in MAOS selection.

Apron/Ramp—A defined area on an airfield intended to accommodate aircraft for the purposes of loading or unloading passengers or cargo, refueling, parking, or maintenance.

Camouflet—Craters with relatively small apparent diameters, but deep penetration and subsurface voids created by the munition puncturing through the pavement surface and exploding in the base material. **Note:** Munitions that penetrate the surface but do not explode are also treated as a camouflets.

Camouflet Field—A cluster of spalls within a defined area.

Crater—The pit, depression, or cavity formed in the surface of the earth by an explosion. It may range from saucer-shaped to conical, depending largely on the depth of burst.

Crater Field—A cluster of small craters (less than two feet apart) where their upheaval joins the neighboring crater within a defined area.

Damage Assessment—1. The determination of the effects that attacks have on targets. 2. (DOD only) A determination of the effect of a compromise of classified information on national security. 3. (AF/CE) The process of identifying and locating damage and unexploded ordnance following an attack. Damage assessment activities generally are separated into two categories: airfield pavements and facility/utility.

Emergency Operations Center (EOC)—A temporary or permanent facility where the coordination of information and resources to support domestic incident management activities normally takes place.

Explosive Ordnance Disposal (EOD)—The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance which has become hazardous by damage or deterioration.

MAOS Selection—The process of plotting damage and UXO locations on an airbase runway map and using this information to select a portion of the damaged runway which can be repaired most quickly to support aircraft operations.

Minimum Airfield Operating Surface (MAOS)—The combined requirement for airfield surfaces for both runway and access routes. For example, the MOS is part of the MAOS.

Minimum Operating Strip (MOS)—1. A runway which meets the minimum requirements for operating assigned and/or allocated aircraft types on a particular airfield at maximum or combat gross weight. 2. The MOS is the smallest amount of area to be repaired to launch and recover aircraft after an attack. Selection of this MOS will depend upon mission requirements, taxi access, resources available, and estimated time to repair. For fighter aircraft, the typically accepted dimensions are 5,000 feet long by 50 feet wide.

Personnel—Those individuals required in either a military or civilian capacity to accomplish the assigned mission.

Procedures—Standard, detailed steps that prescribe how to perform specific tasks.

Ramp—see “apron.”

Runway—A defined rectangular area of an airfield, prepared for the landing and takeoff run of aircraft along its length. A runway is measured from the outer edge of the thresholds from one end of the runway to the others. The width of the runway is typically measured from the outer edge of the load-bearing pavement on one side to the outer edge of the load-bearing pavement on the other side. In some cases the runway may be measured from the outside edge of the runway marking line on one side to the outside edge of the marking line on the other side and any remaining load bearing pavement is considered shoulder.

Runway Surface Condition (RSC)—Identifies the condition of the runway surface when covered with slush, snow, ice or water. In regards to MOS selection, Airfield Management personnel estimate to the extent or depth to the nearest 1/10 of an inch of any precipitation on the MOS and report this measurement to the MOS Selection Team prior to MOS selection.

Spall—Pavement damage that does not penetrate through the pavement surface to the underlying soil layers. A spall damage area could be up to 1.5 meters (5 feet) in diameter.

Spall Field—A cluster of spalls within a defined area.

Taxiway—A specially-prepared or designated path on an airfield or heliport, other than apron areas, on which aircraft move under their own power to and from landing, takeoff, service, and parking areas.

Techniques—Non-prescriptive ways or methods use to perform missions, functions, or tasks.

Unexploded Explosive Ordnance (UXO)—Explosive ordnance which has been primed, fused, armed, or otherwise prepared for action, and which has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material, and remains unexploded either by malfunction or design.

Attachment 2

BLANK FORMS FOR REPRODUCTION

Figure A2.1. Density Ratio Chart.

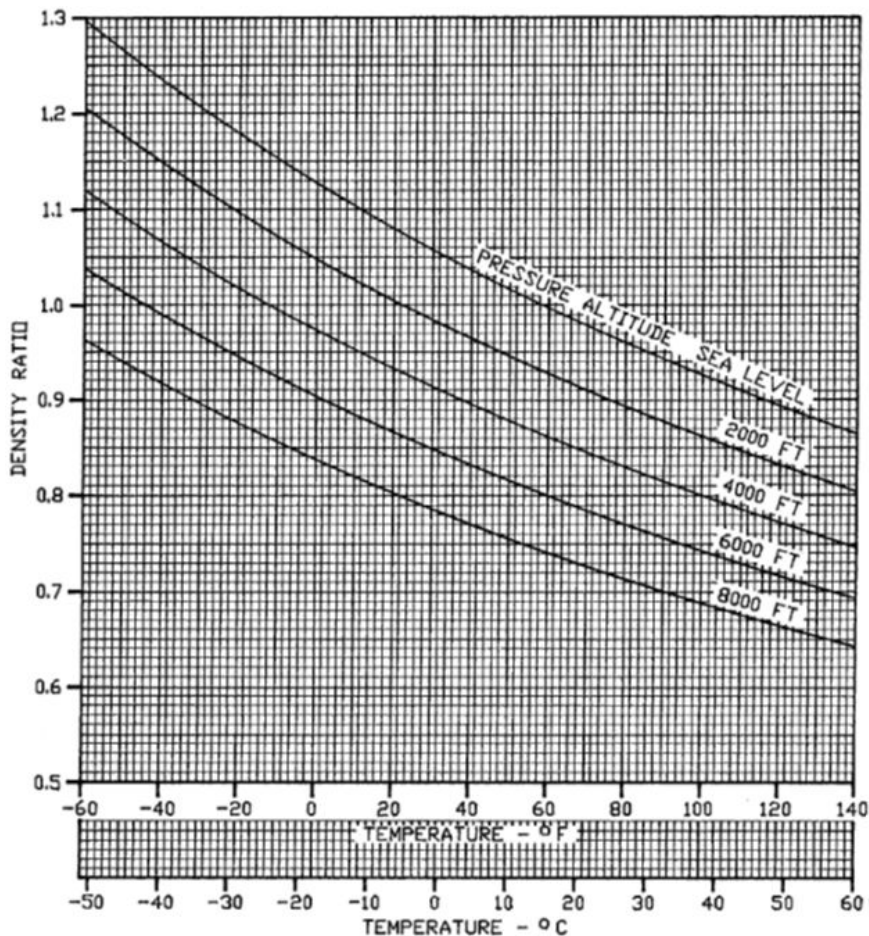


Figure A2.2. Worksheet 1.

WORKSHEET 1 - REPAIR QUALITY CRITERIA (RQC) ENVIRONMENTAL DATA									
TEMPERATURE (°F)		MOS THRESHOLD (Feet)		RSC		RUNWAY SURFACE CONDITION (RSC)		SLR/LSR/PSR/IR	
ALTITUDE (FT)		DEPARTURE END (Feet)		DEPARTURE END		Condition (Choose One)		WR <input type="checkbox"/> DRY <input type="checkbox"/> PSR/IR <input type="checkbox"/>	
DENSITY RATIO		MOS LENGTH (Feet)		MOS LENGTH		Condition Depth (Estimated to Nearest Tenth)		___' ___" Inch	
AIRCRAFT MODEL		OPERATION		SPECIAL LANDING PROCEDURES		DIRECTION (Choose One)		CHART	
OPERATION NUMBER		GROSS WEIGHT (Lbs)		OPERATION		FROM MOS THRESHOLD		OPERATION LENGTH (Feet)	
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			
						<input type="checkbox"/> FROM MOS THRESHOLD			
						<input type="checkbox"/> FROM DEPARTURE END			

RSC: WR=WET RUNWAY SLR=SLUSH ON RUNWAY LSR=LOOSE SNOW ON RUNWAY PSR=PACKED SNOW ON RUNWAY IR=ICE ON RUNWAY

[illegible]

Attachment 3

AIRCRAFT MOS REQUIREMENT CHARTS

Figure A3.1. F-4 C/D Takeoff.

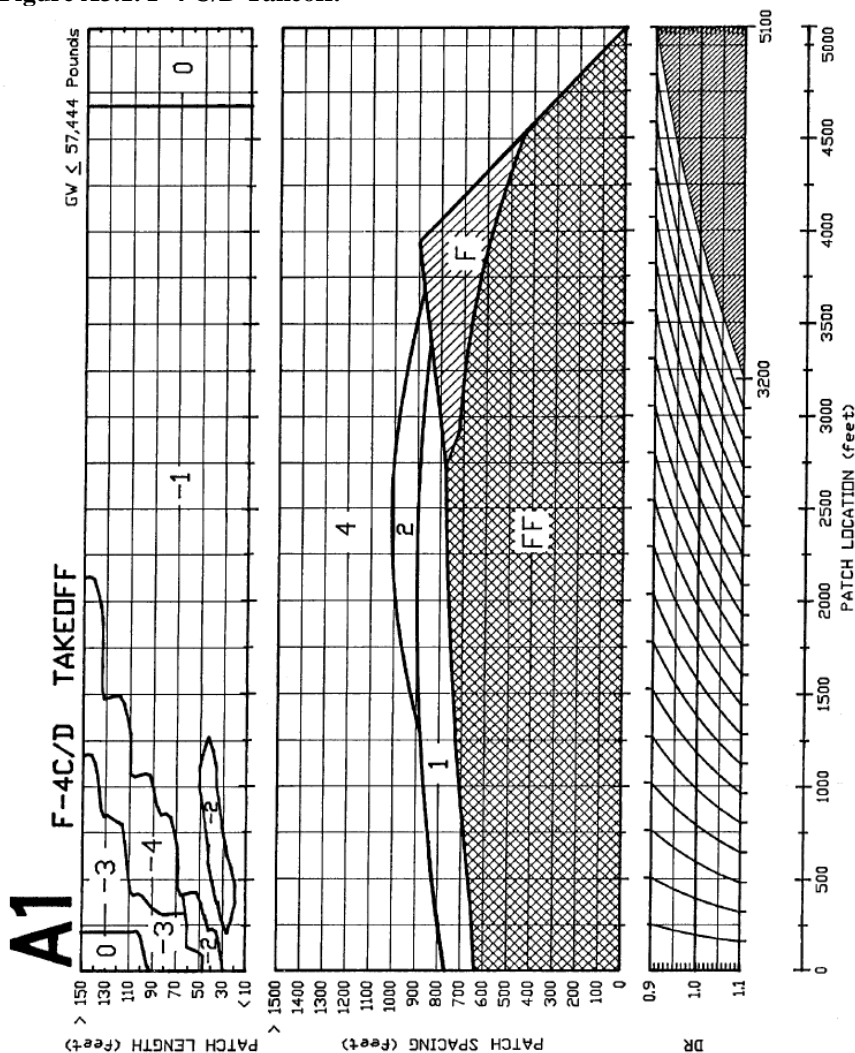
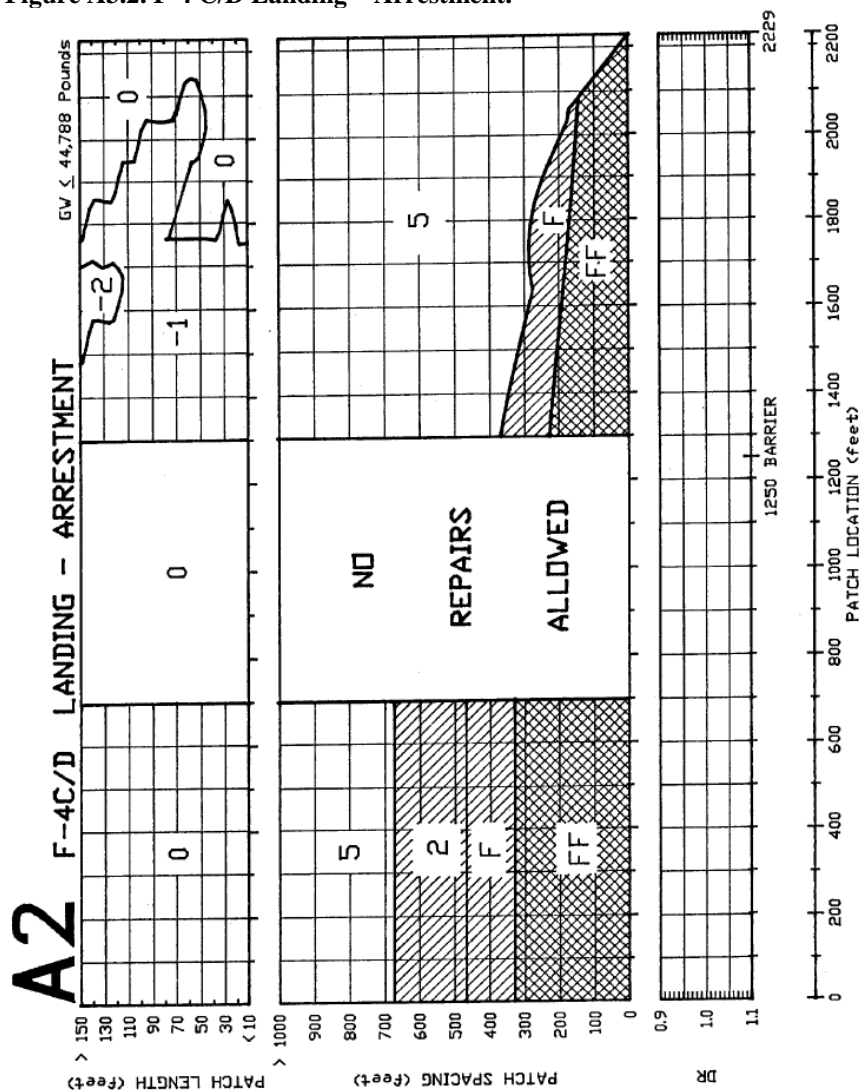


Figure A3.2. F-4 C/D Landing – Arrestment.



Note: This chart reflects a 979 ft maximum runout for an arrestment landing. Current maximum runout is 1,200 ft, which requires adding an additional 221 ft to arrestment landing operational length.

Figure A3.3. F-4 C/D Landing – With Chute.

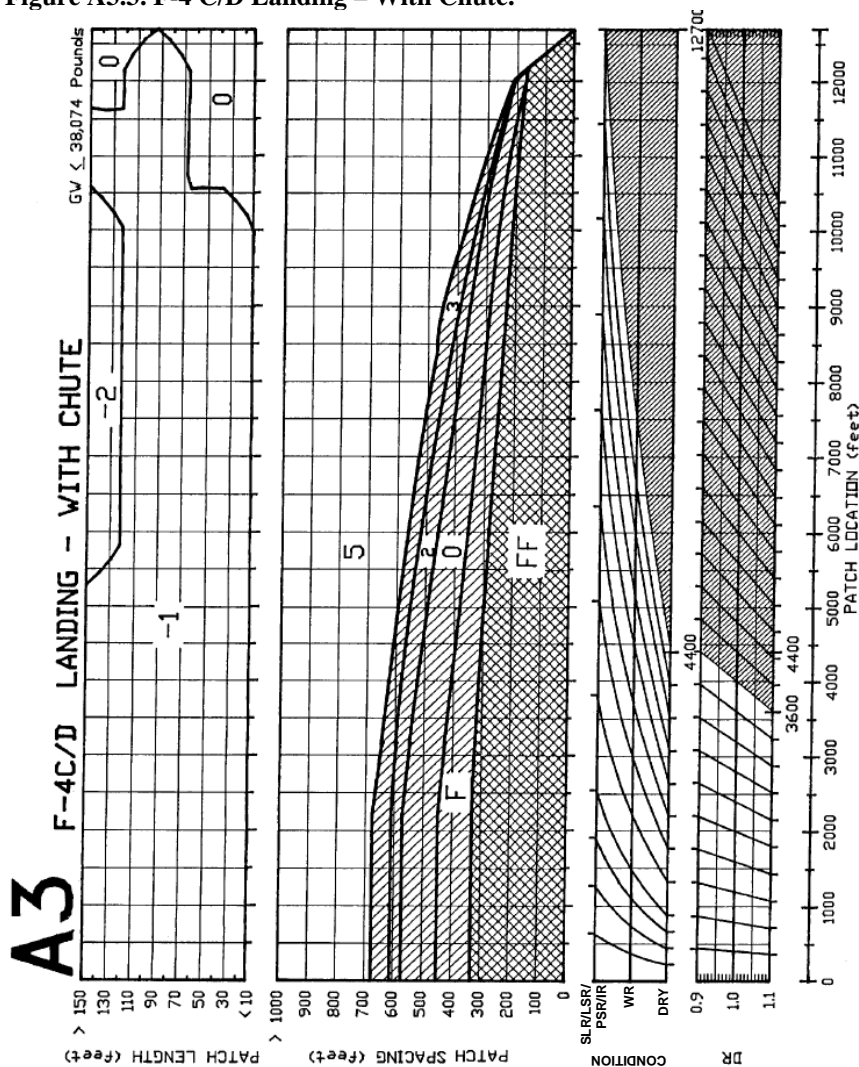


Figure A3.4. F-4 C/D Landing – Without Chute.

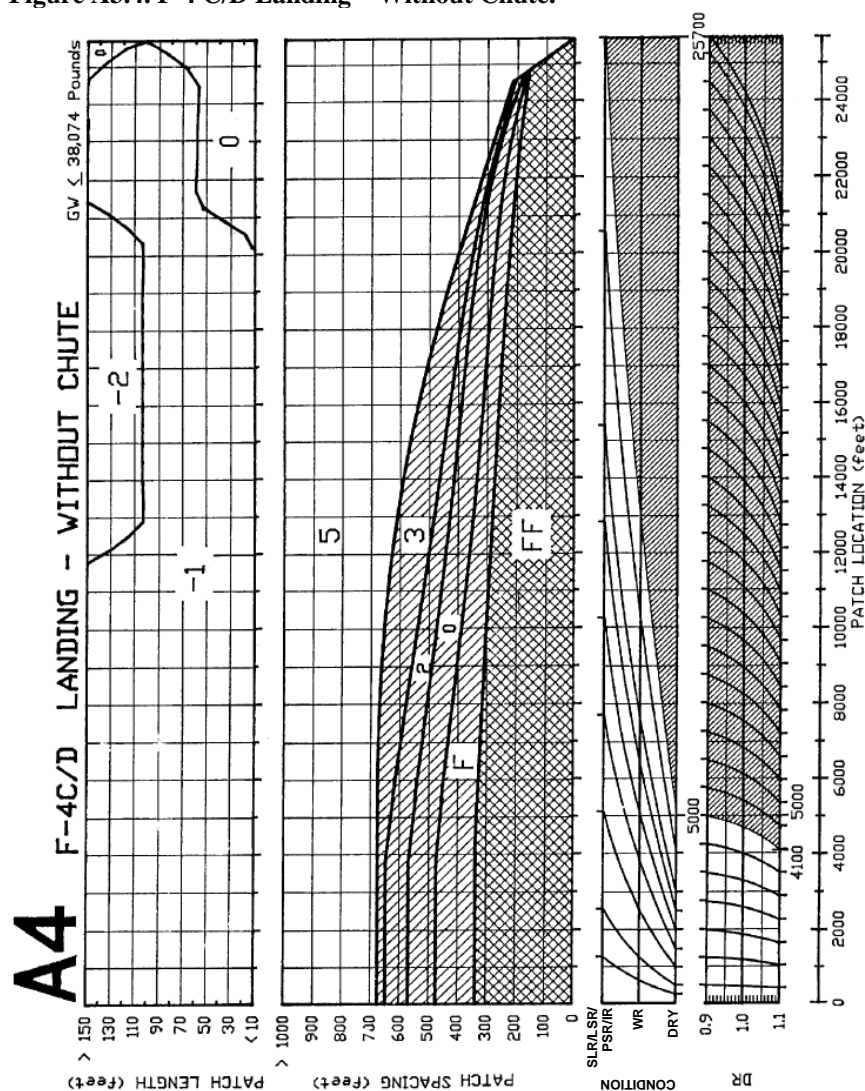


Figure A3.5. F-4 C/D Evacuation.

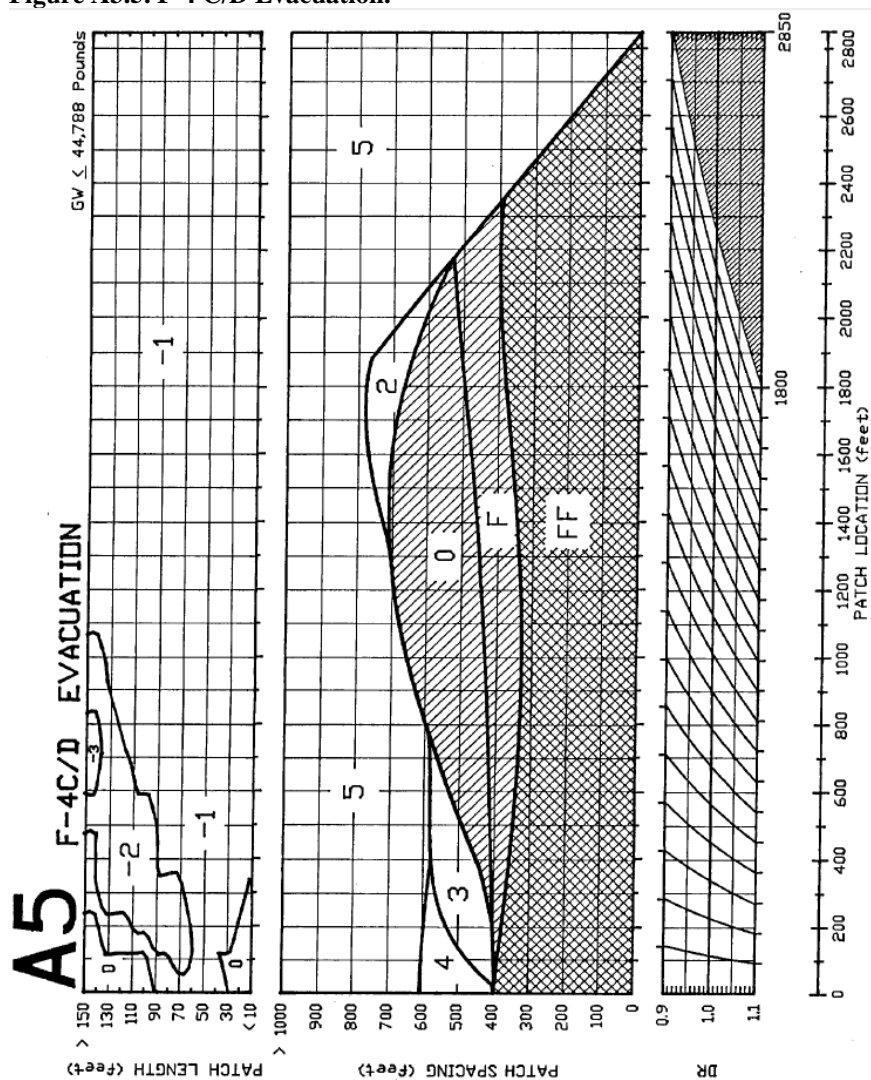


Figure A3.6. F-4 E Takeoff.

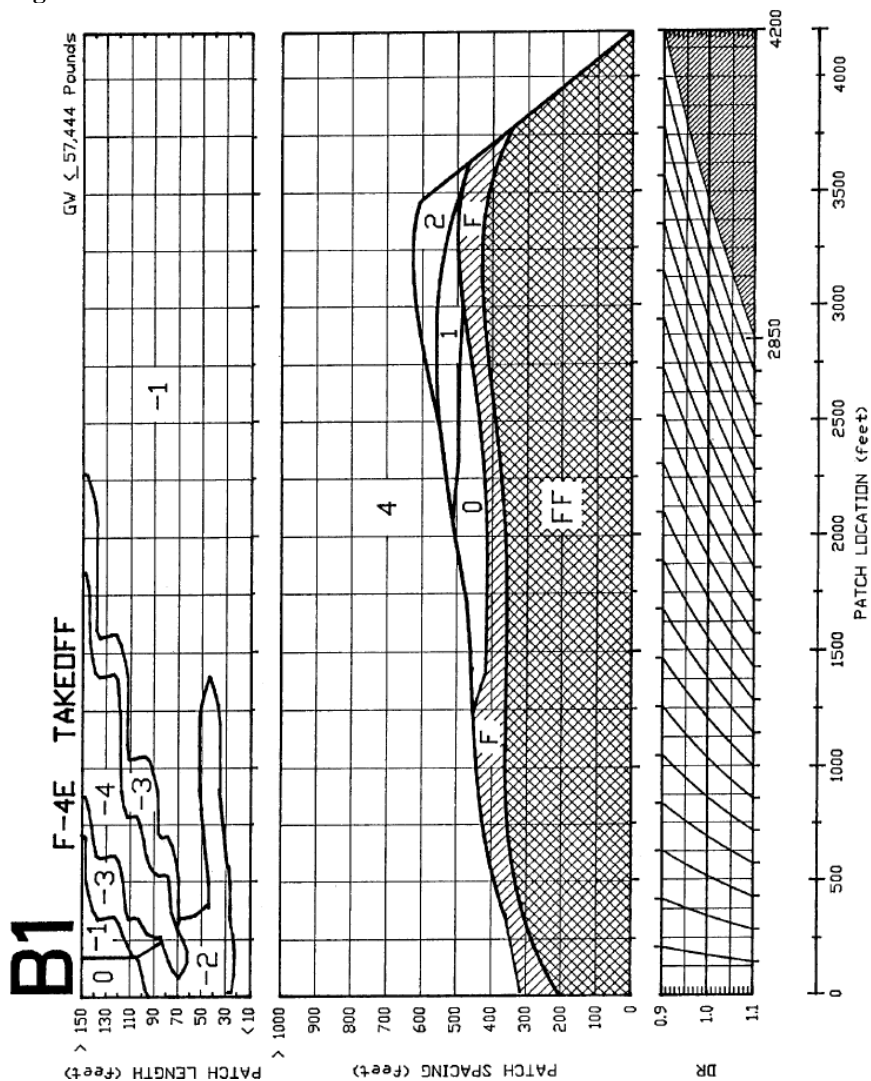
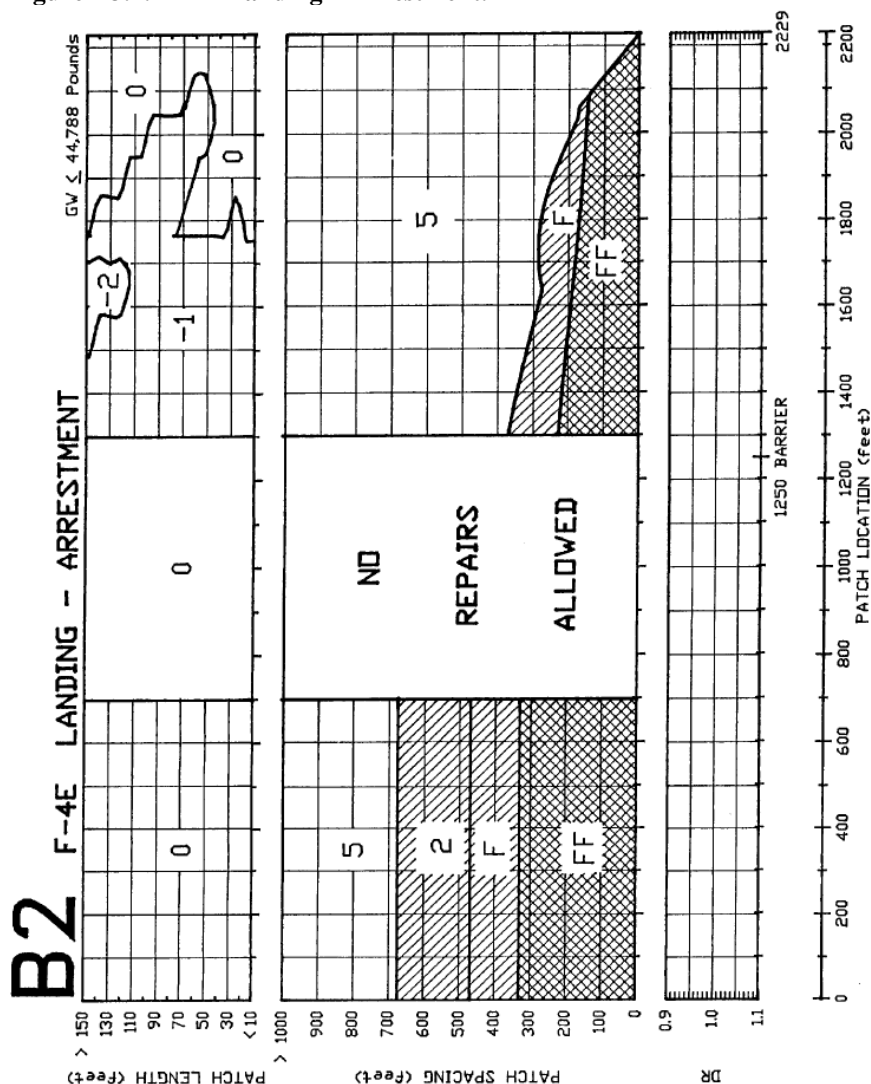


Figure A3.7. F-4 E Landing – Arrestment.



Note: This chart reflects a 979 ft maximum runout for an arrestment landing. Current maximum runout is 1,200 ft, which requires adding an additional 221 ft to arrestment landing operational length.

Figure A3.8. F-4 E Landing – With Chute.

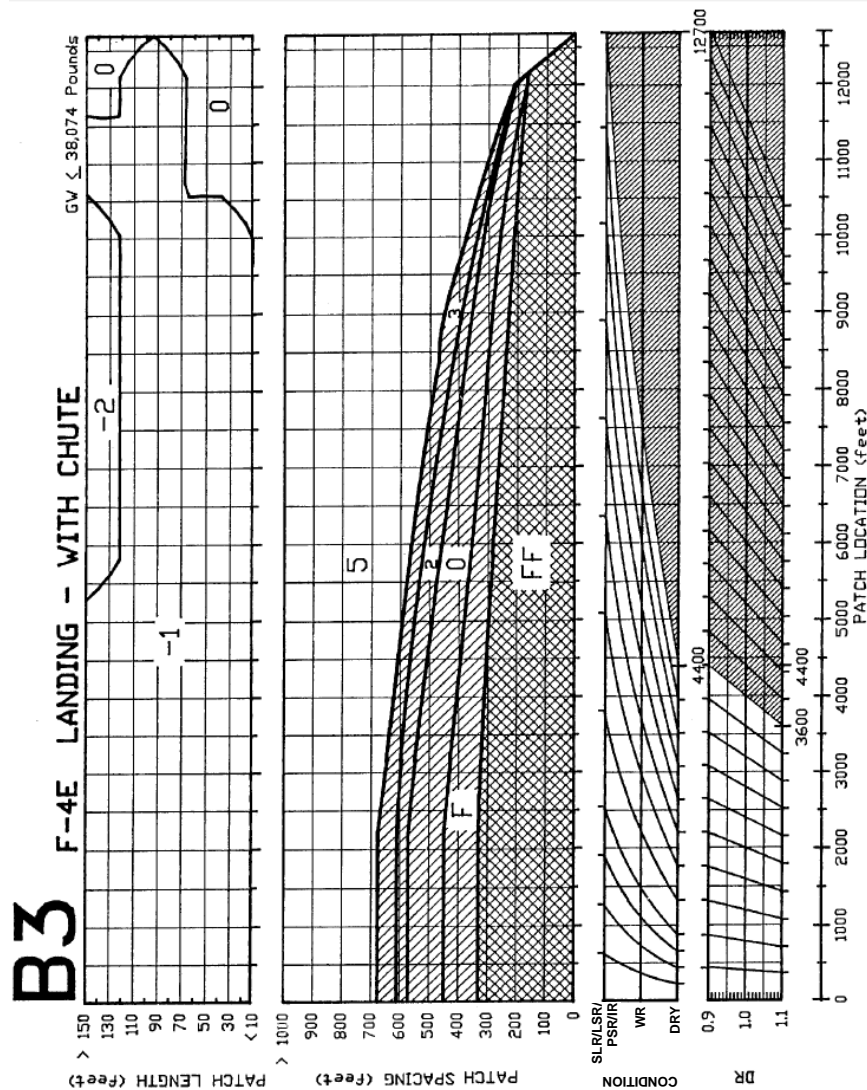
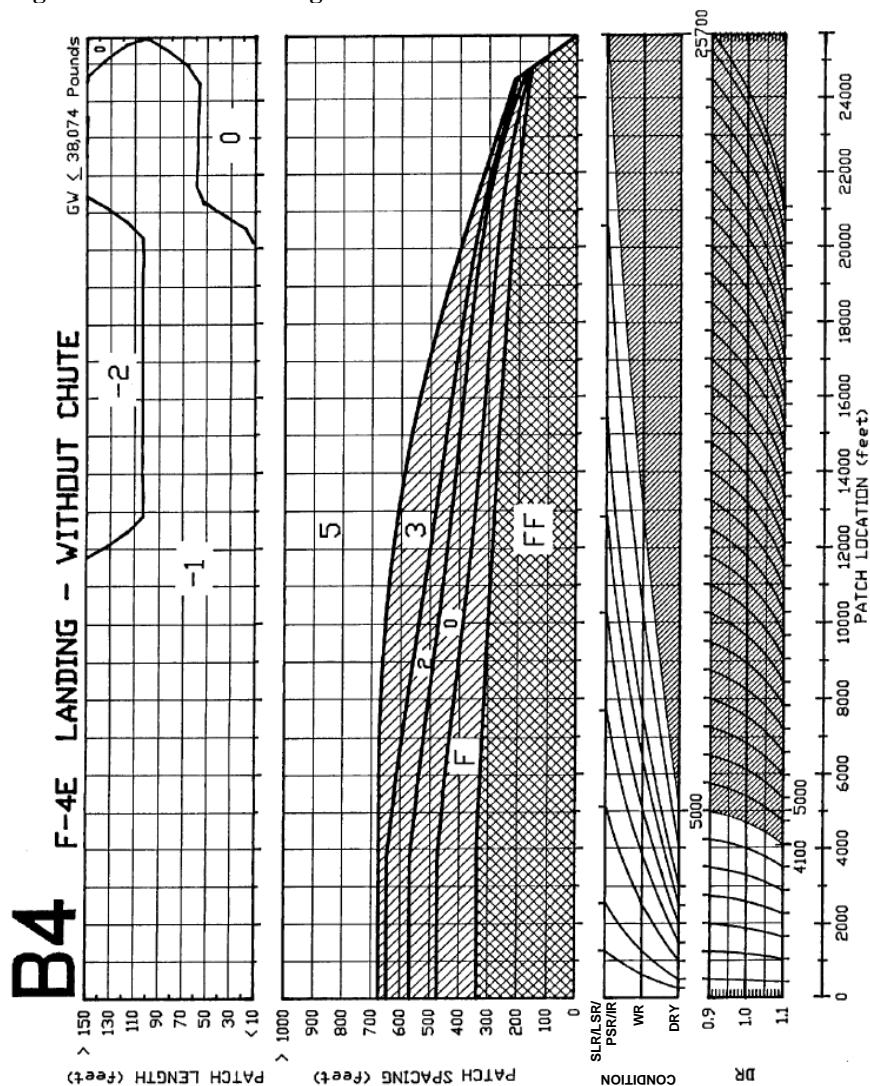


Figure A3.9. F-4 E Landing Without Chute.



A3.10. F-4 E Evacuation.

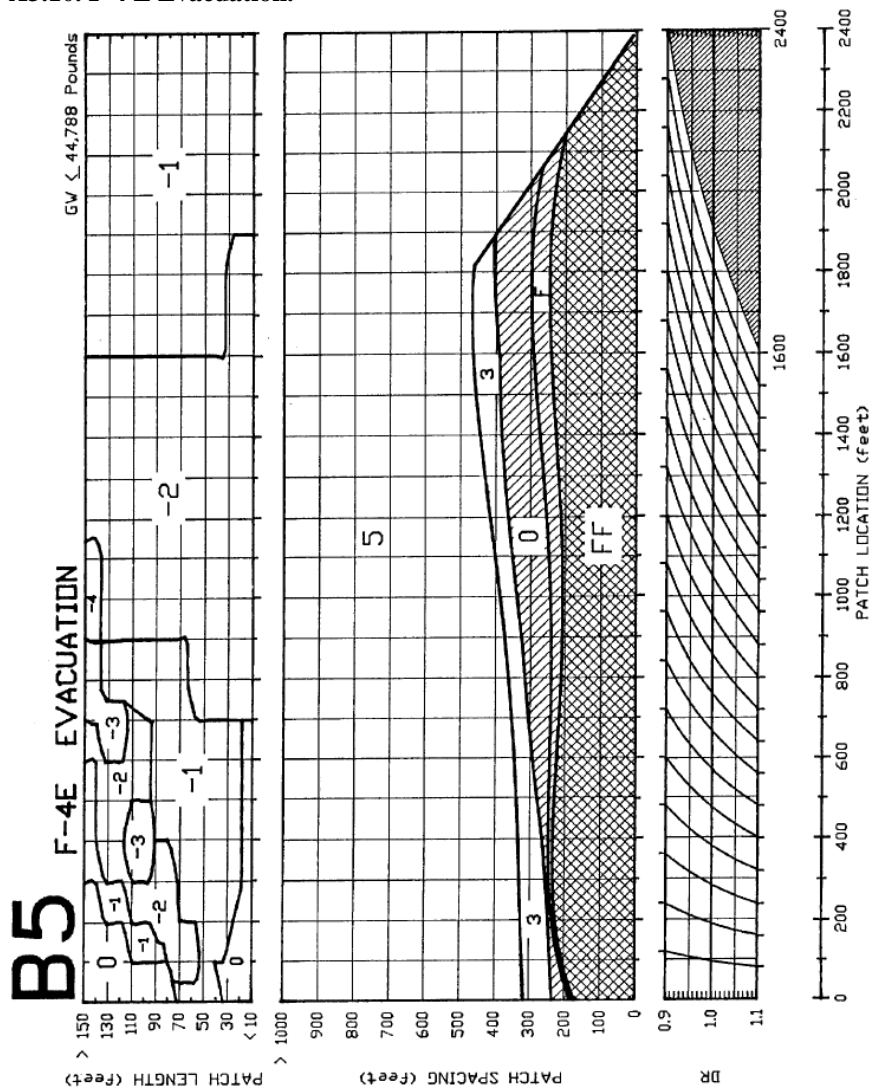


Figure A3.11. F-15 A/B Takeoff.

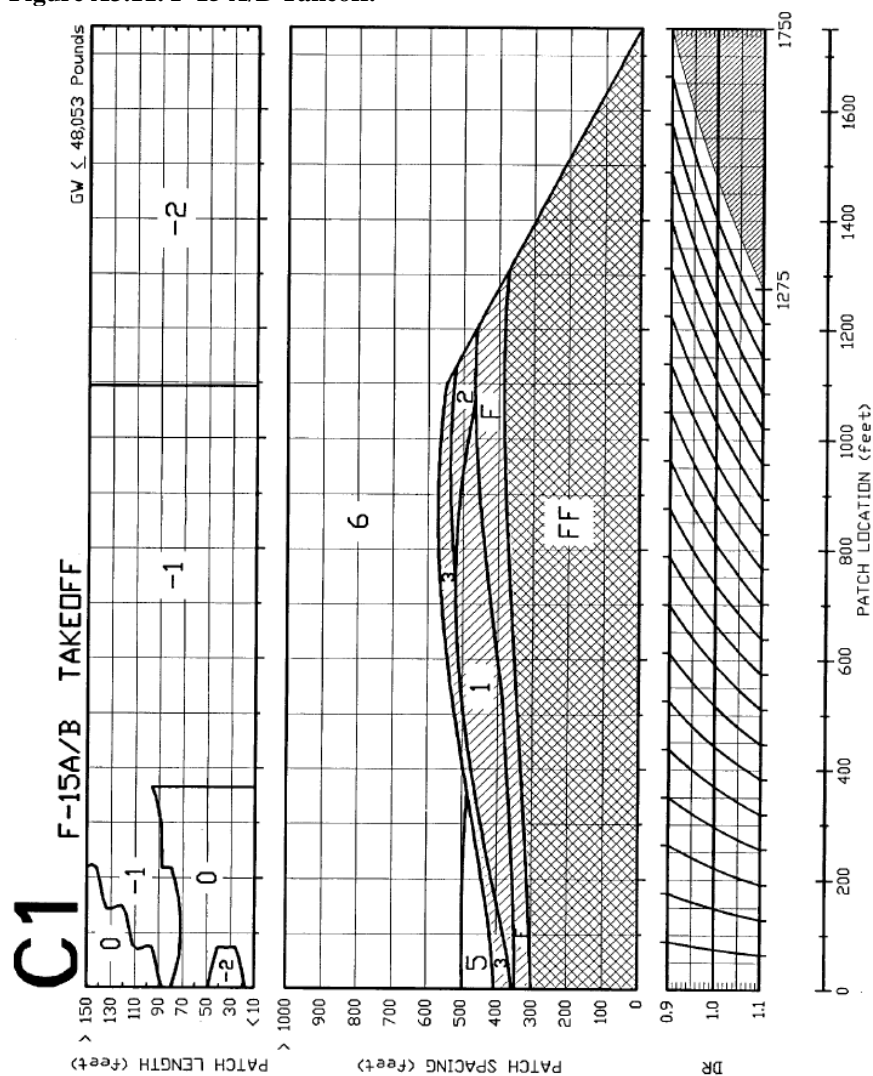


Figure A3.12. F-15 A/B Landing – Aerobraking.

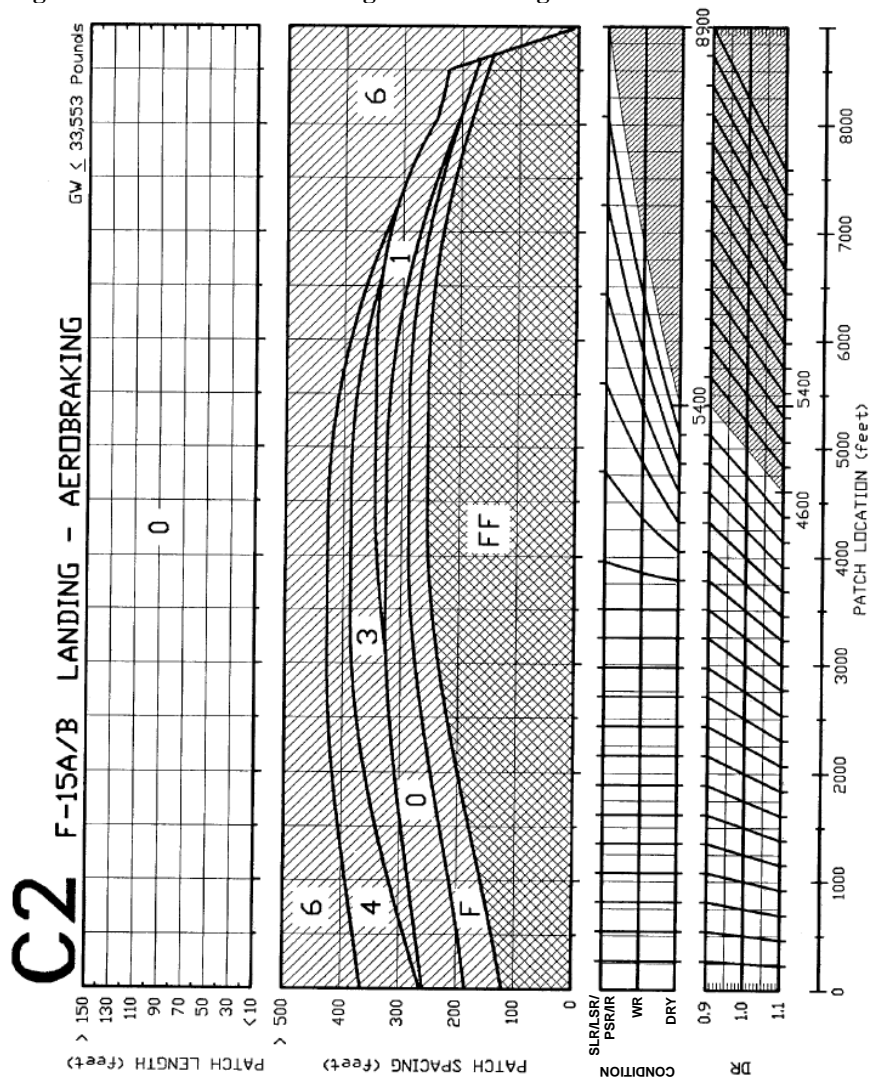


Figure A3.13. F-15 A/B Landing – Wheel Braking.

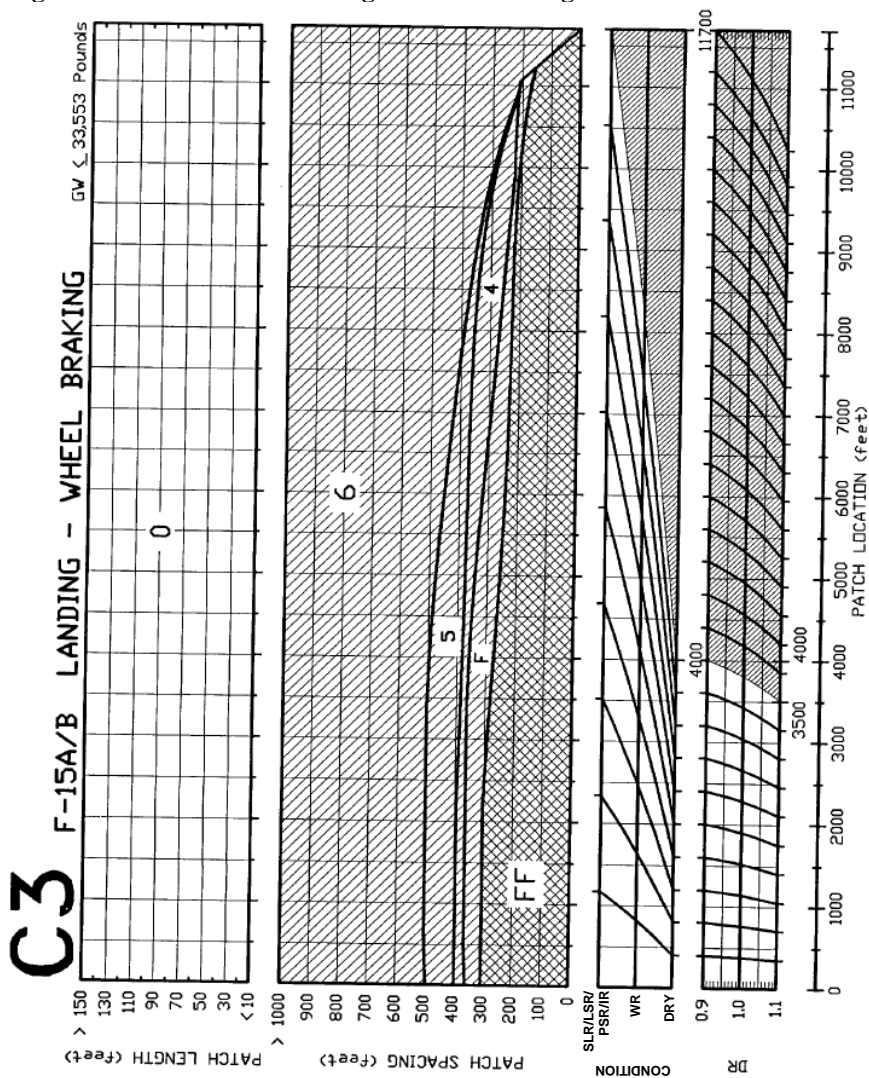


Figure A3.14. F-15 A/B Landing – Arrestment.

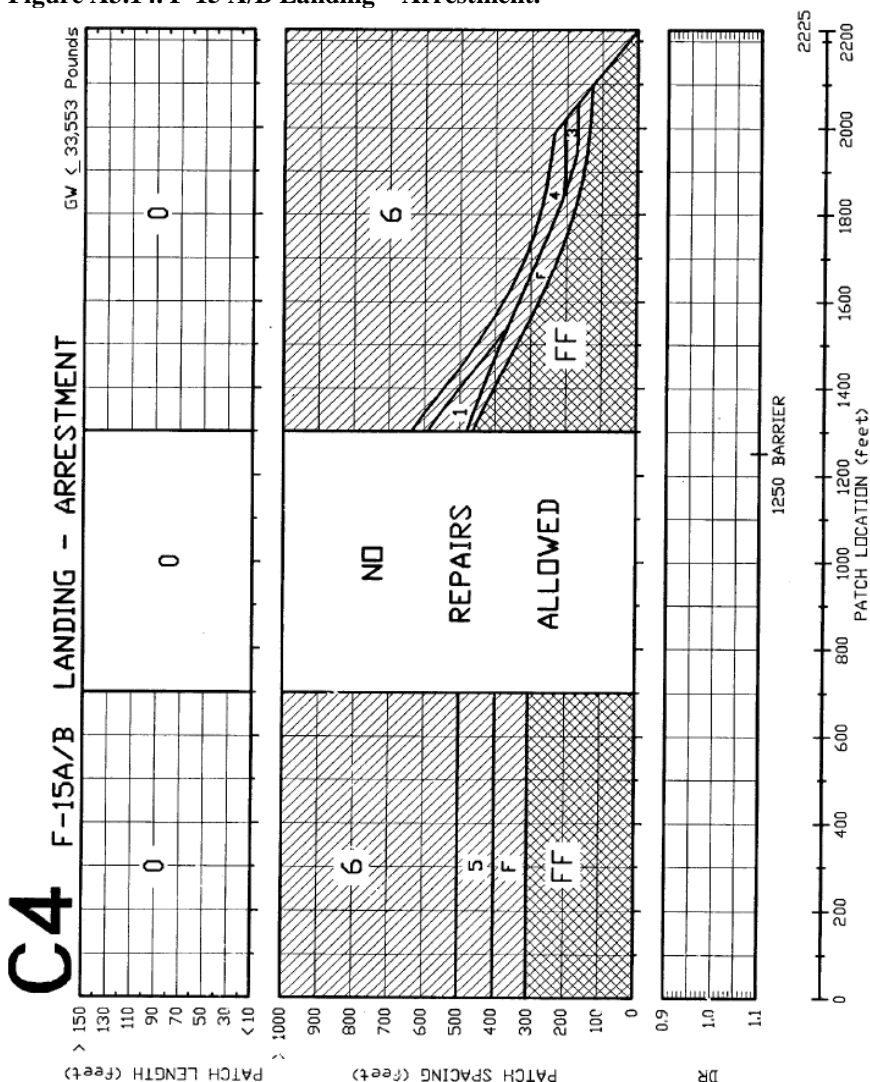


Figure A3.15. F-15 A/B Evacuation.

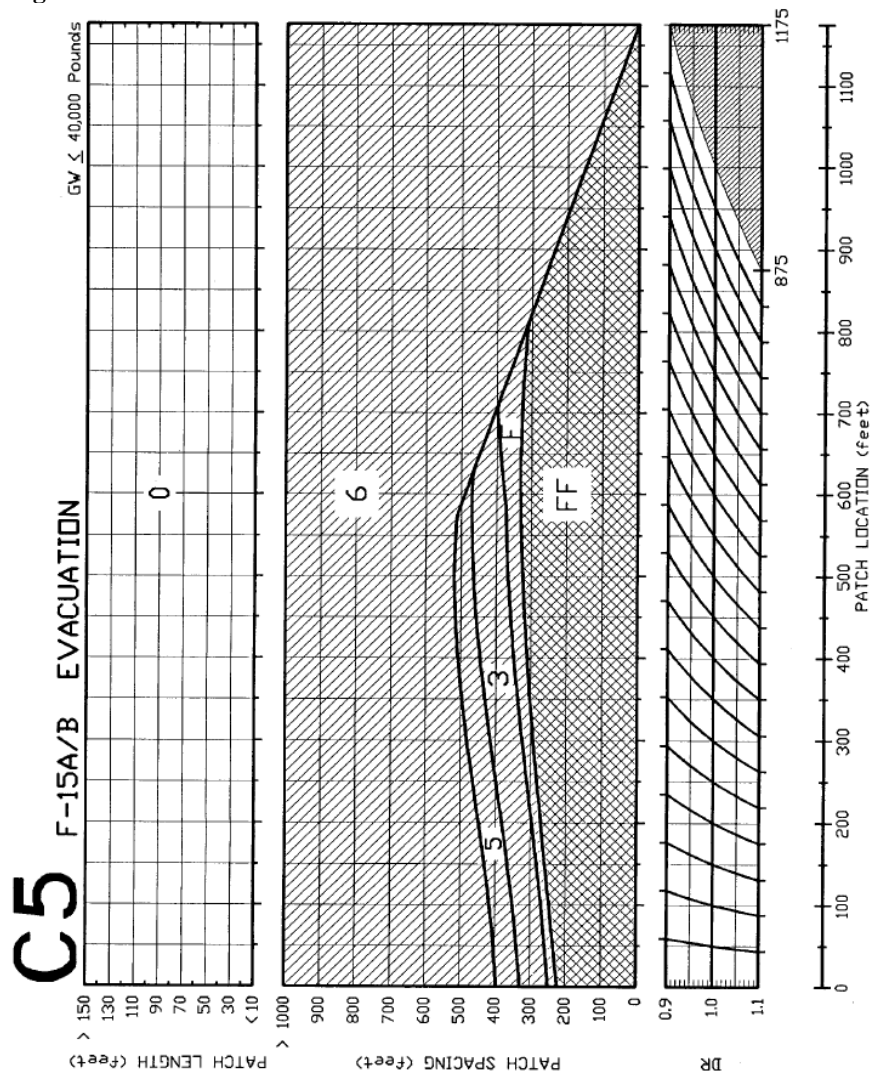


Figure A3.16. F-15 C/D Takeoff.

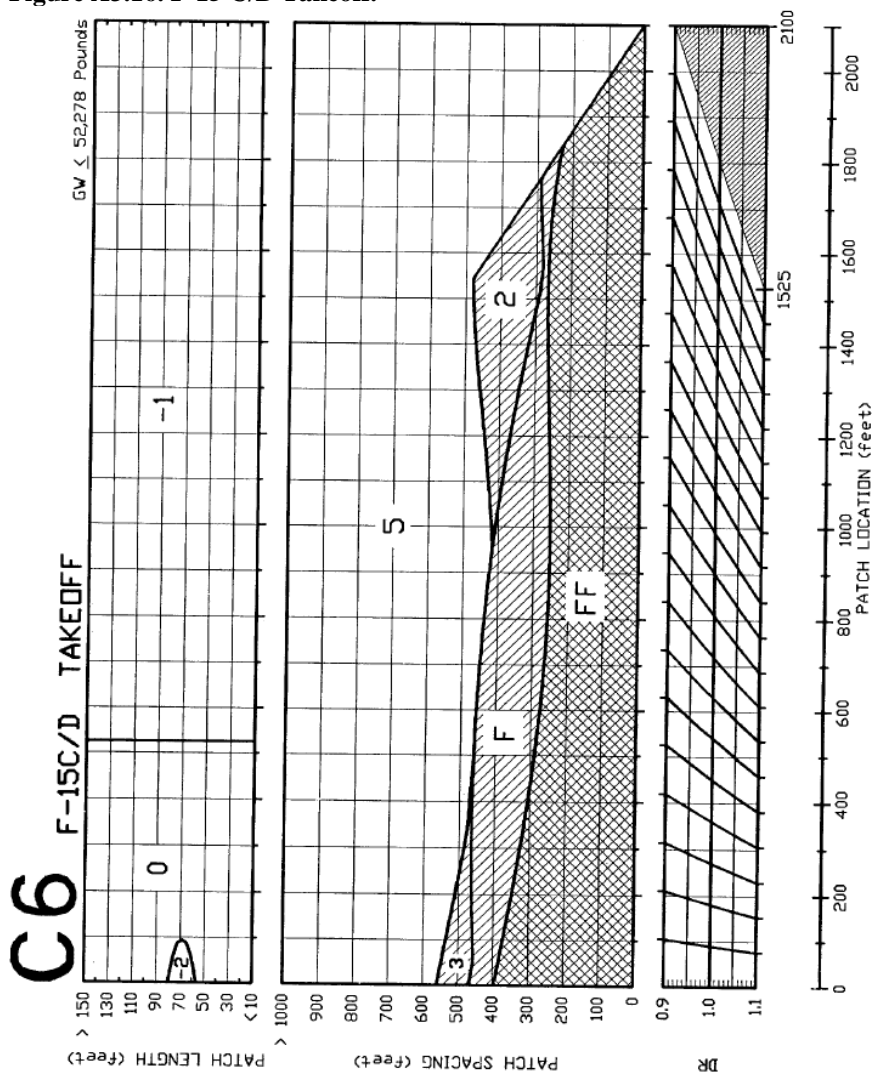


Figure A3.17. F-15 C/D Landing – Aerobraking.

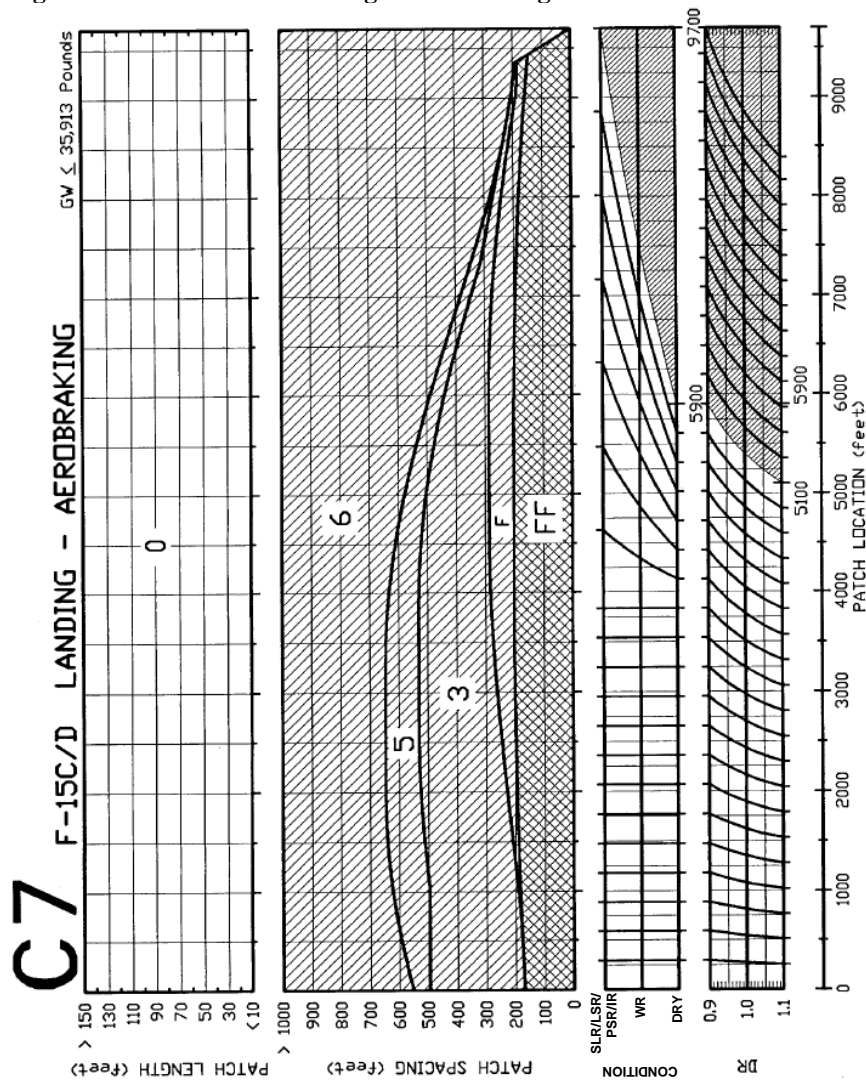


Figure A3.18. F-15 C/D Landing – Wheel Braking.

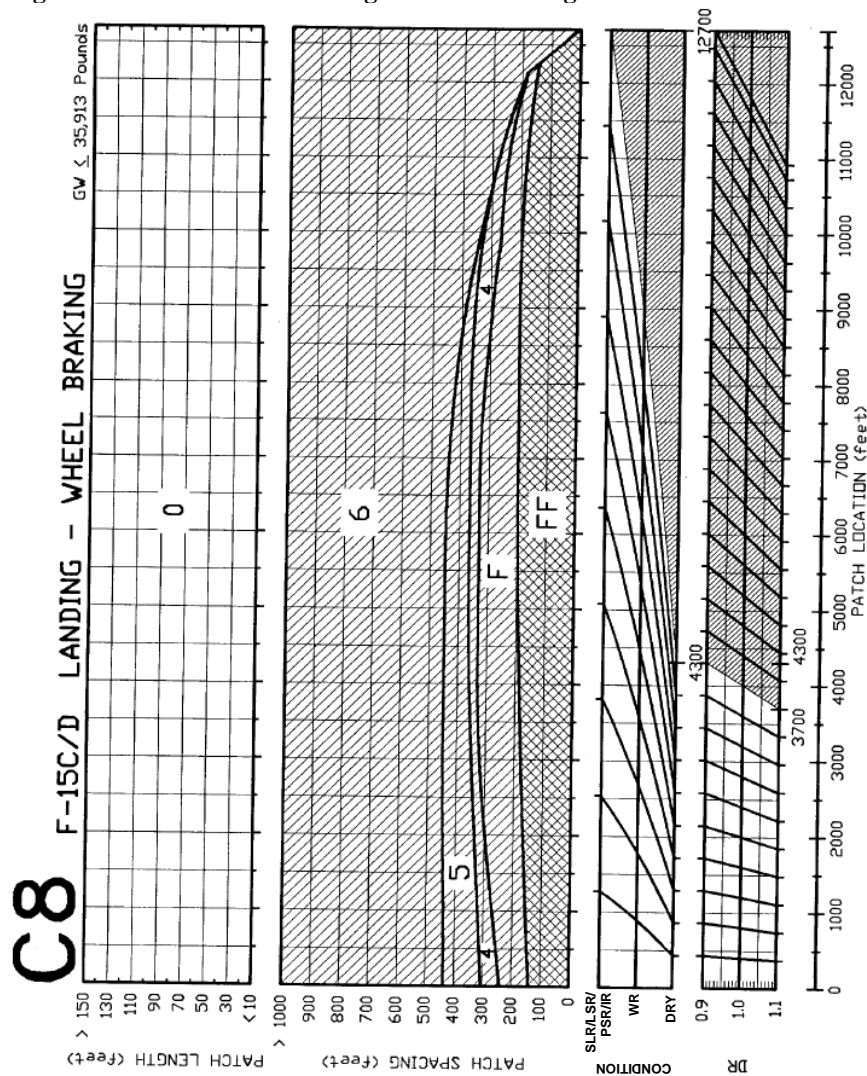
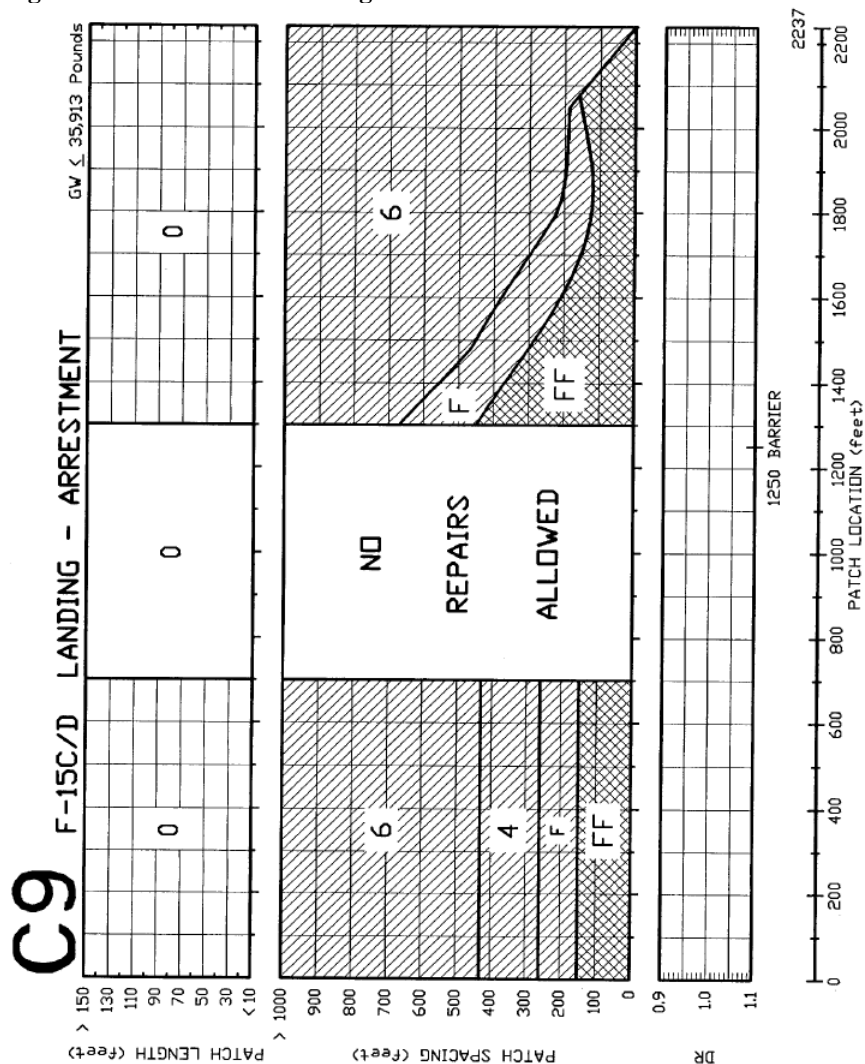


Figure A3.19. F-15 C/D Landing – Arrestment.



Note: This chart reflects a 987 ft maximum runout for an arrestment landing. Current maximum runout is 1,200 ft, which requires adding an additional 213 ft to arrestment landing operational length.

Figure A3.20. F-15 C/D Evacuation.

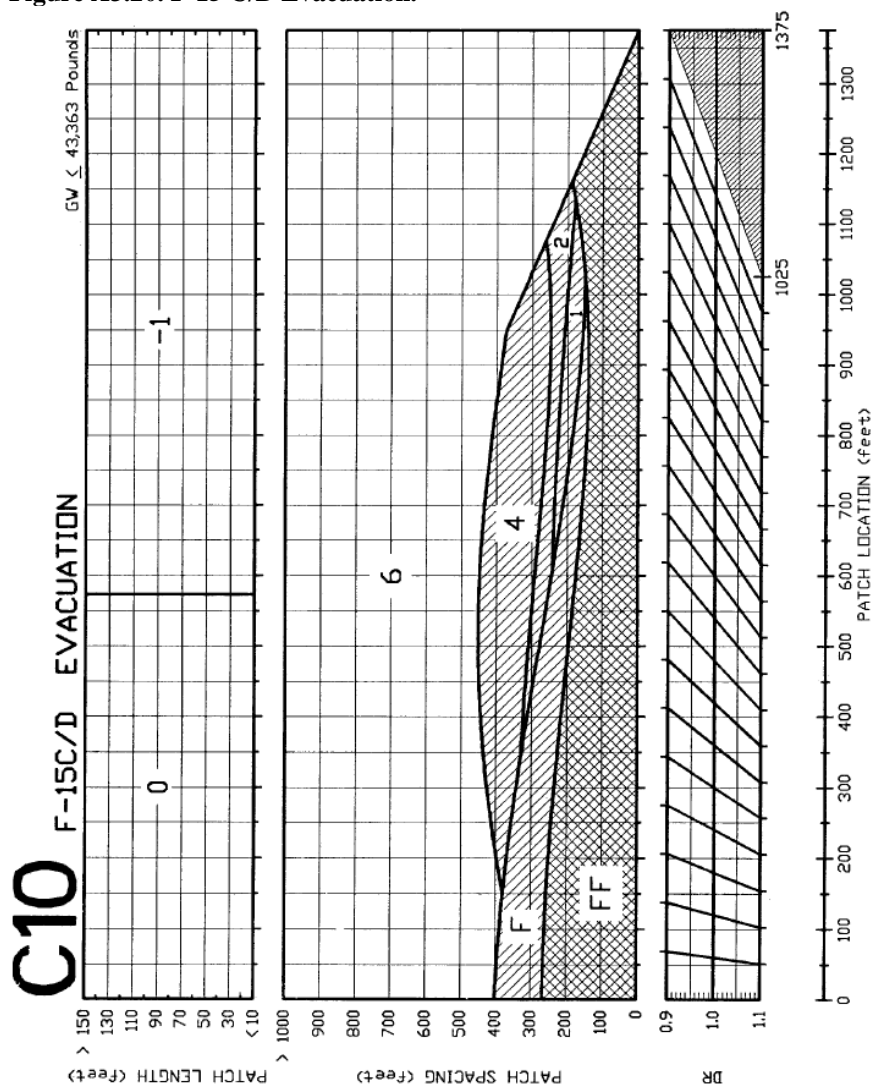


Figure A3.21. F-15 E Takeoff.

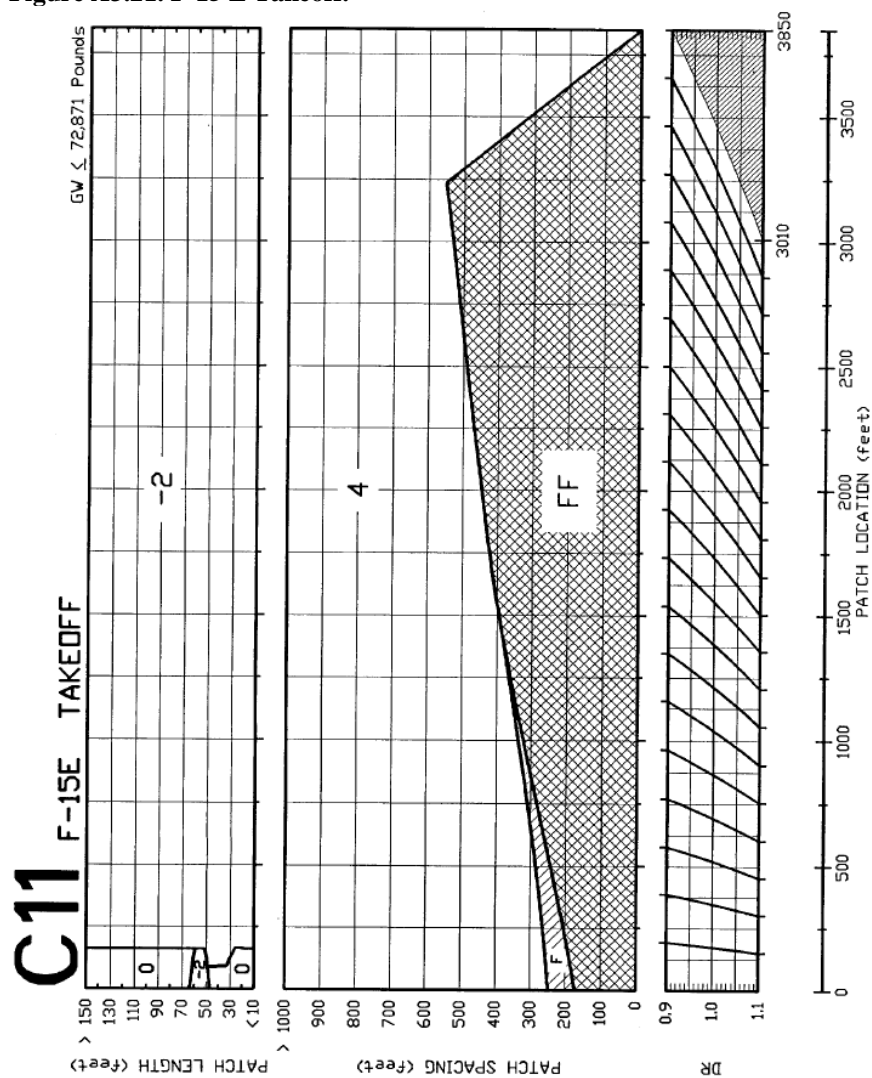


Figure A3.22. F-15 E Landing.

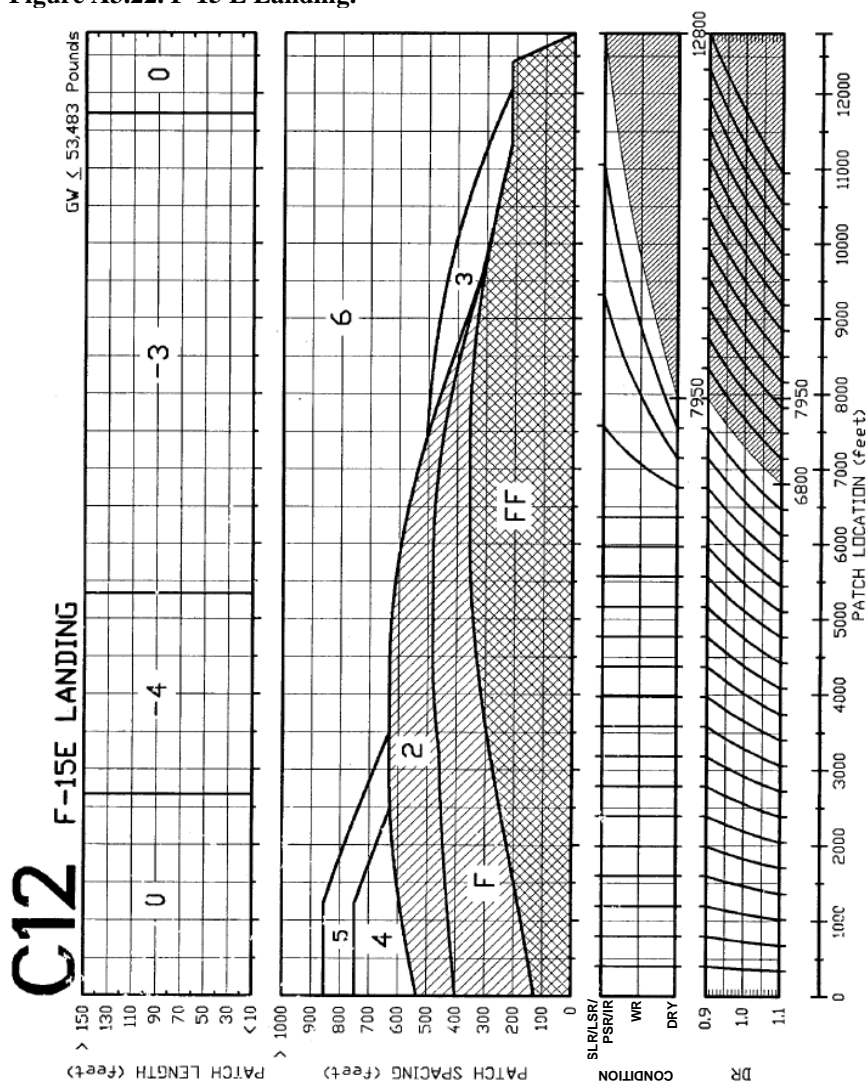


Figure A3.23. F-15 E Landing – Arrestment.

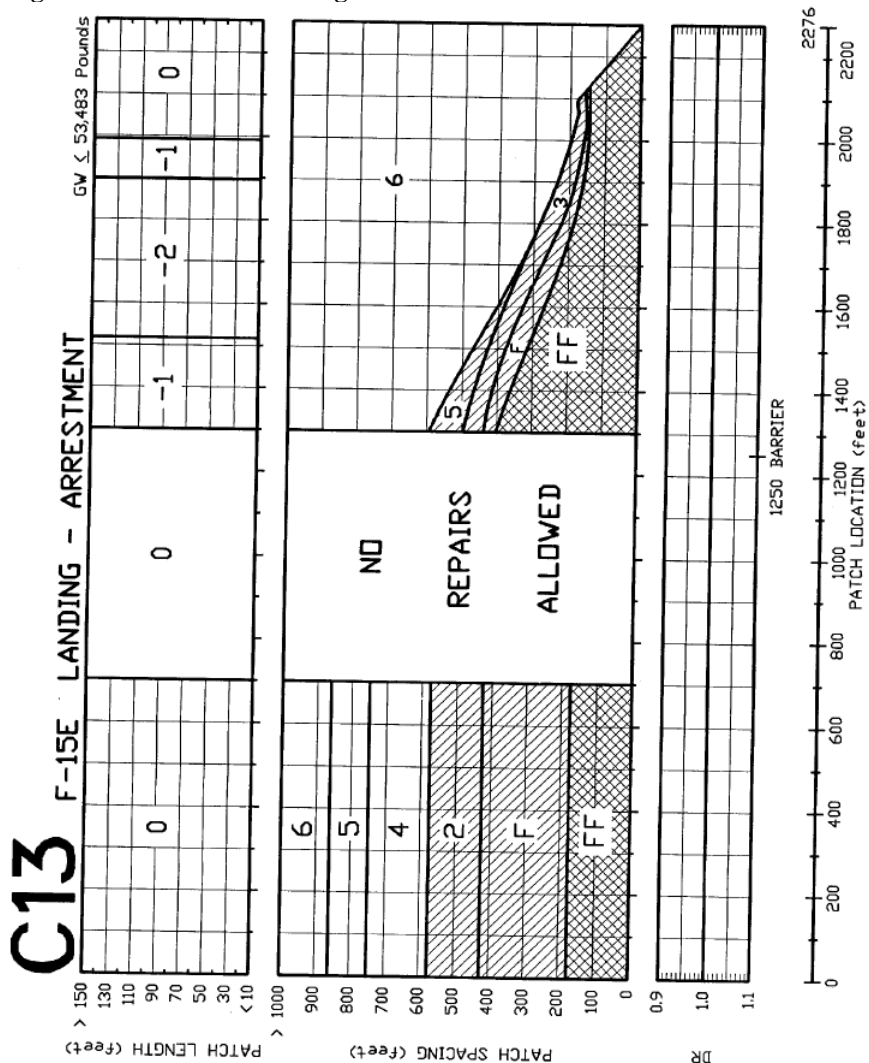


Figure A3.24. F-15 E Evacuation.

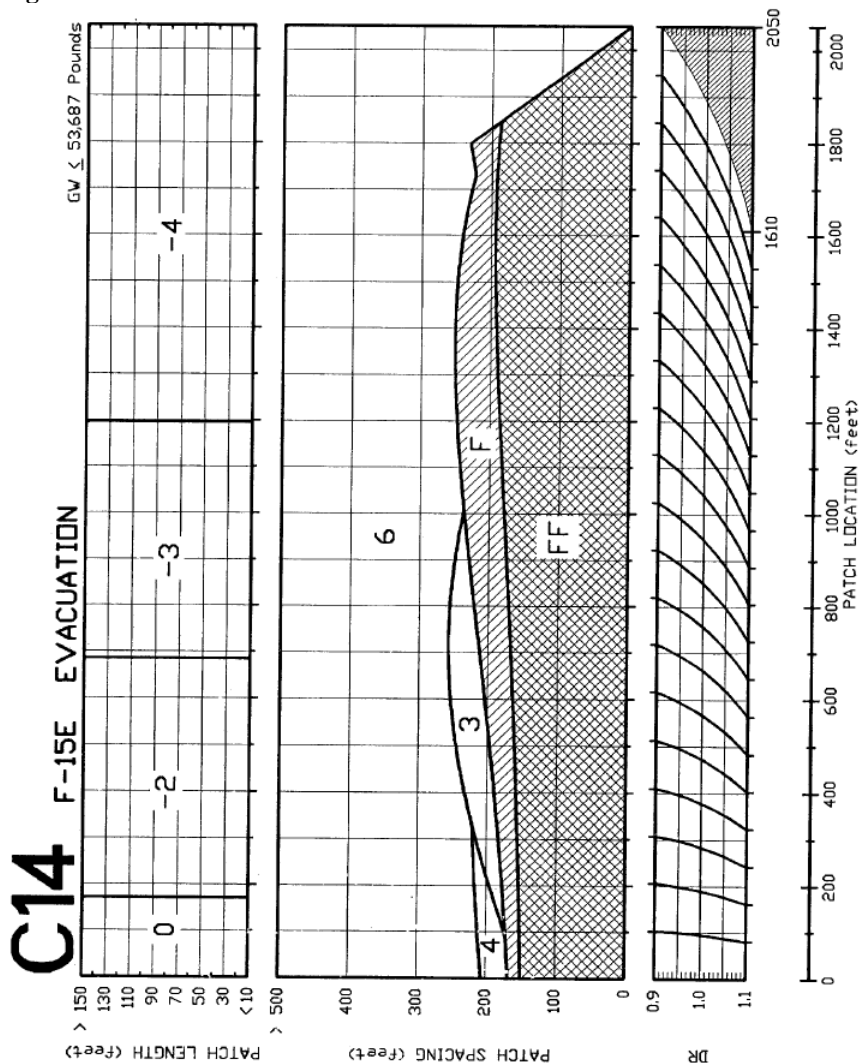


Figure A3.25. F-16 A/B Block 10 and 15 Takeoff.

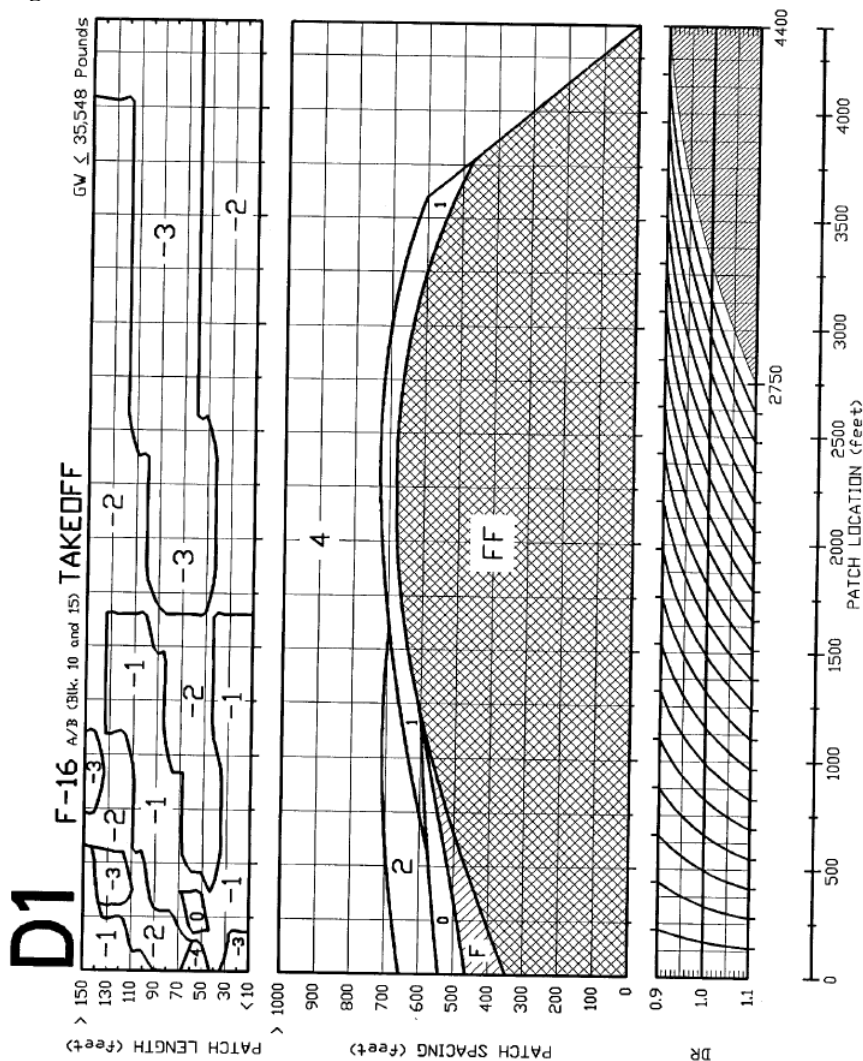
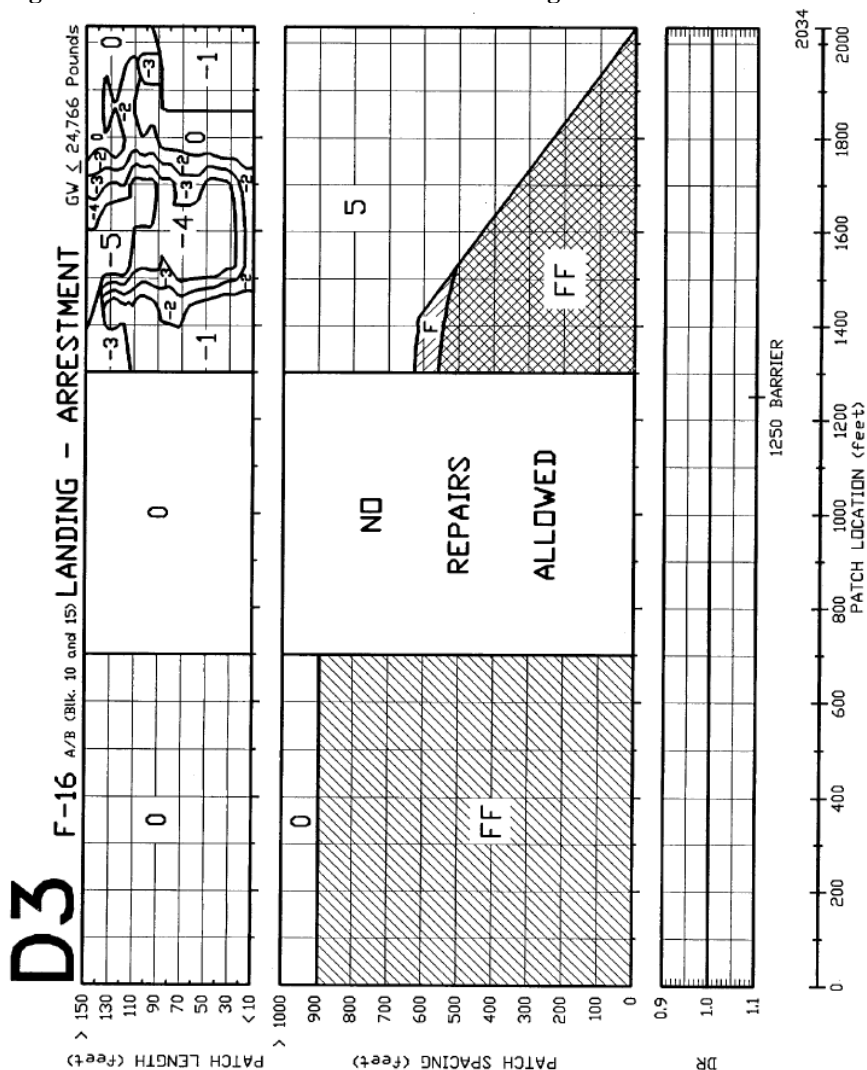


Figure A3.27. F-16 A/B Block 10 and 15 Landing – Arrestment.



NOTE: This chart reflects a 784 ft maximum runout for an arrestment landing. Current maximum runout is 1,200 ft, which requires adding an additional 416 ft to arrestment landing operational length.

Figure A3.28. F-16 A/B Block 10 and 15 Evacuation.

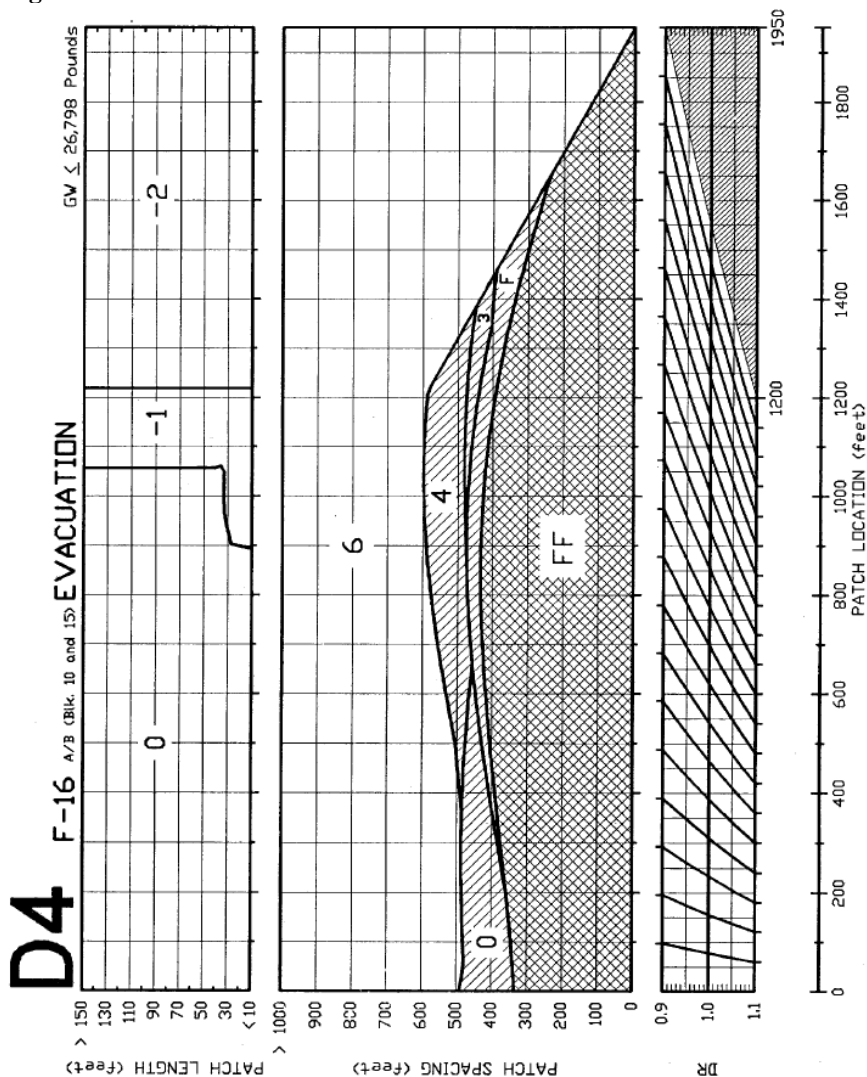


Figure A3.29. F-16 C/D Block 25, 30, 32 Takeoff.

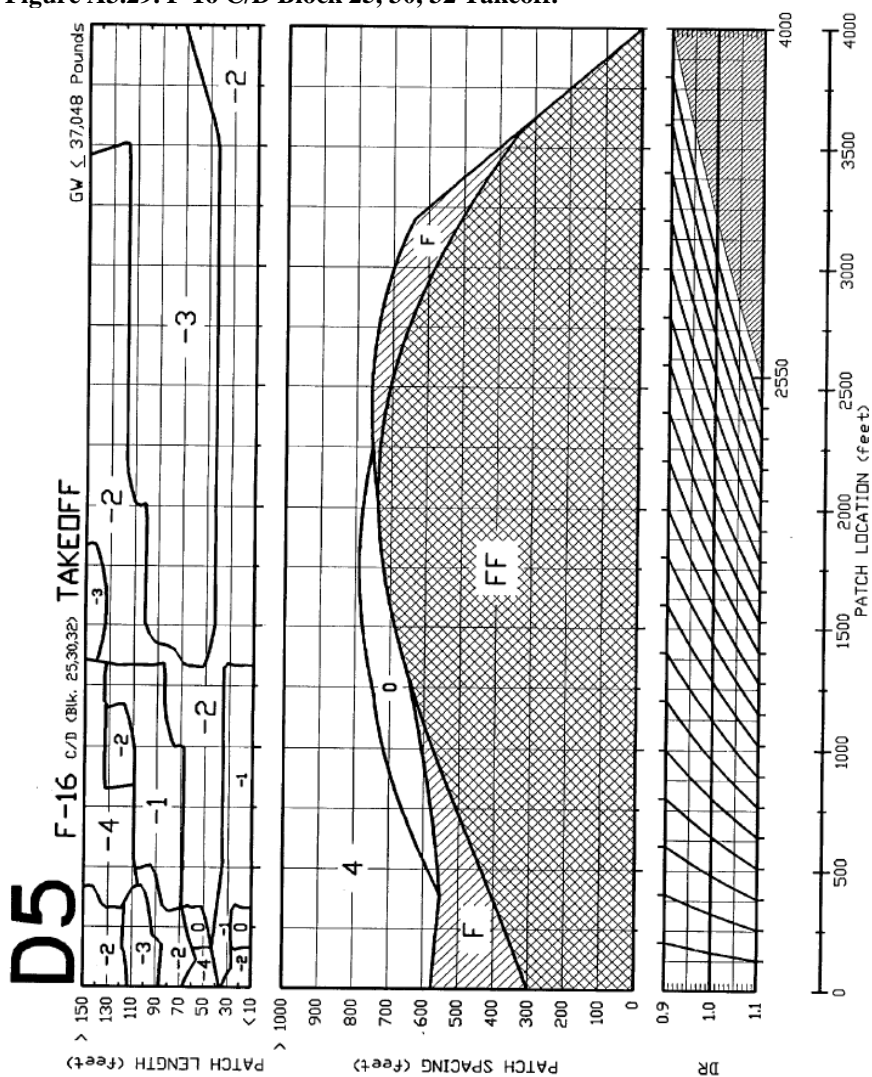


Figure A3.30. F-16 C/D Block 25, 30, 32 Landing.

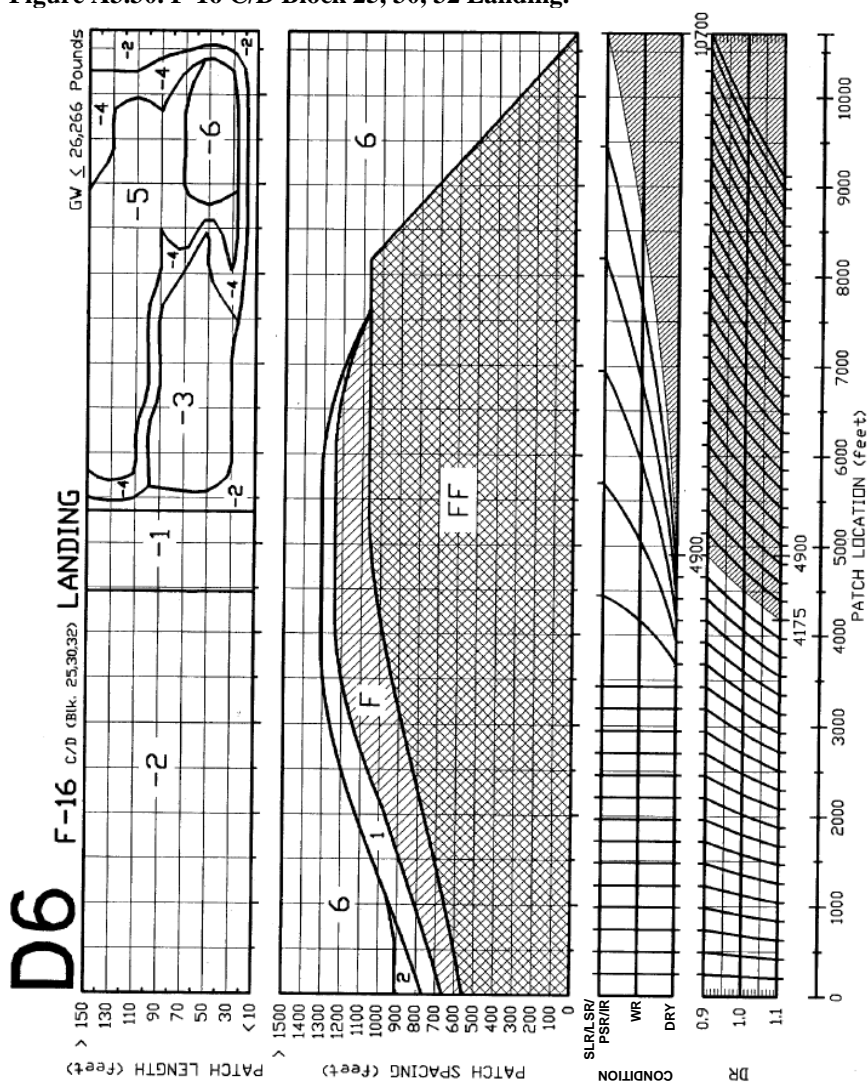
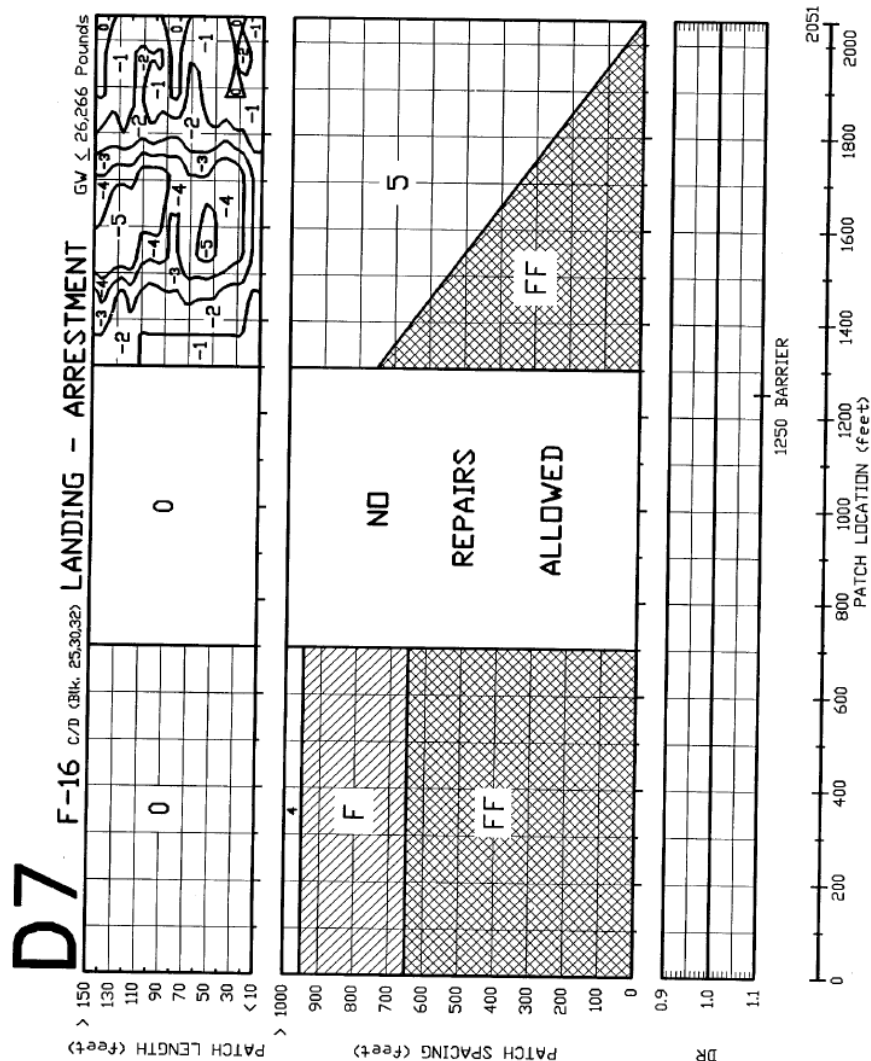


Figure A3.31. F-16 C/D Block 25, 30, 32 Landing – Arrestment.



NOTE: This chart reflects a 801 ft maximum runoff for an arrestment landing. Current maximum runoff is 1,200 ft, which requires adding an additional 399 ft to arrestment landing operational length.

Figure A3.32. F-16 C/D Block 25, 30, 32 Evacuation.

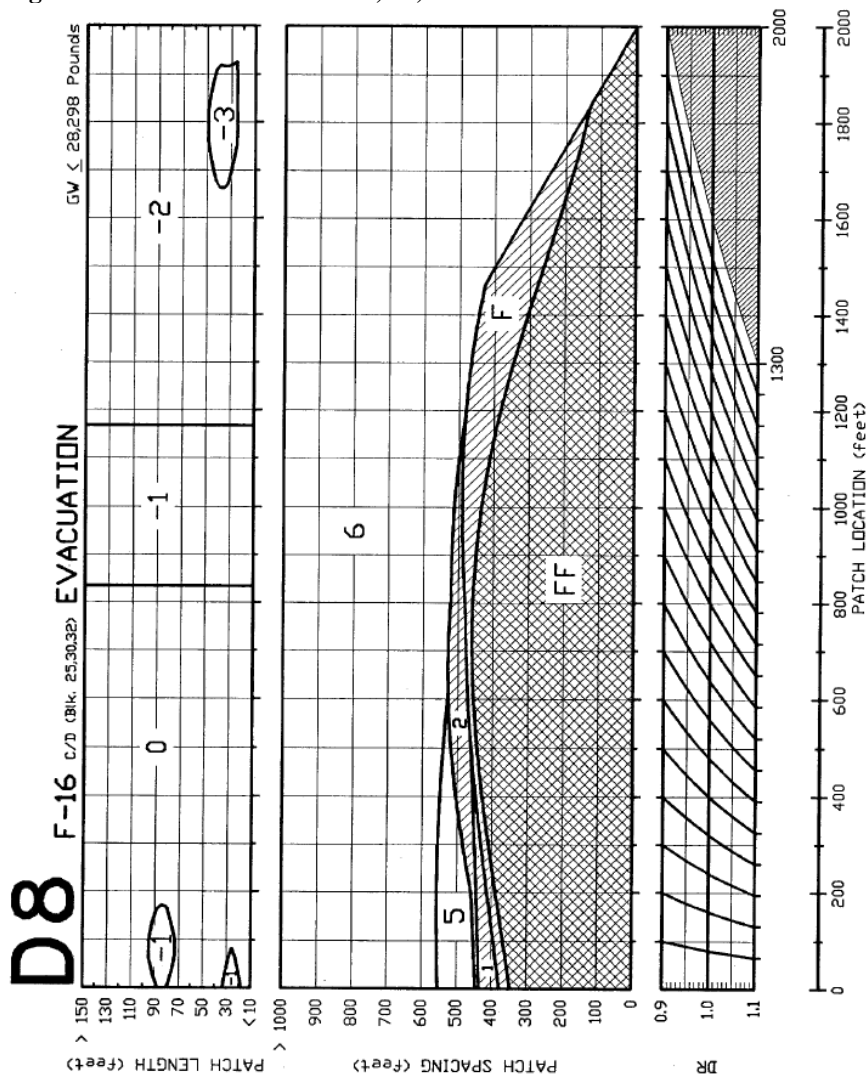


Figure A3.33. F-16 C/D Block 40, 42 Takeoff.

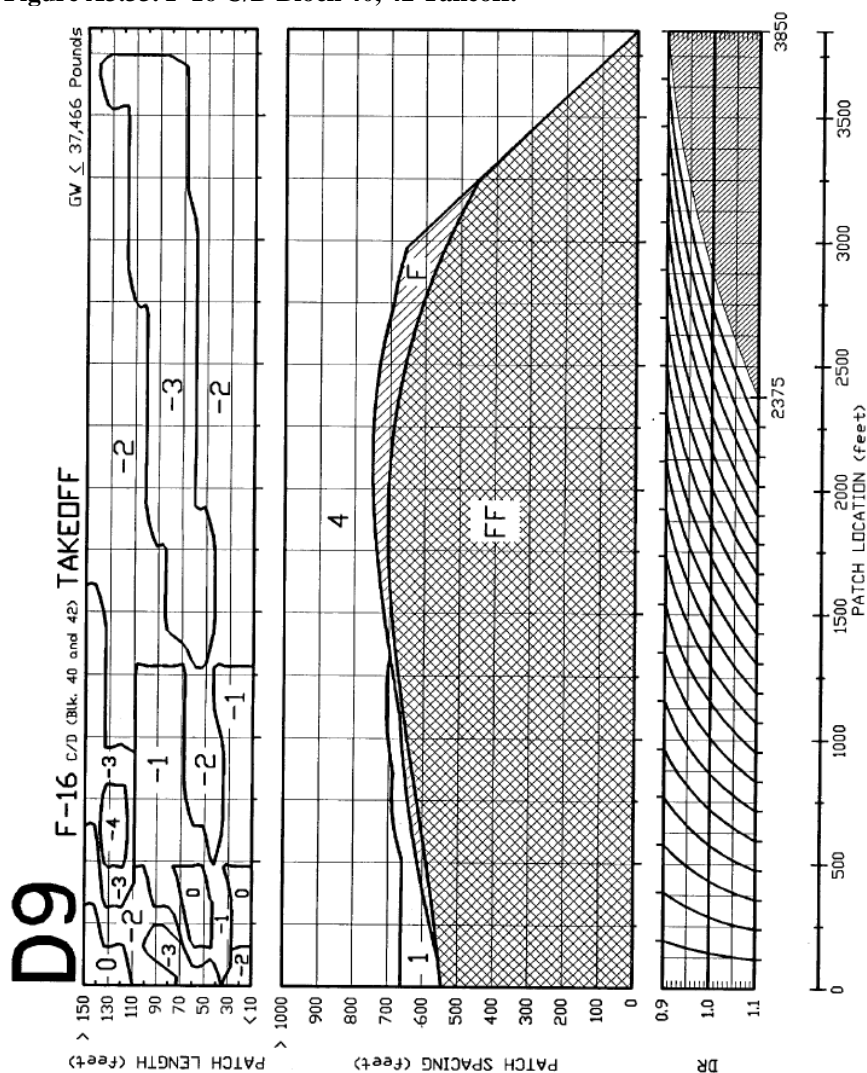


Figure A3.34. F-16 C/D Block 40, 42 Landing.

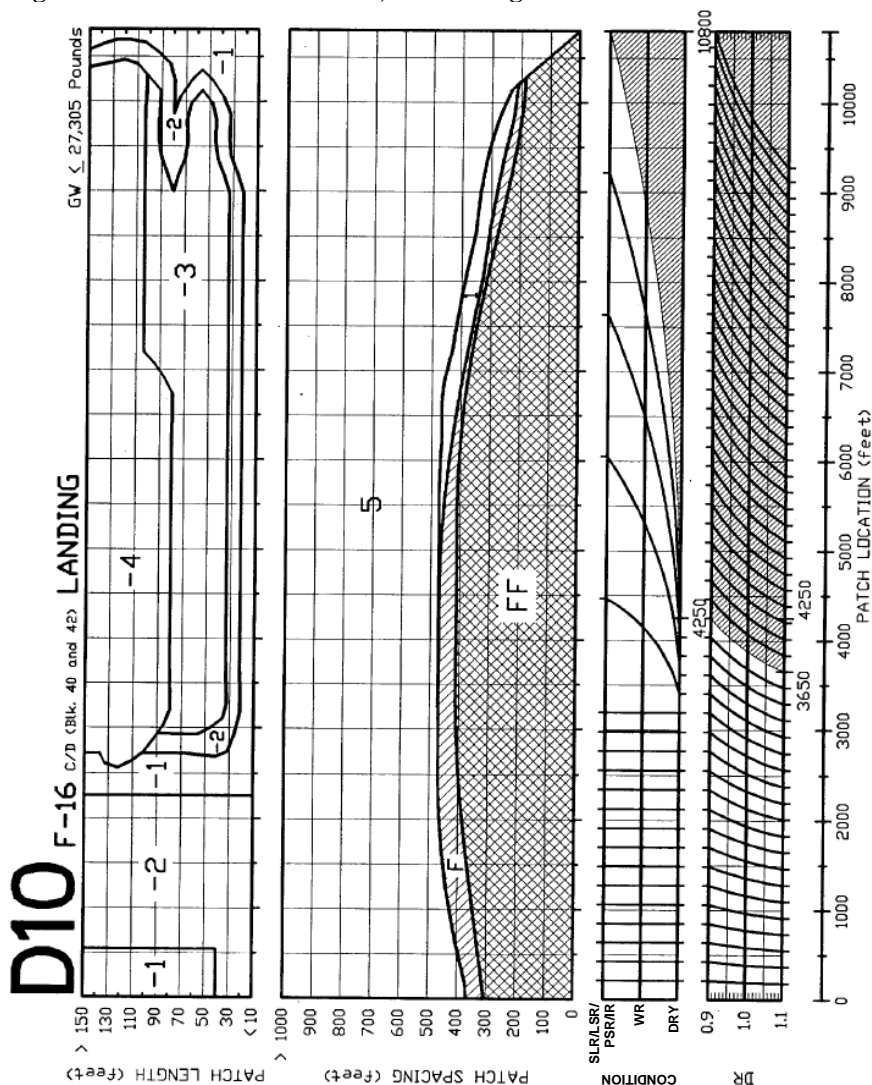


Figure A3.35. F-16 C/D Block 40, 42 Landing – Arrestment.

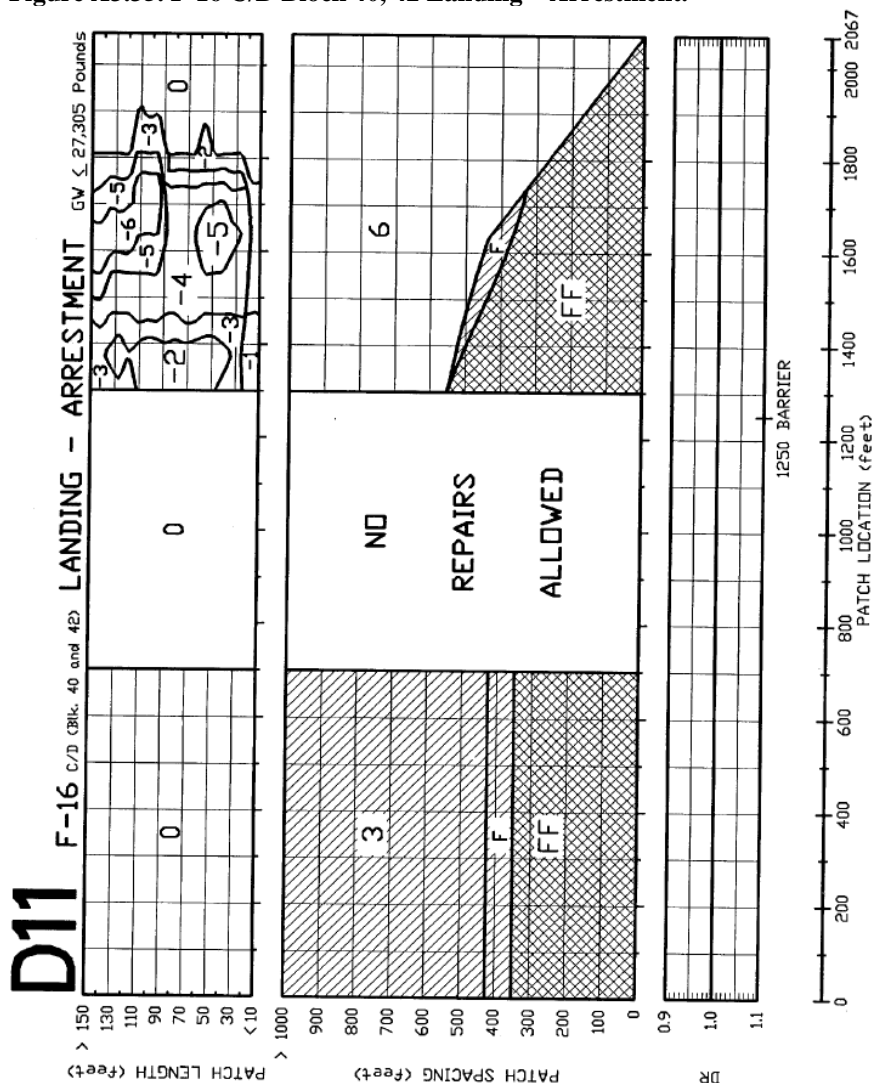


Figure A3.36. F-16 C/D Block 40, 42 Evacuation.

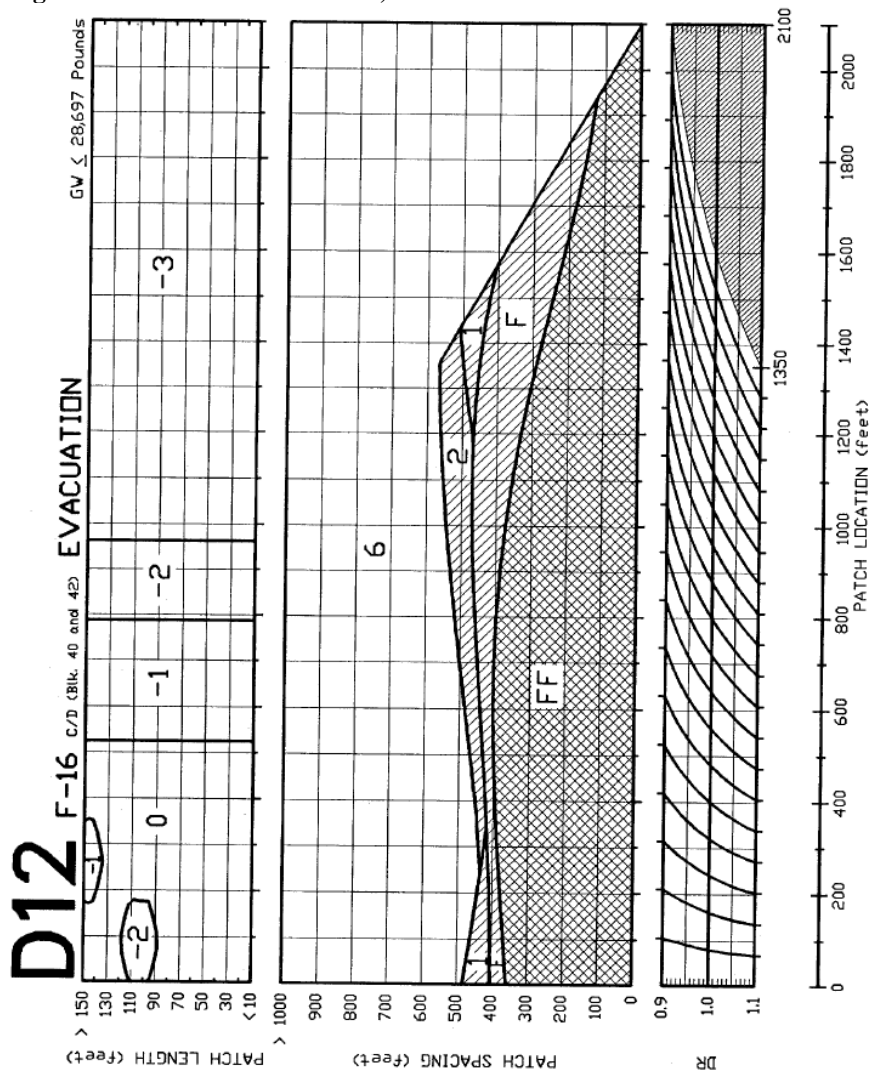


Figure A3.37. F-111 A/E Takeoff.

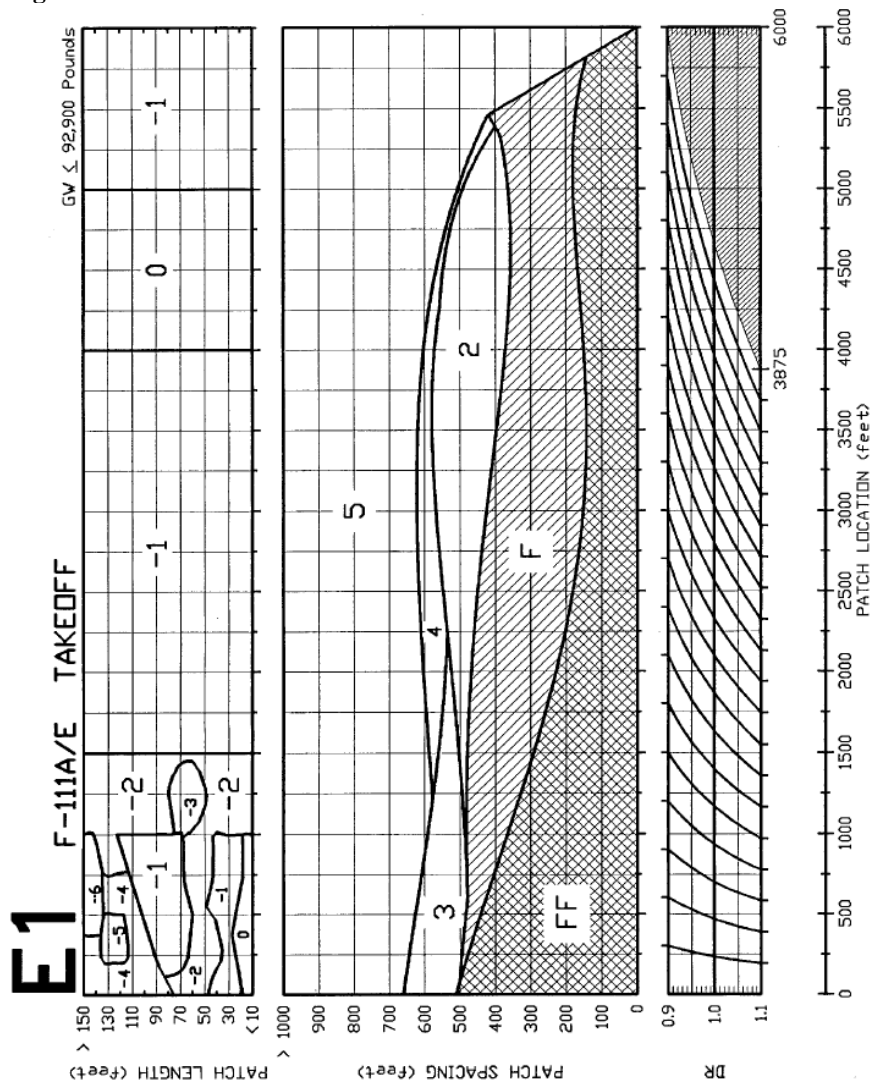


Figure A3.39. F-111 A/E Landing – Short Field.

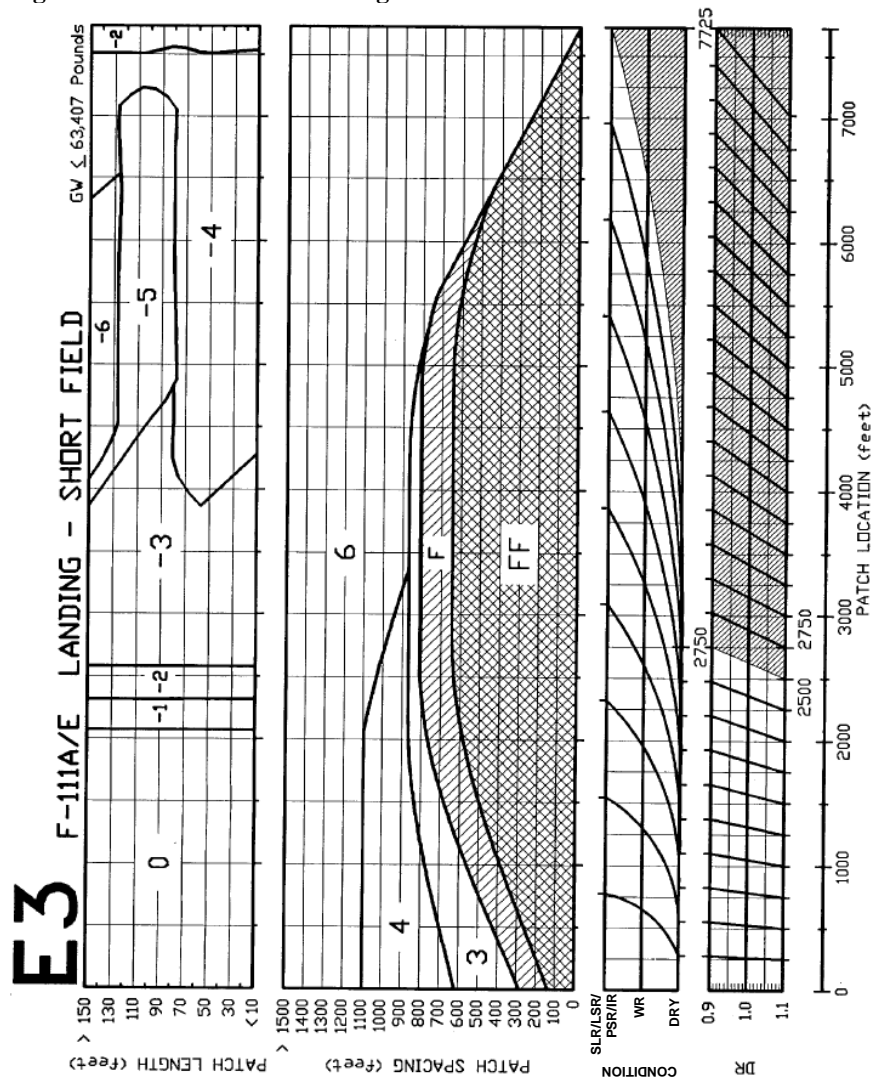
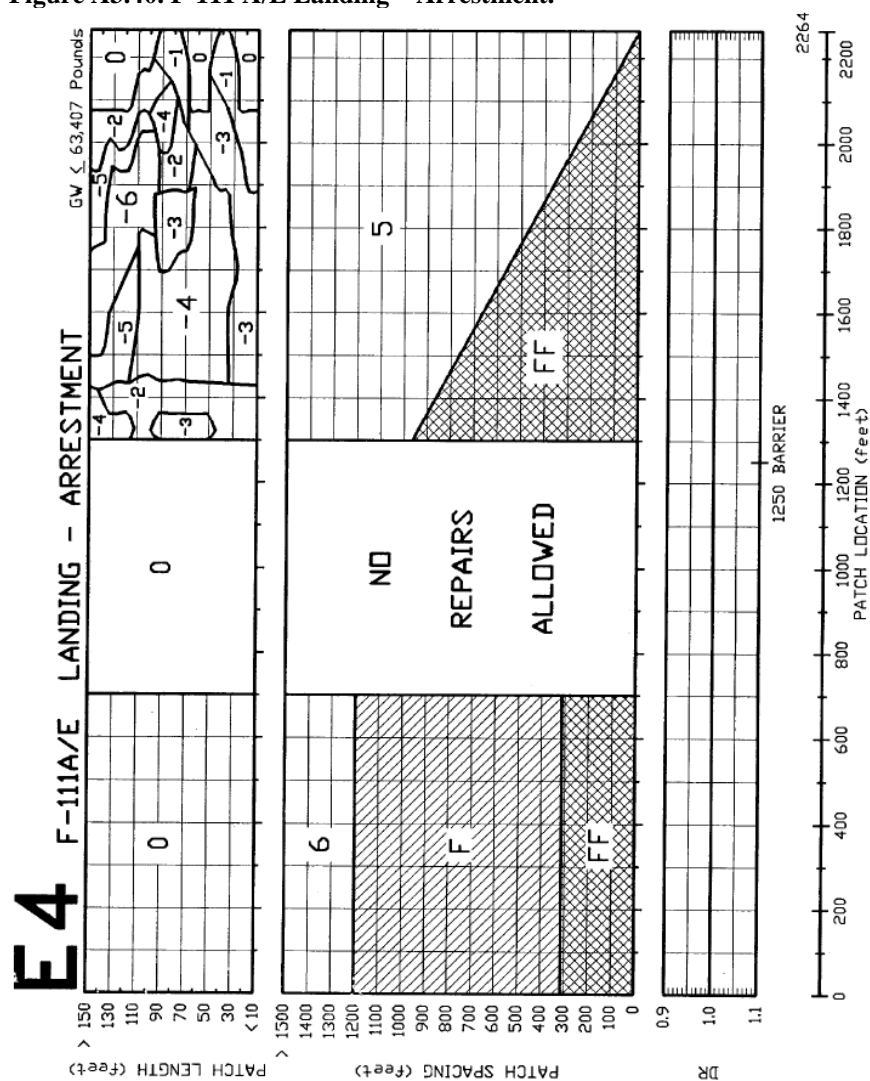


Figure A3.40. F-111 A/E Landing – Arrestment.



NOTE: This chart reflects a 1,014 ft maximum runout for an arrestment landing. Current maximum runout is 1,200 ft, which requires adding an additional 186 ft to arrestment landing operational length.

Figure A3.41. F-111 A/Evacuation.

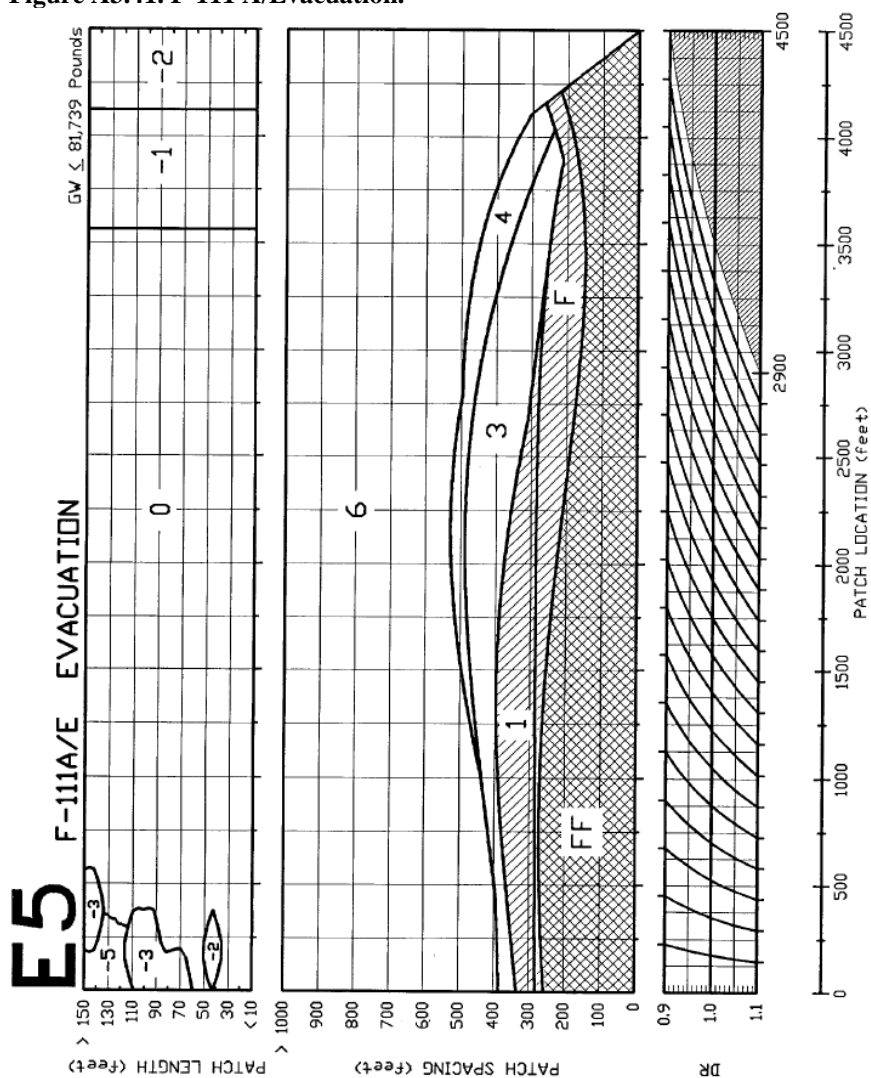


Figure A3.42. C-5 B Takeoff.

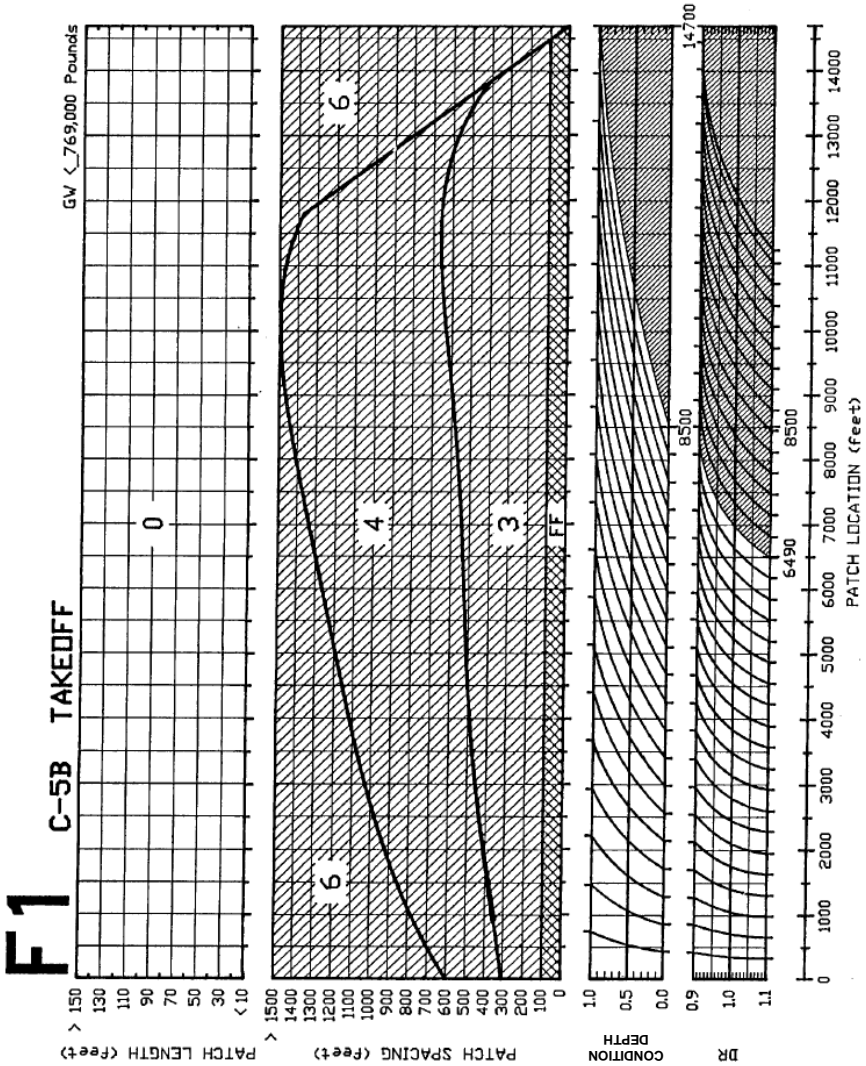


Figure A3.43. C-5 B Landing.

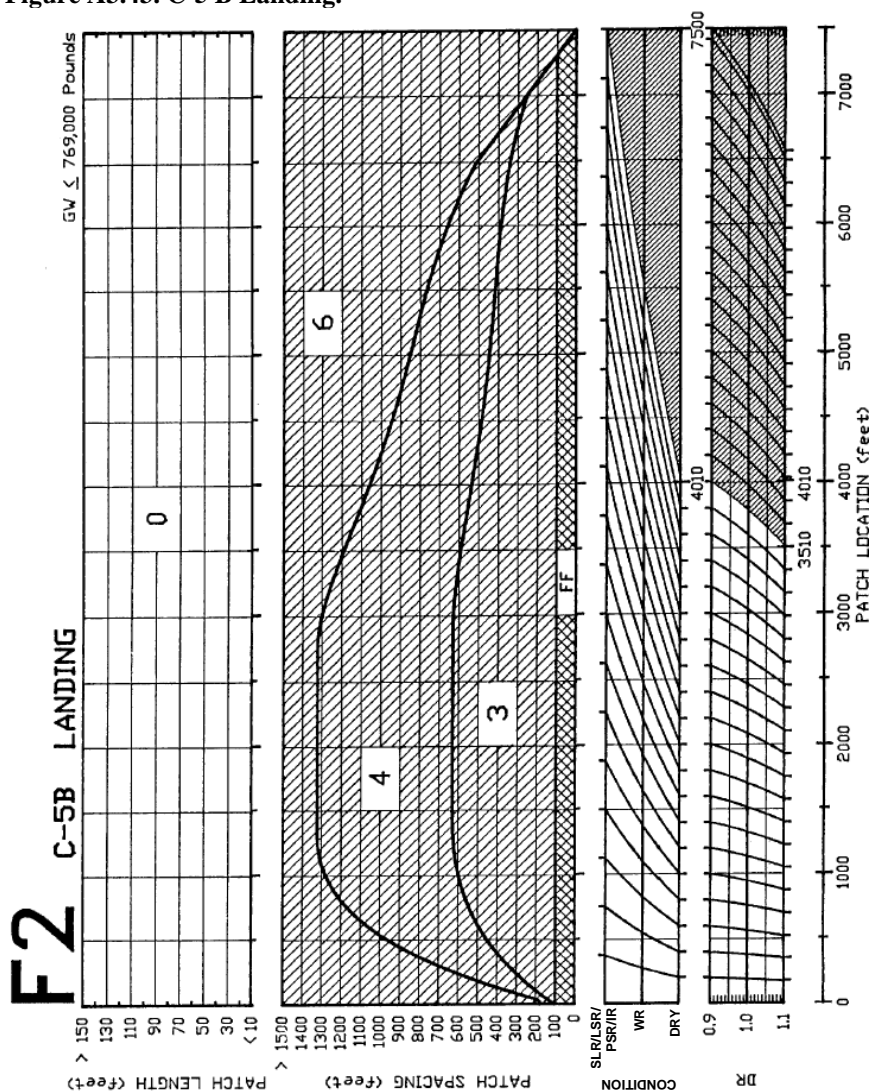


Figure A3.44. C-130 E/H Takeoff.

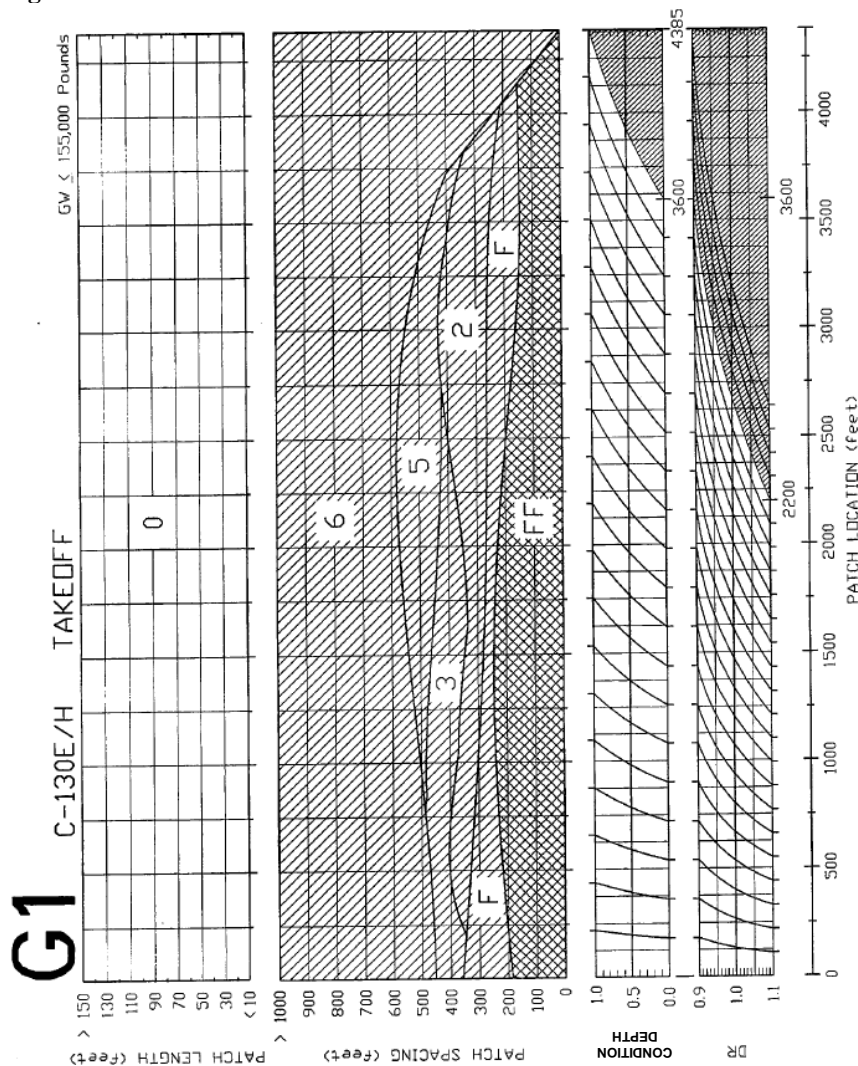


Figure A3.45. C-130 E/H Landing.

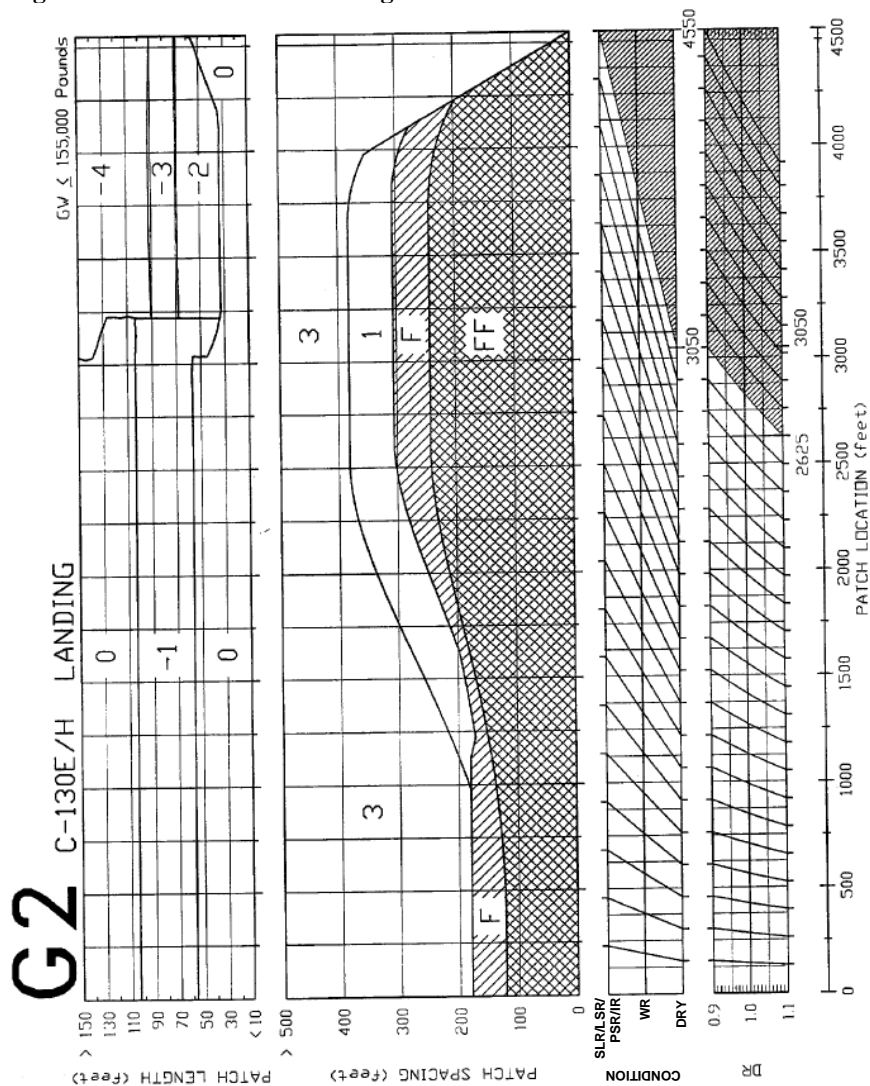


Figure A3.46. C-141 A/B Heavy Weight Takeoff.

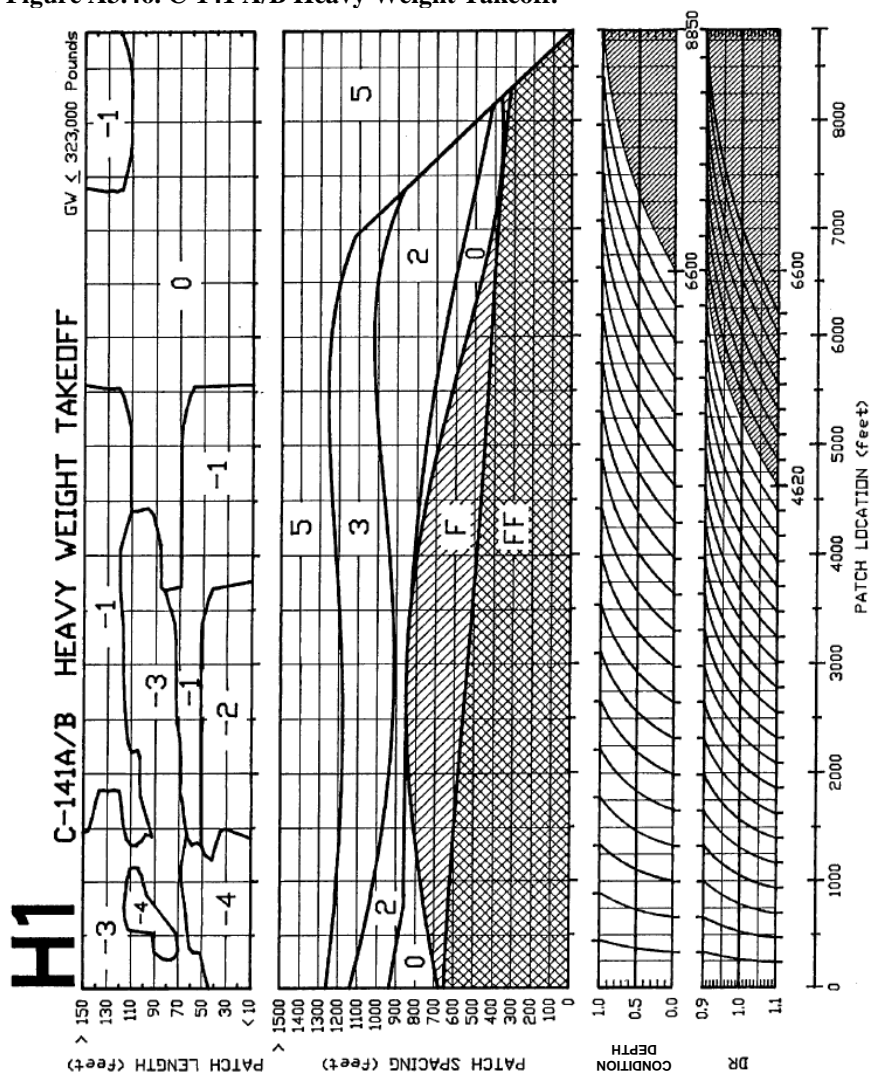


Figure A3.47. C-141 A/B Heavy Weight Landing.

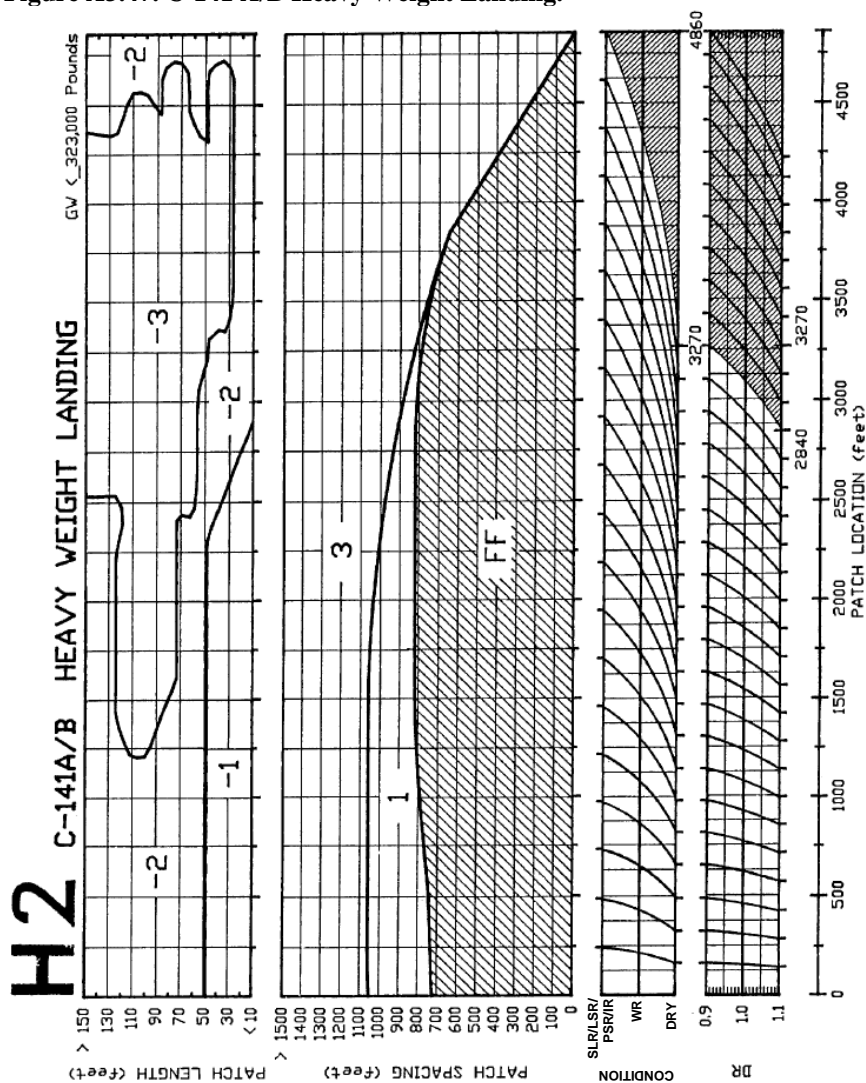


Chart A3.48. C-141 A/B Medium Weight Takeoff.

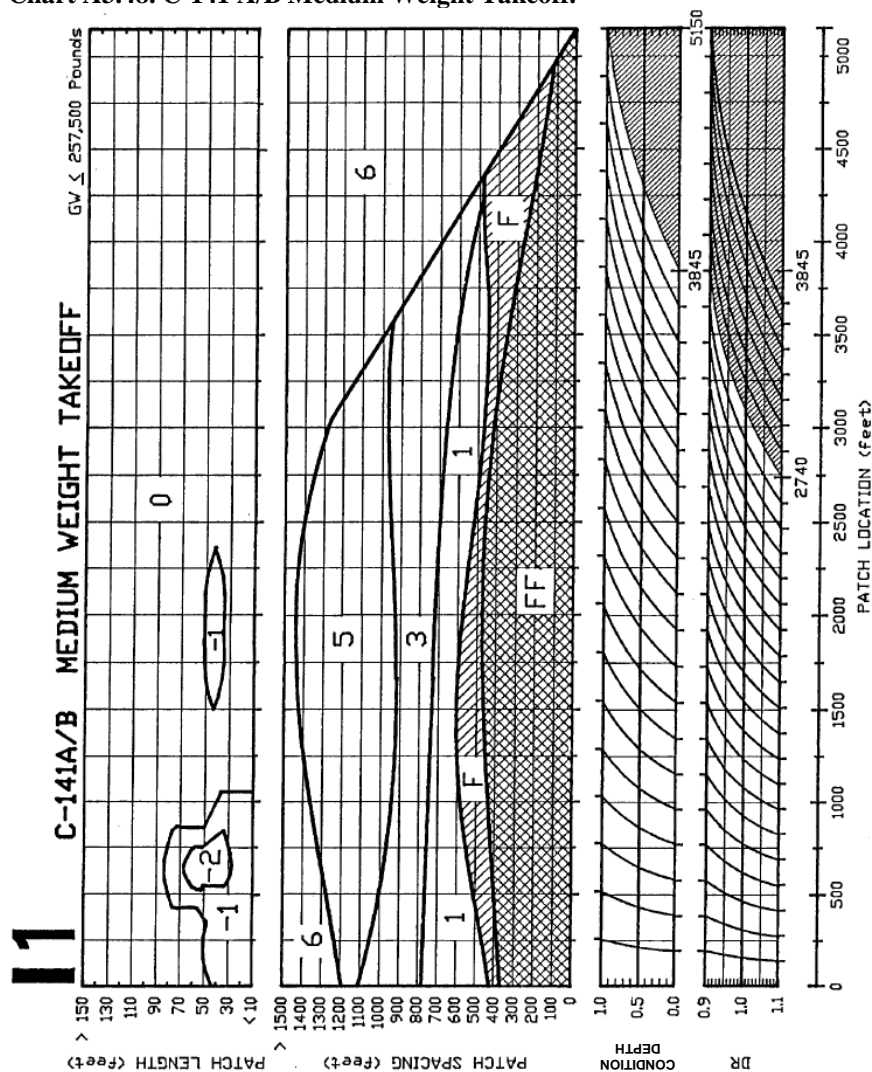


Figure A3.49. C-141 A/B Medium Weight Landing.

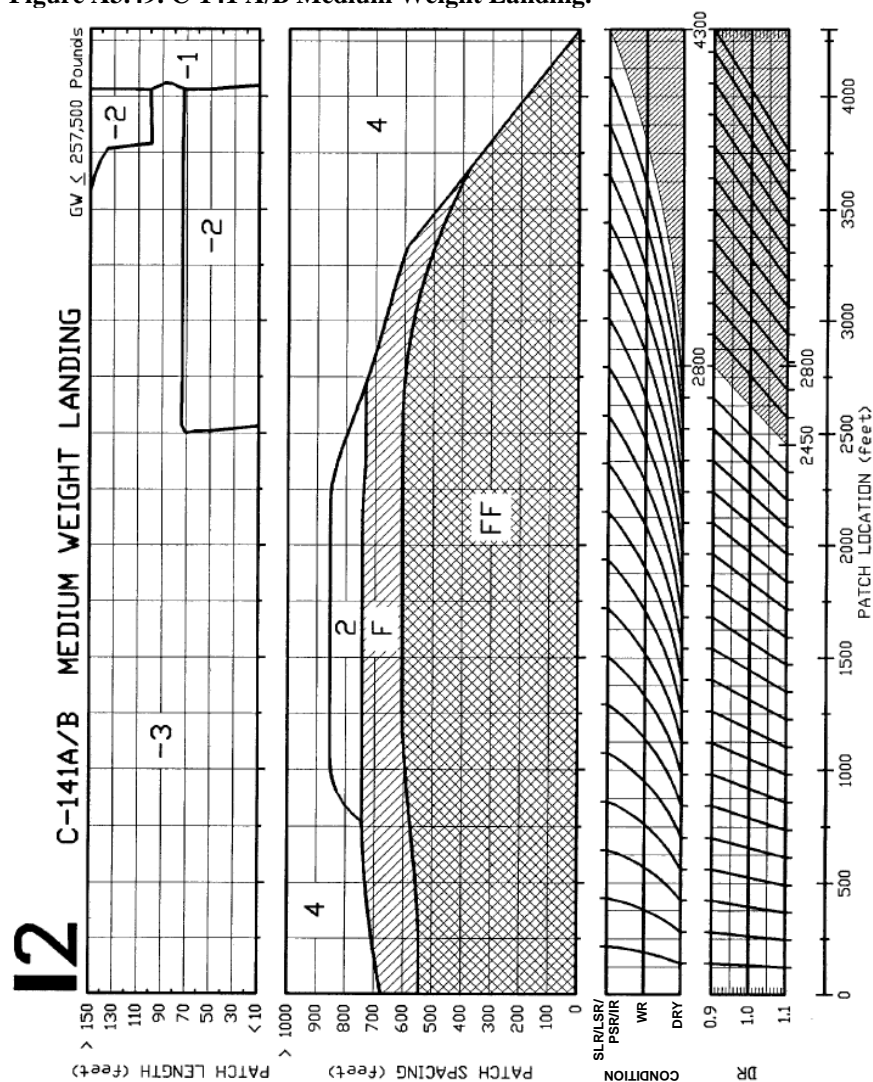


Figure A3.50. A7 D Takeoff.

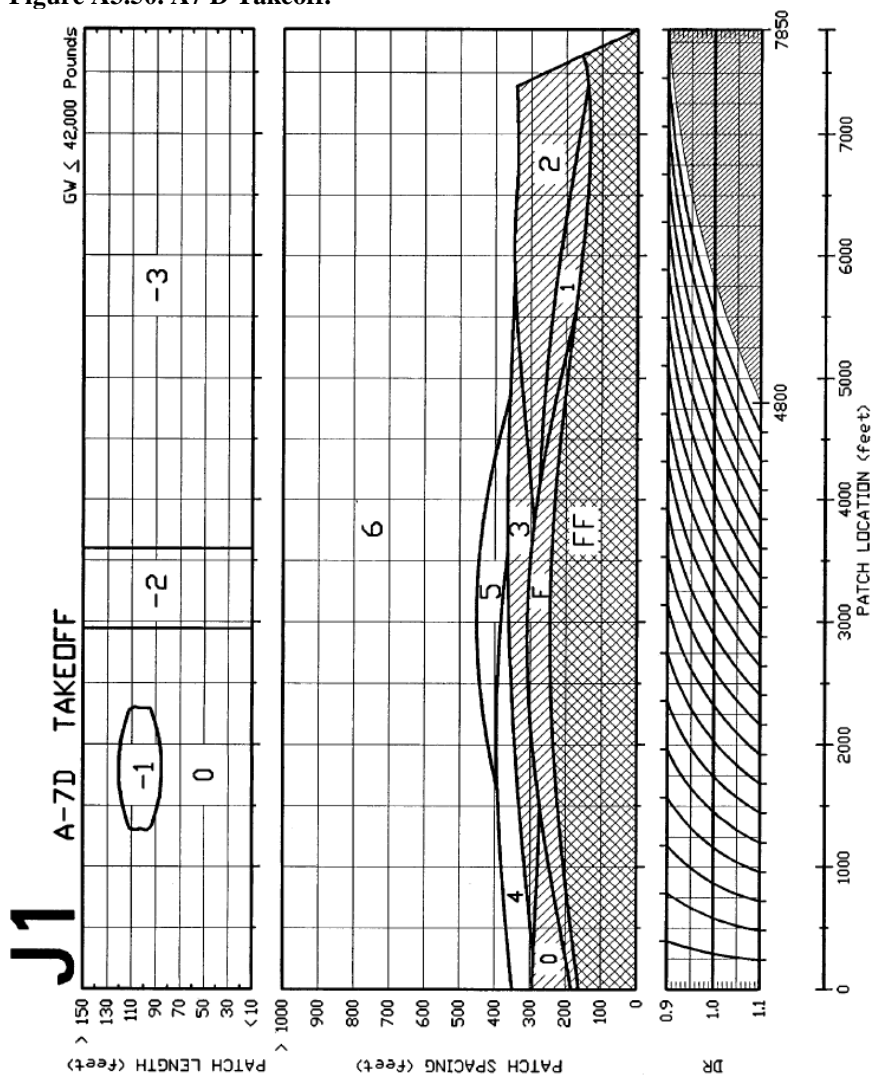


Figure A3.51. A-7 D Landing.

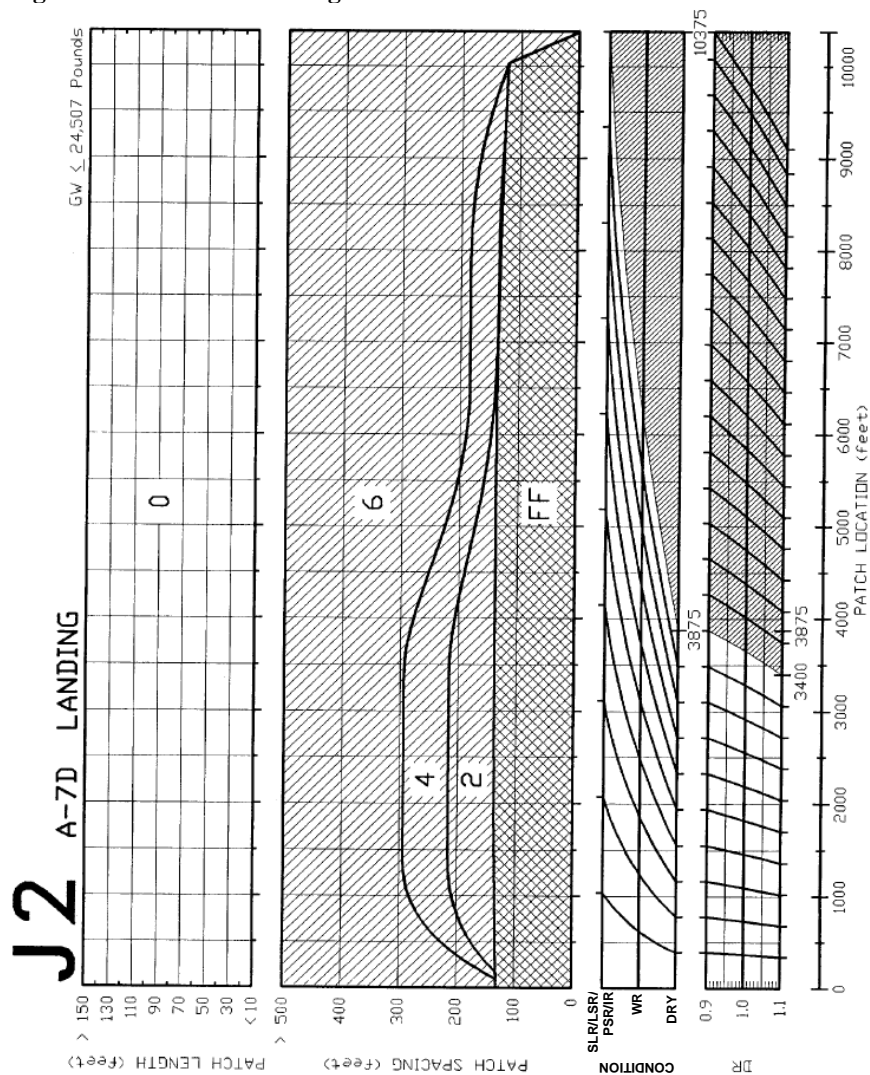
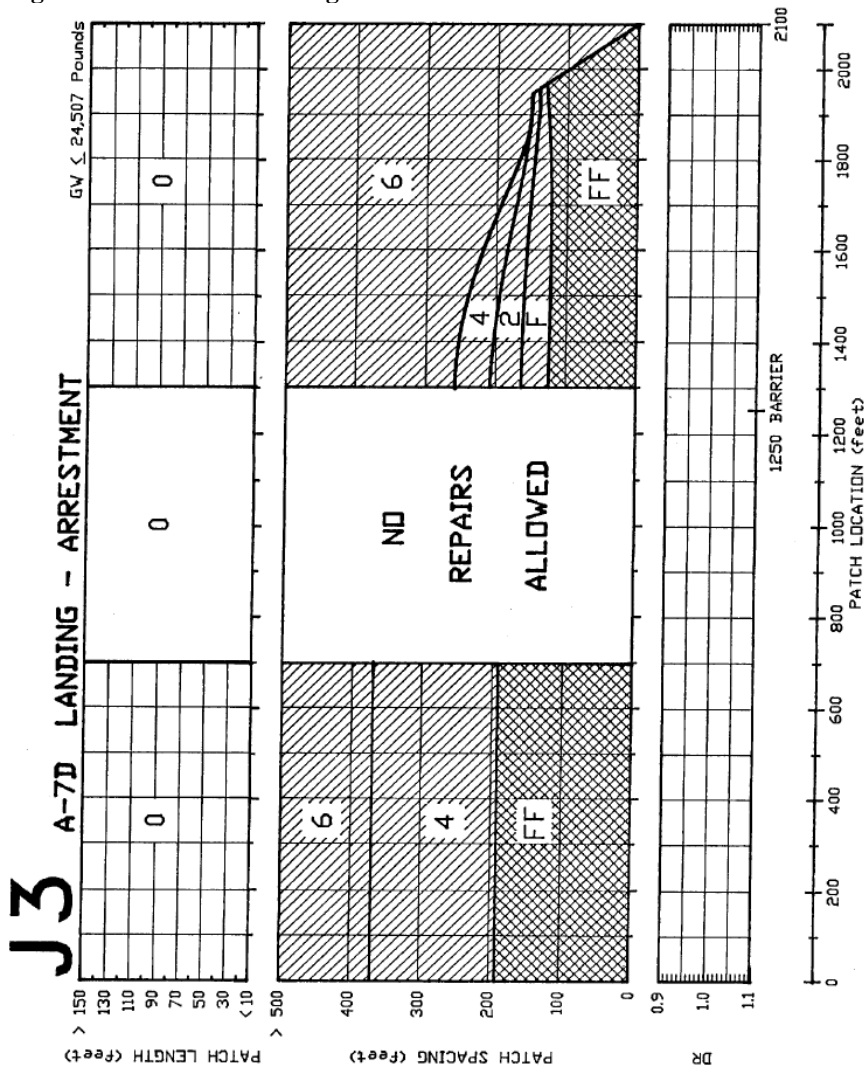


Figure A3.52. A-7 D Landing – Arrestment.



NOTE: This chart reflects a 850 ft maximum runout for an arrestment landing. Current maximum runout is 1,200 ft, which requires adding an additional 350 ft to arrestment landing operational length.

Figure A3.53. A-7 D Evacuation.

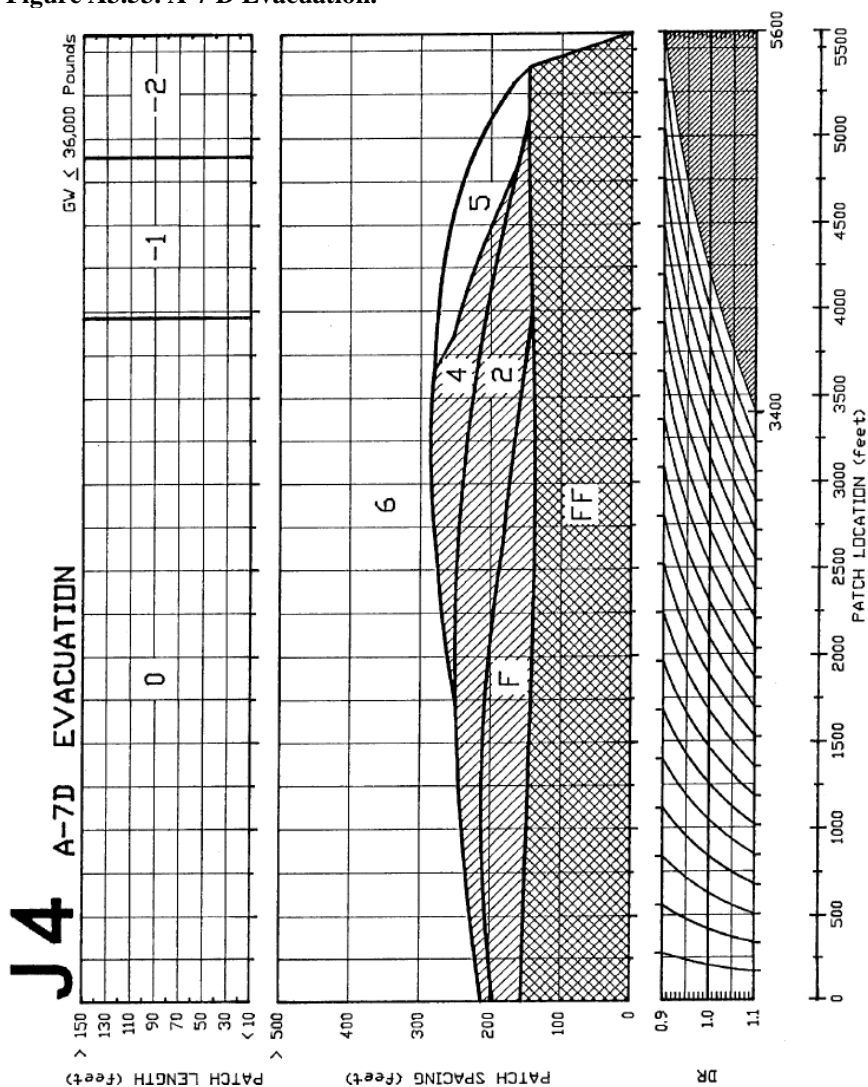


Figure A3.54. A-10 A Takeoff.

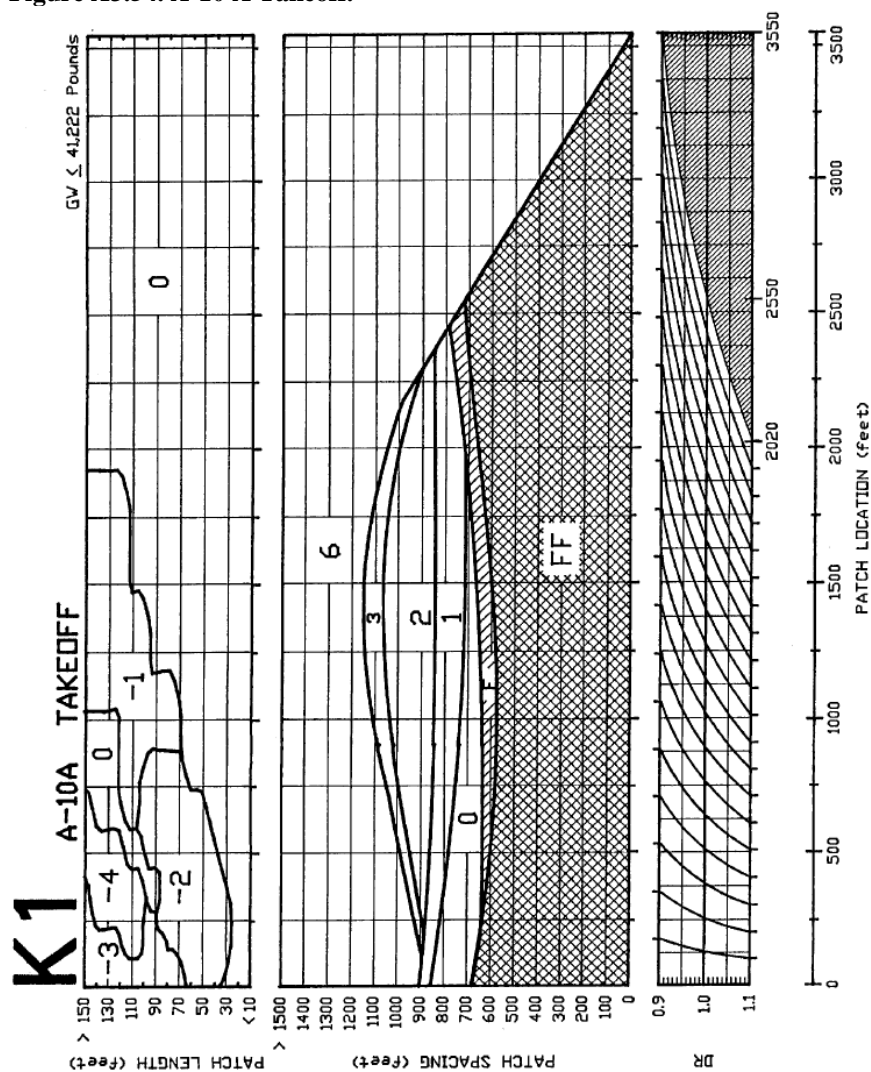


Figure A3.55. A-10 A Landing.

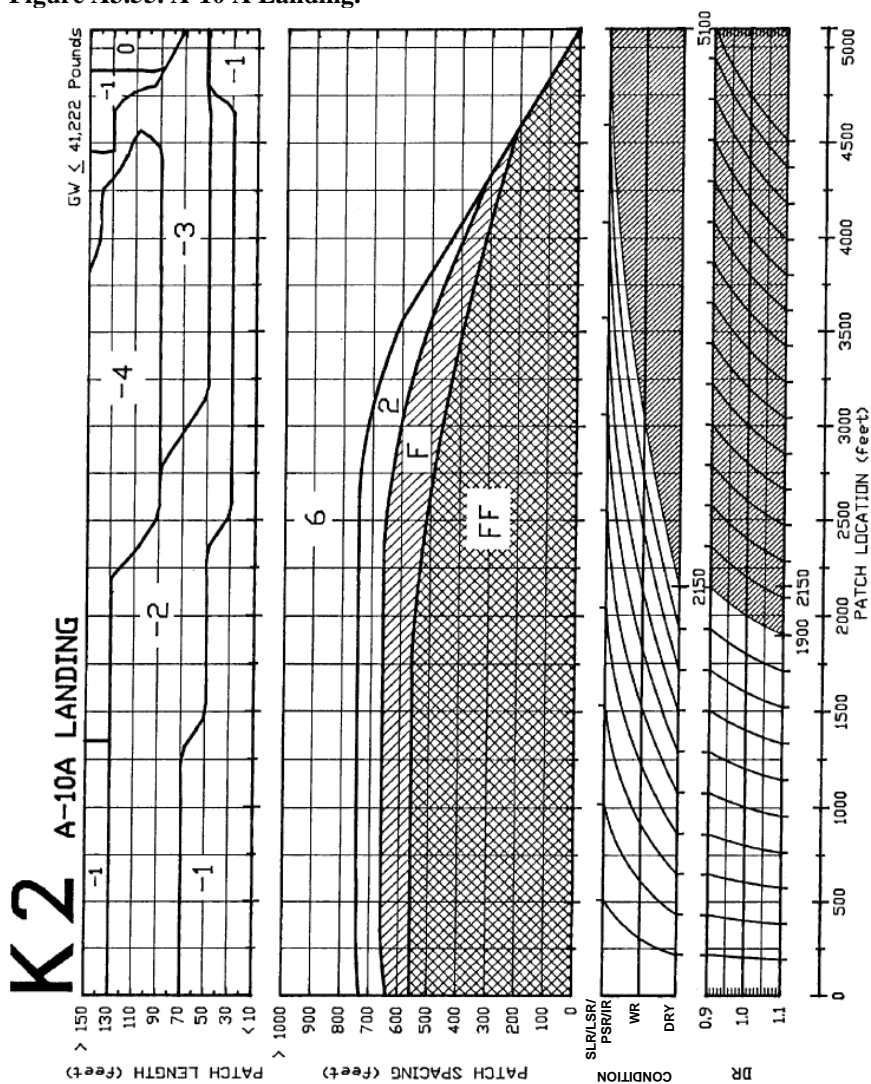


Figure A3.56. KC-135 R Heavy Weight Takeoff.

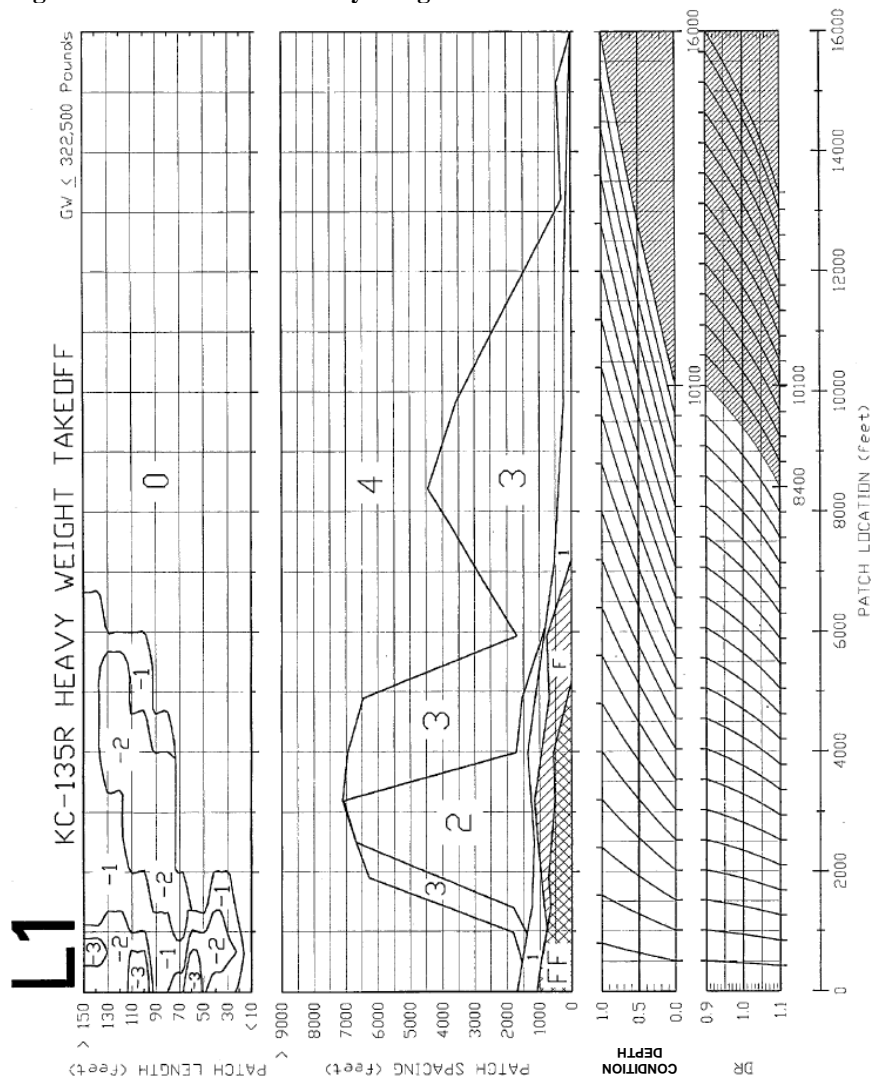


Figure A3.57. KC-135 R Nominal Weight Takeoff.

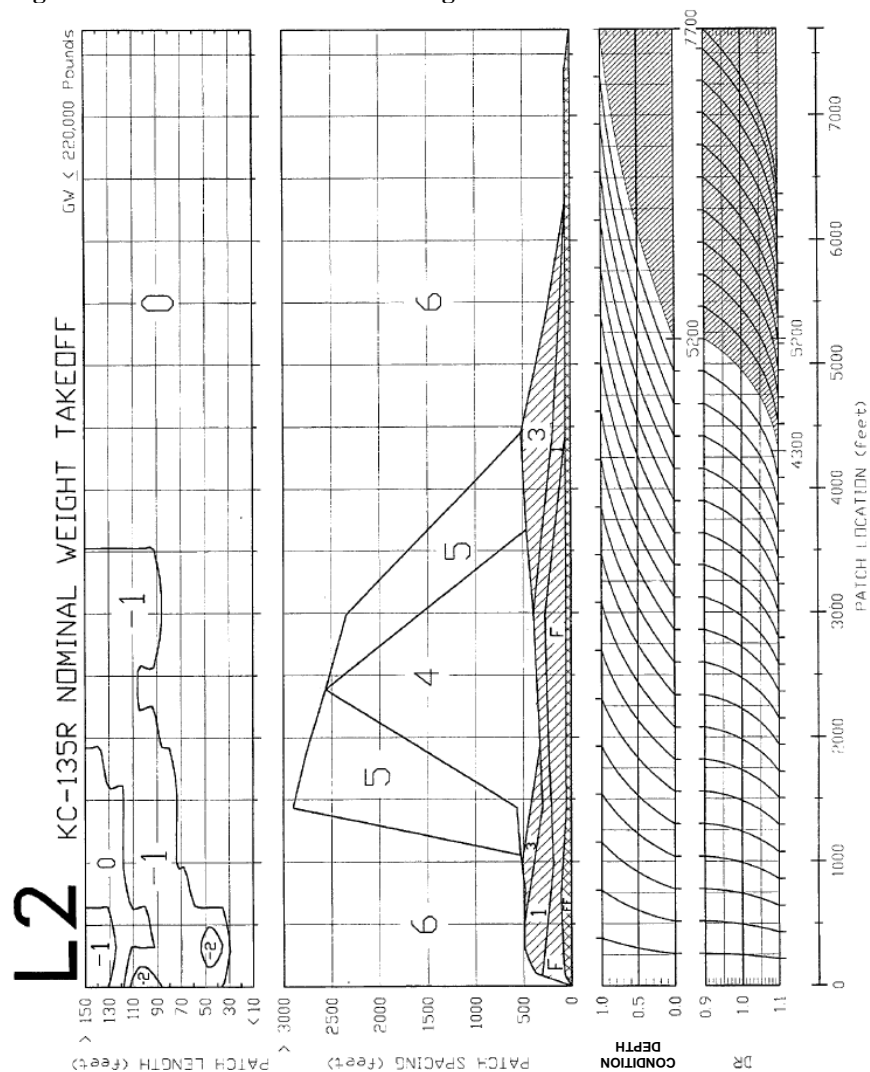


Figure A3.58. KC-135 R Landing.

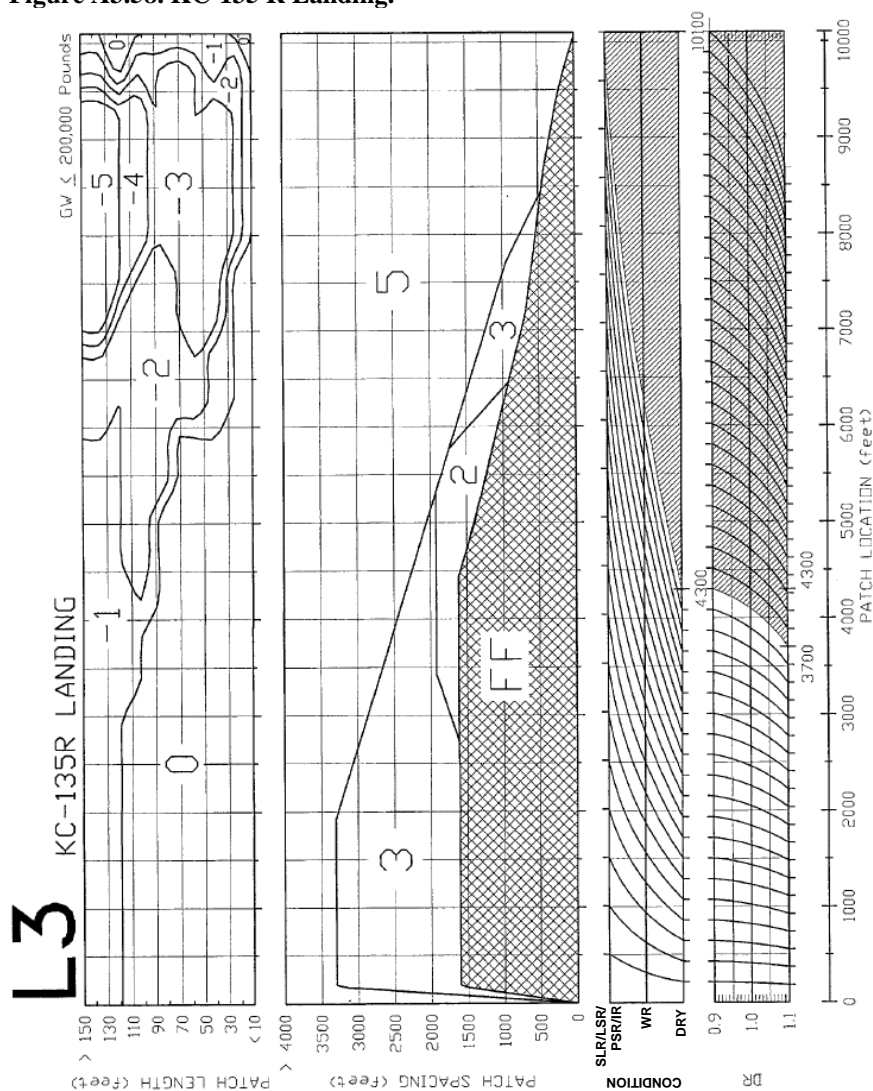


Figure A3.59. KC-10 Heavy Weight Takeoff.

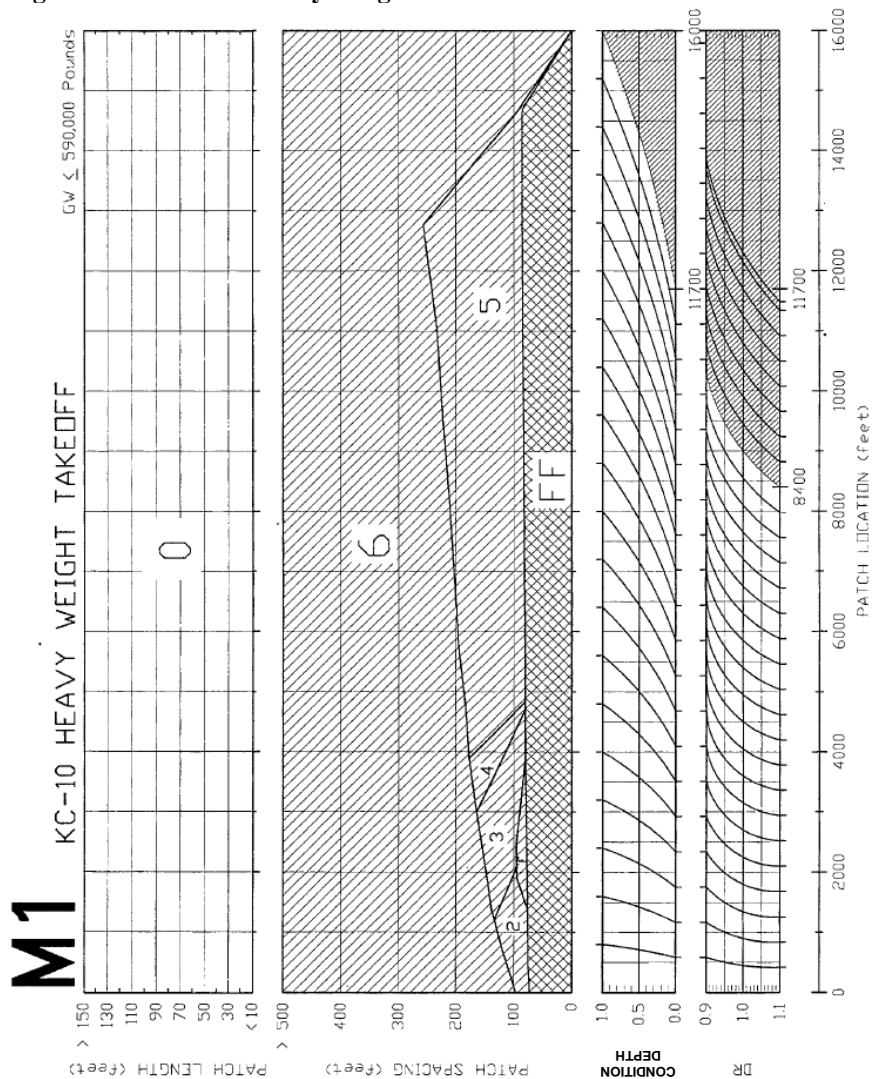


Figure A3.60. KC-10 Nominal Weight Takeoff.

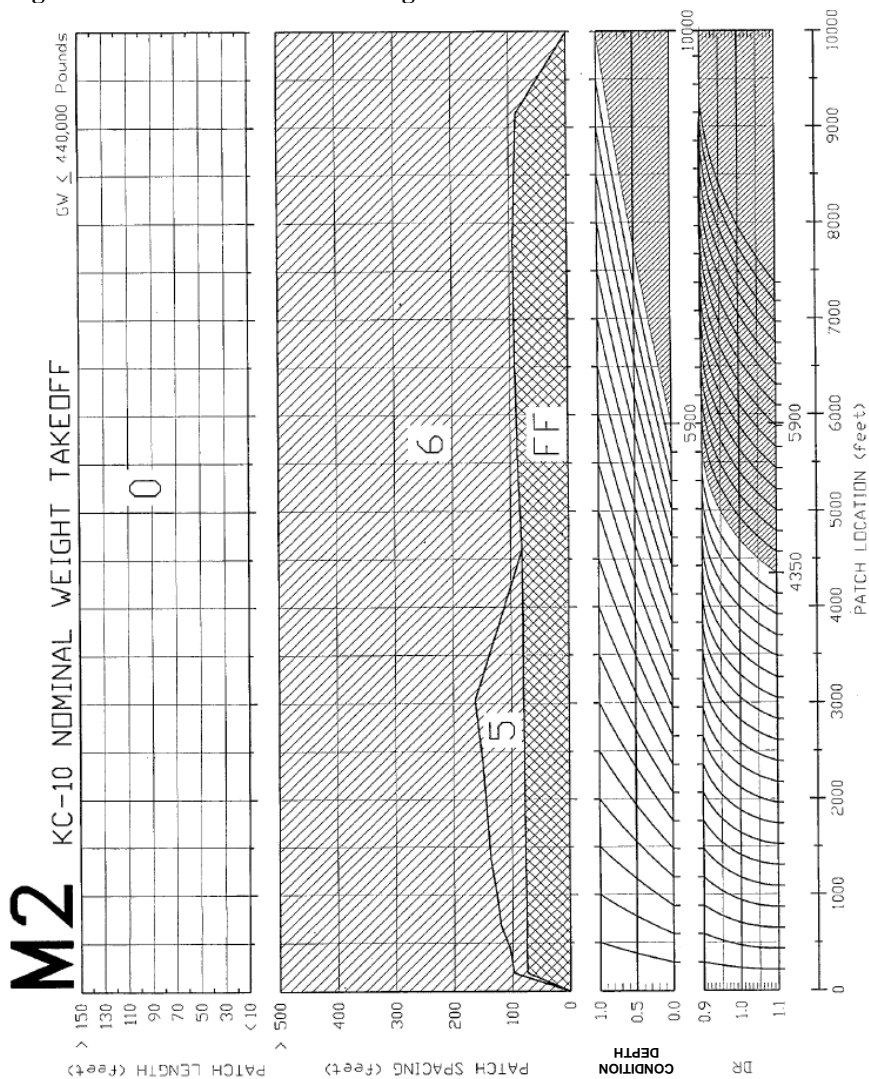


Figure A3.61. KC-10 Landing.

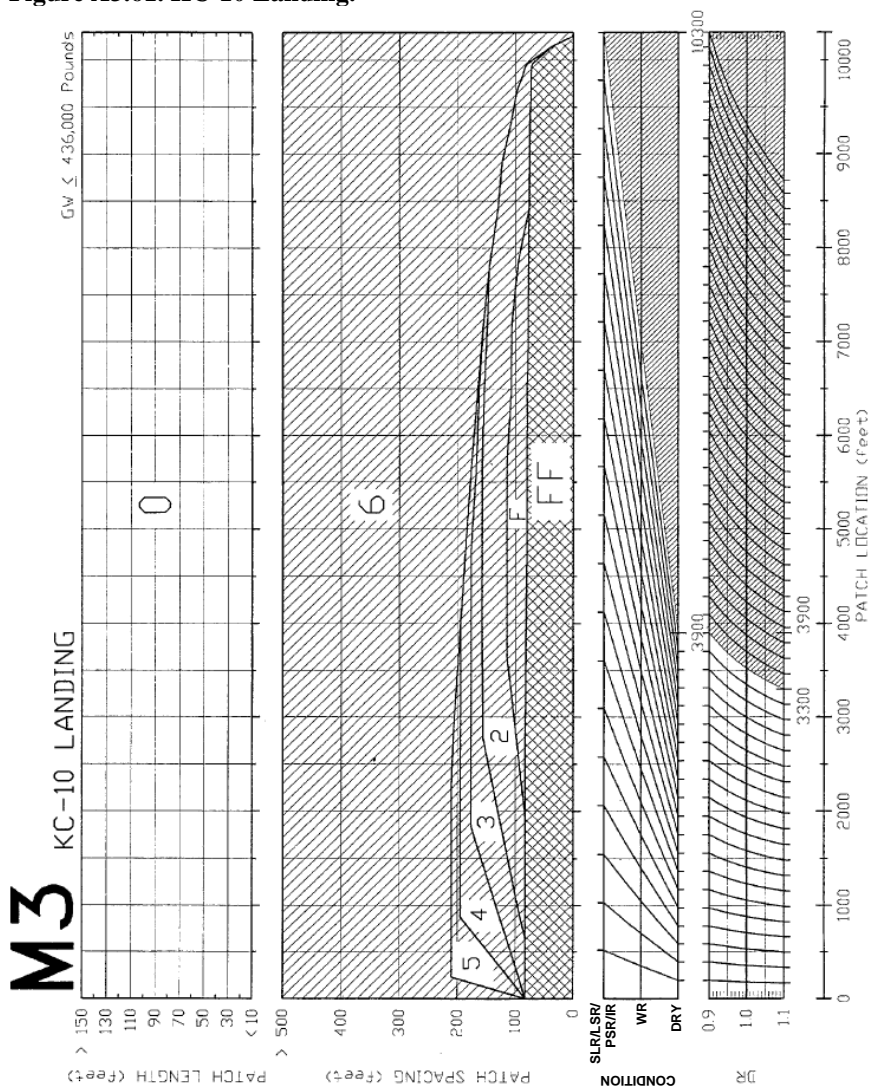


Figure A3.62. C-9 Heavy Weight Takeoff.

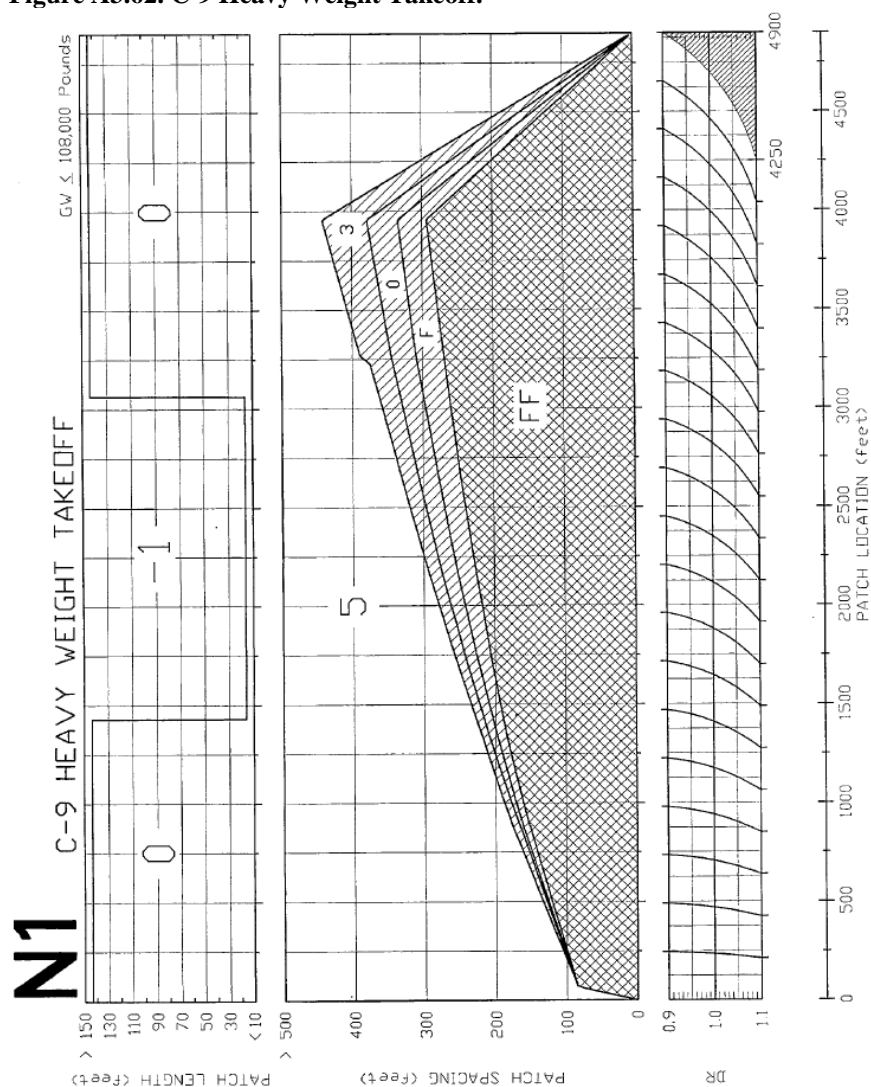


Figure A3.63. C-9 Nominal Weight Takeoff.

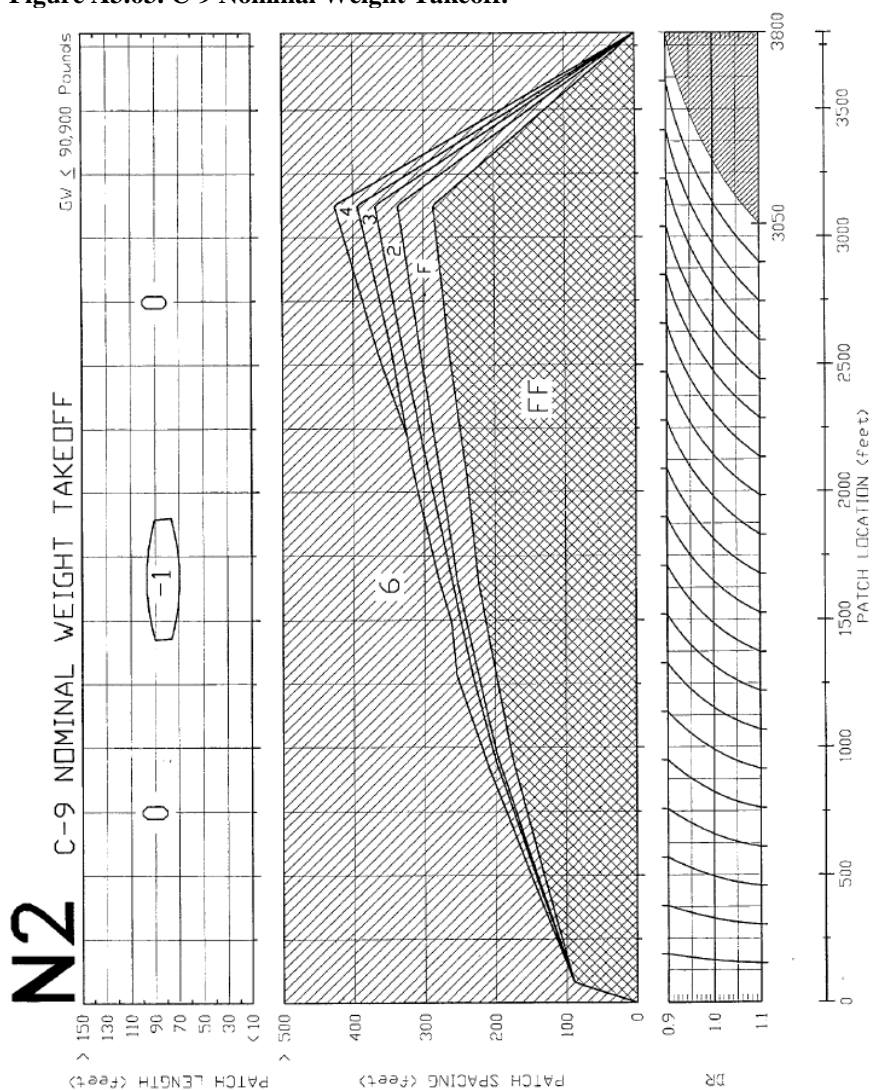
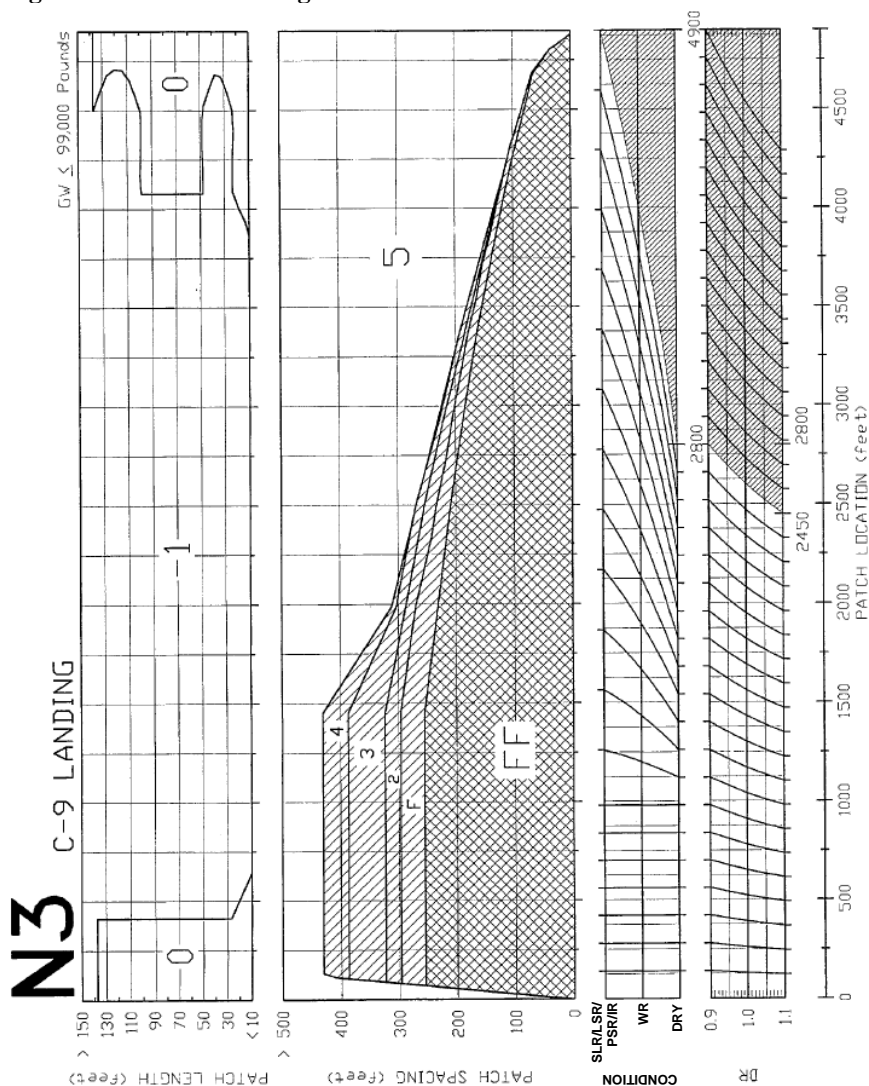


Figure A3.64. C-9 Landing.



01

DISCLAIMER

REPAIR QUALITY CRITERIA CHARTS FOR THE C-17

NOTE

The data used to create the following C-17 Repair Quality Criteria charts were developed using information provided by the manufacturer and were not based on instrumented taxi tests conducted by ASC/WMO.

Figure A3.65. Disclaimer.

Figure A3.66. C-17 Heavy Weight Takeoff.

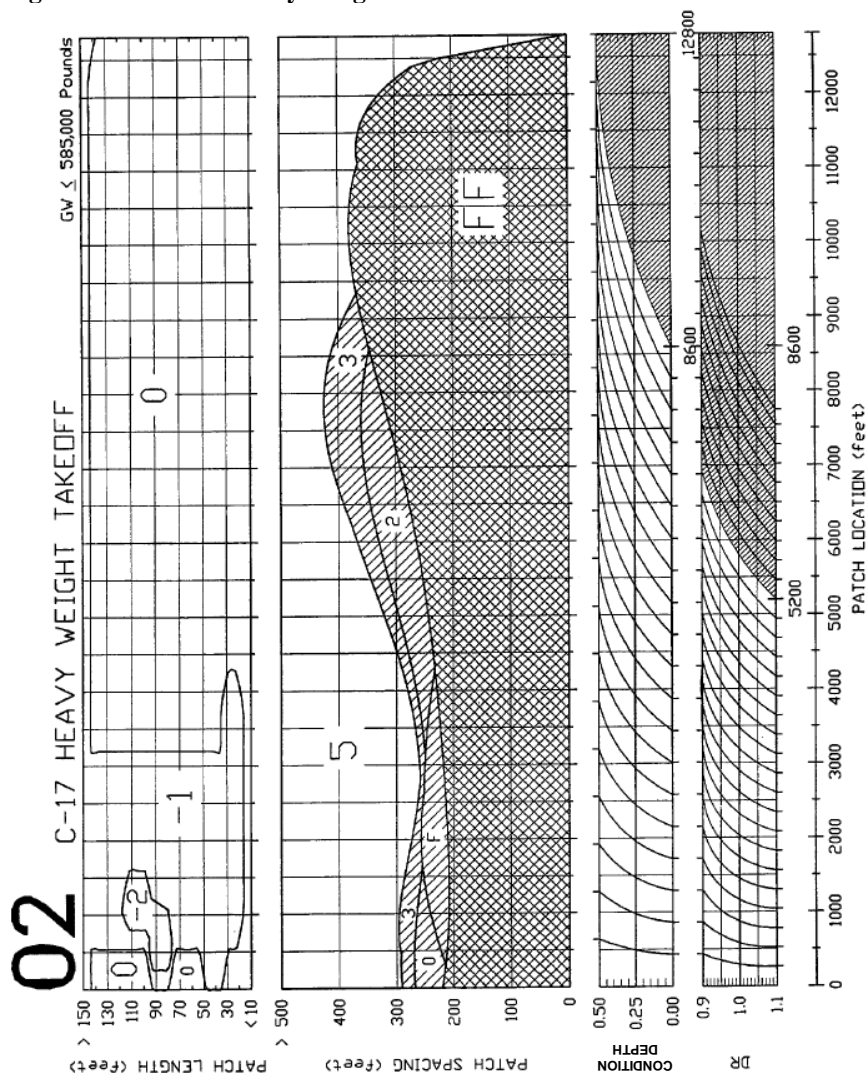


Figure A3.67. C-17 Nominal Weight Takeoff.

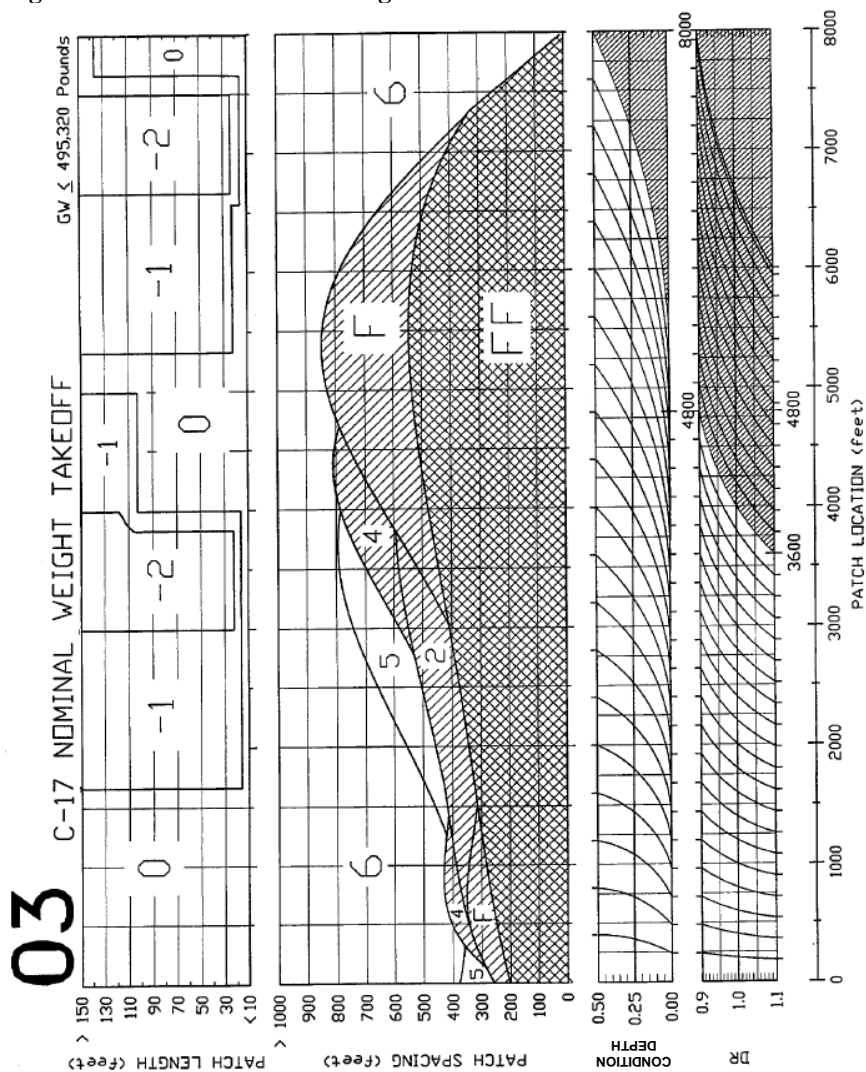


Figure A3.68. C-17 Heavy Weight Landing – Steep Approach.

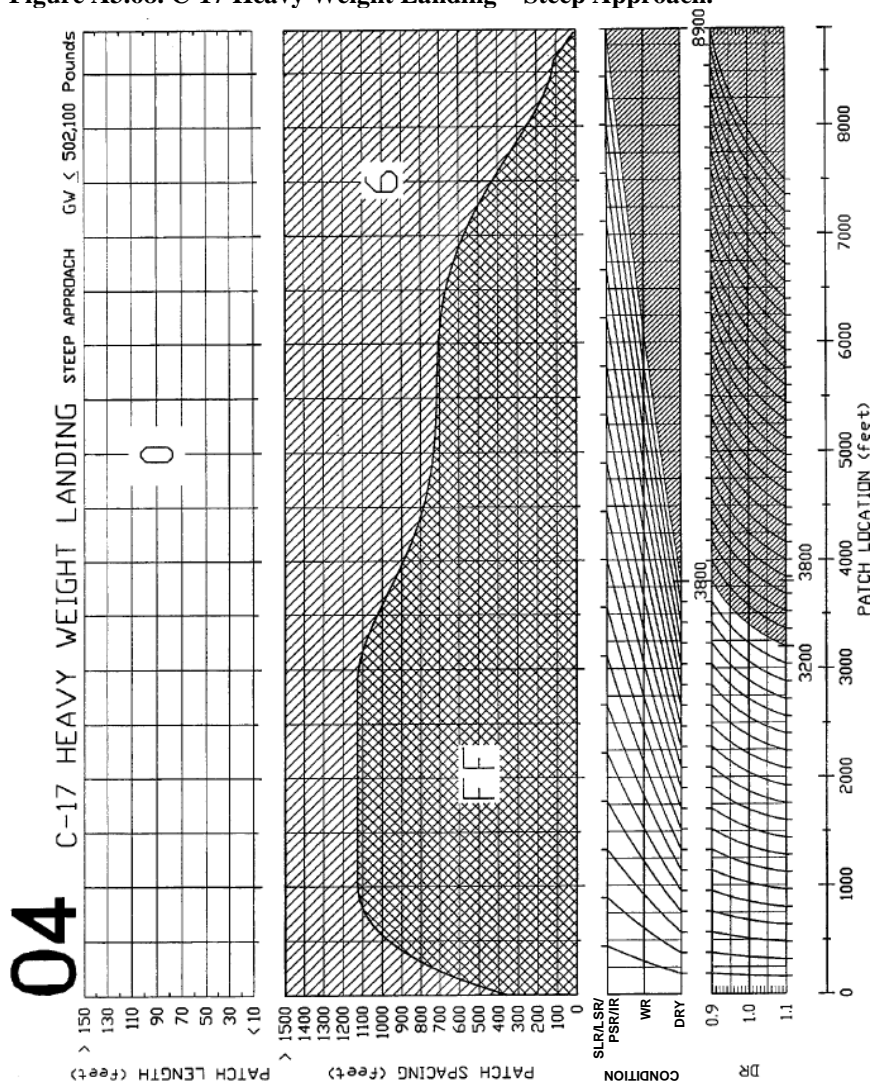


Figure A3.69. C-17 Heavy Weight Landing – Normal Approach.

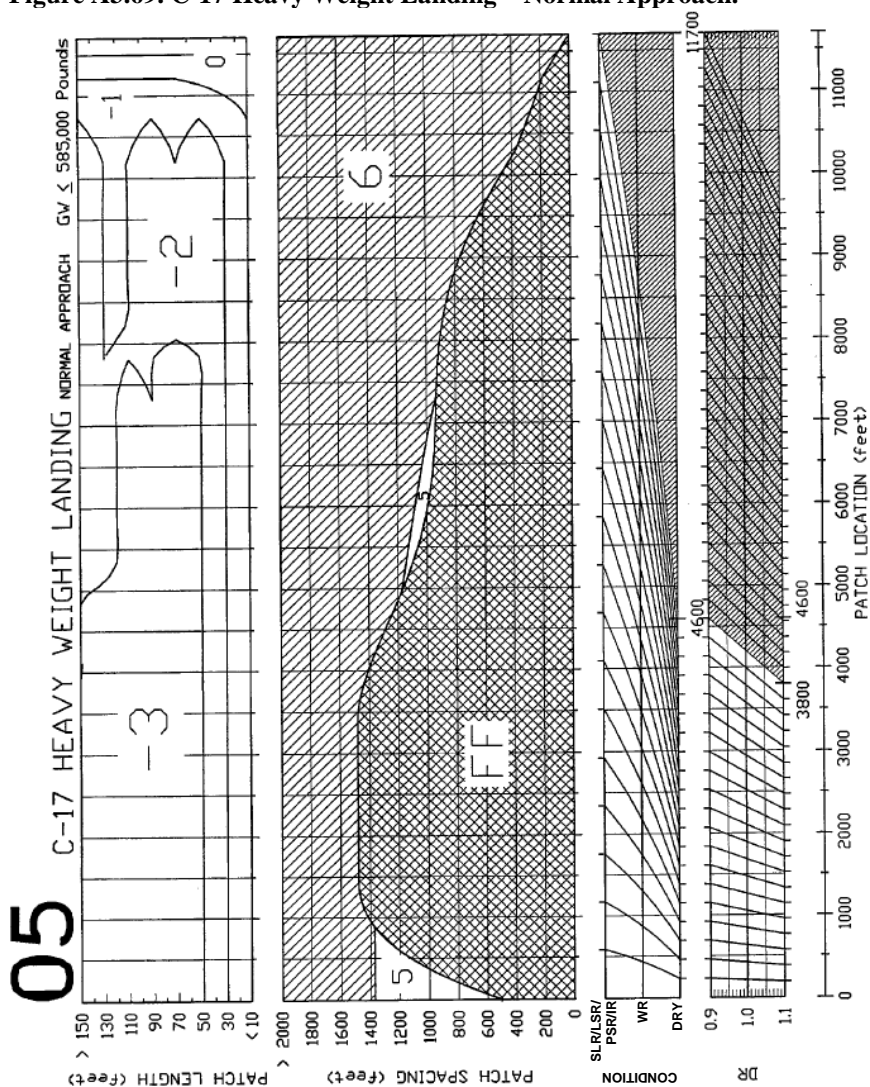


Figure A3.70. C-17 Nominal Weight Landing – Normal Approach.

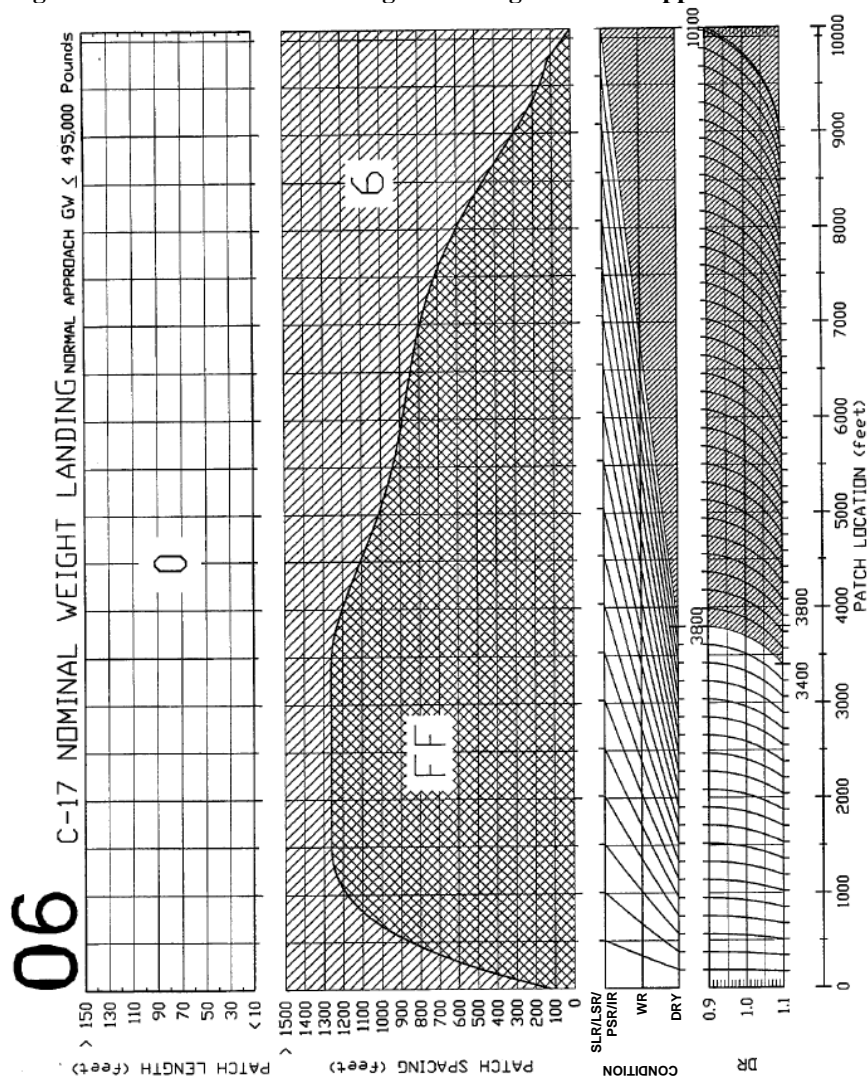


Figure A3.71. F-117 Heavy Weight Takeoff.

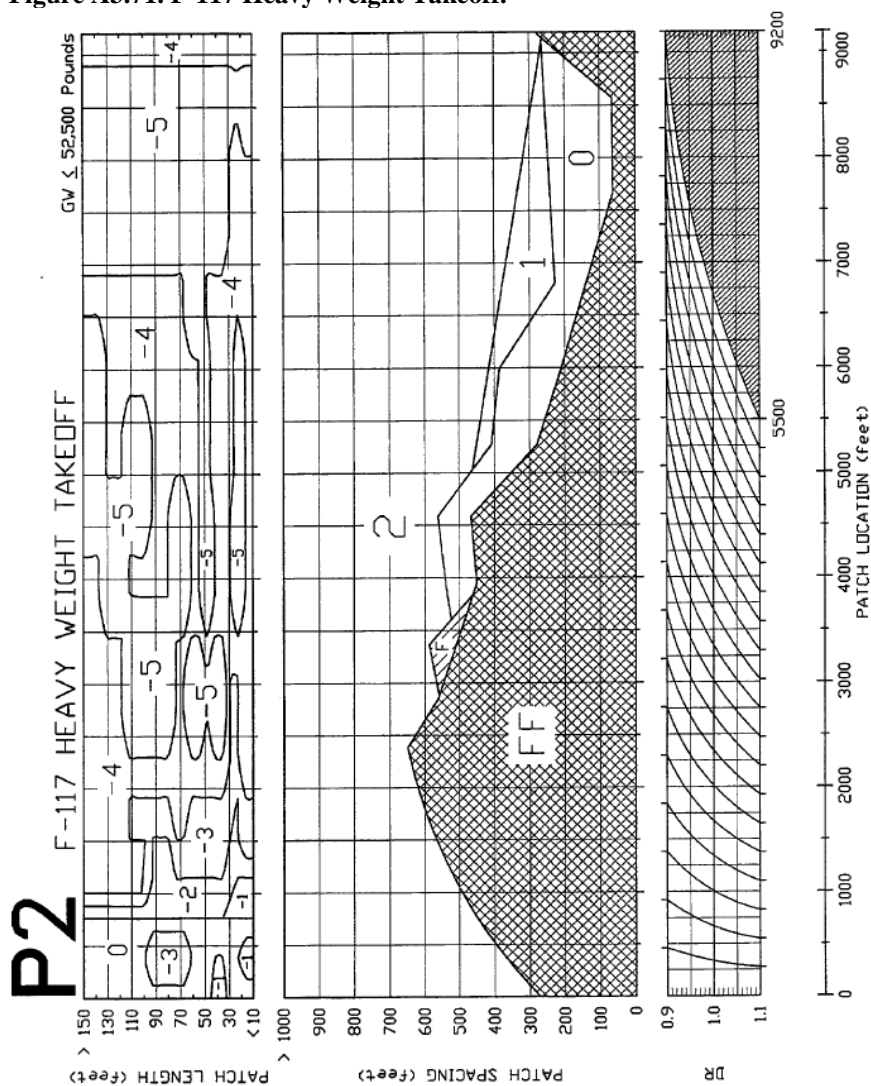


Figure A3.72. Nominal Weight Takeoff.

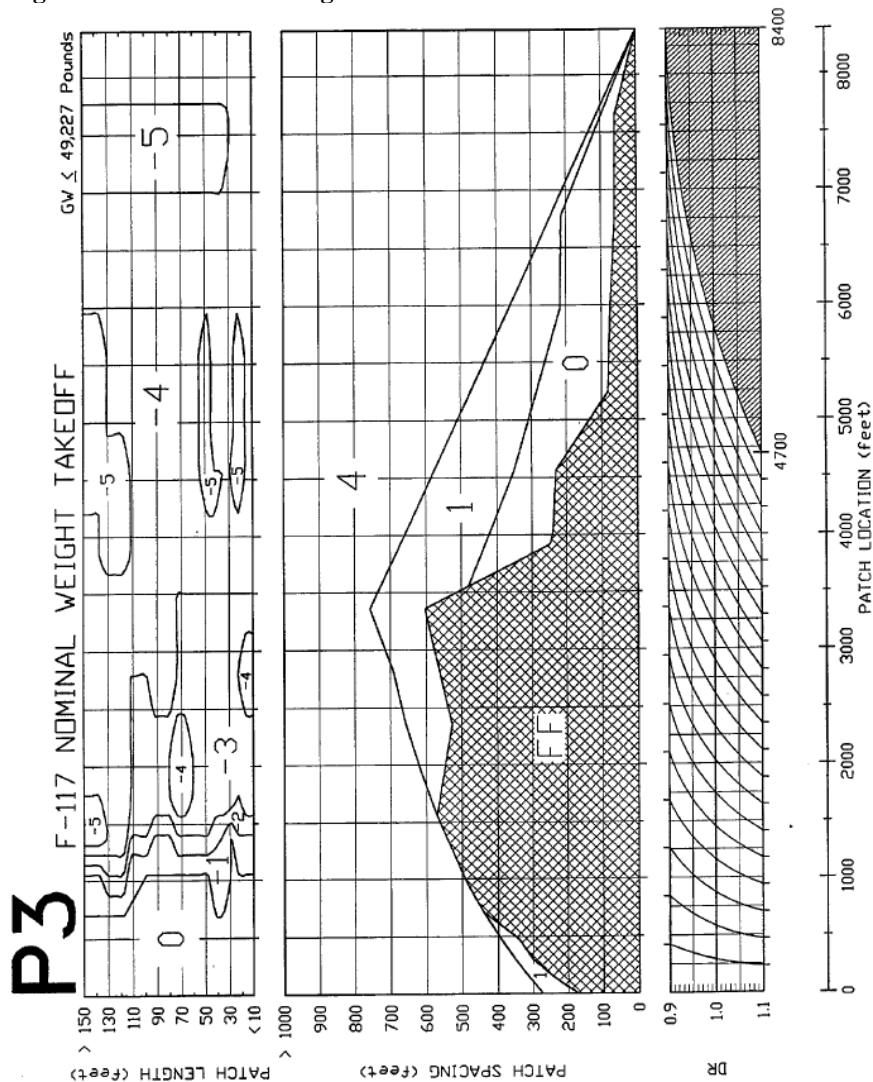


Figure A3.73. F-117 Light Weight Takeoff.

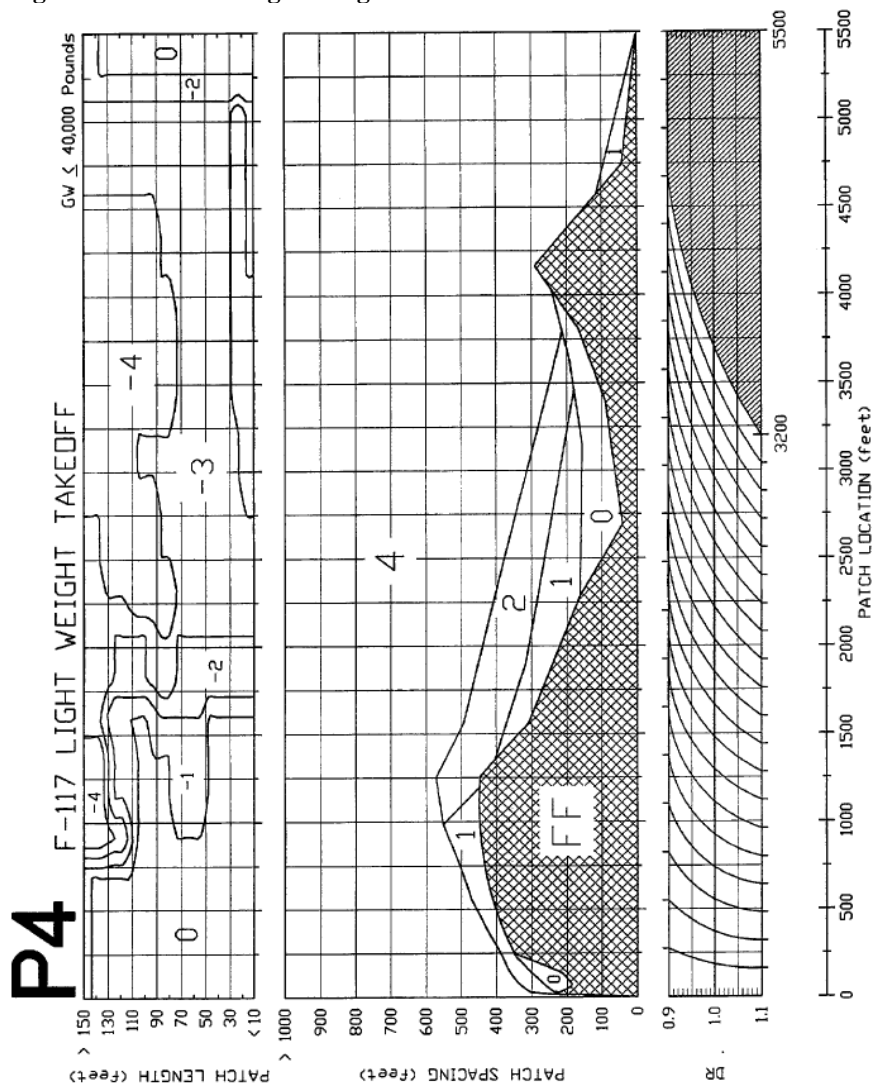


Figure A3.74. F-117 Nominal Weight Landing – No Chute.

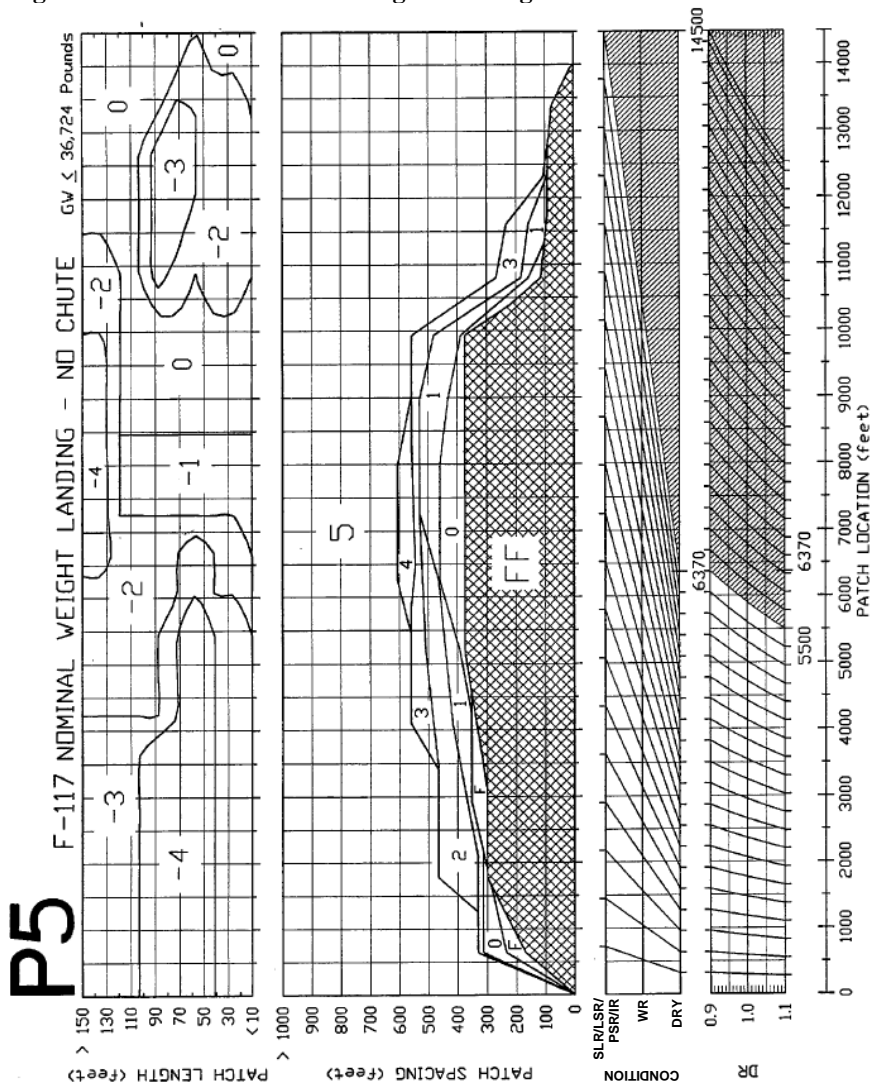


Figure A3.75. F-117 Nominal Weight Landing – Chute.

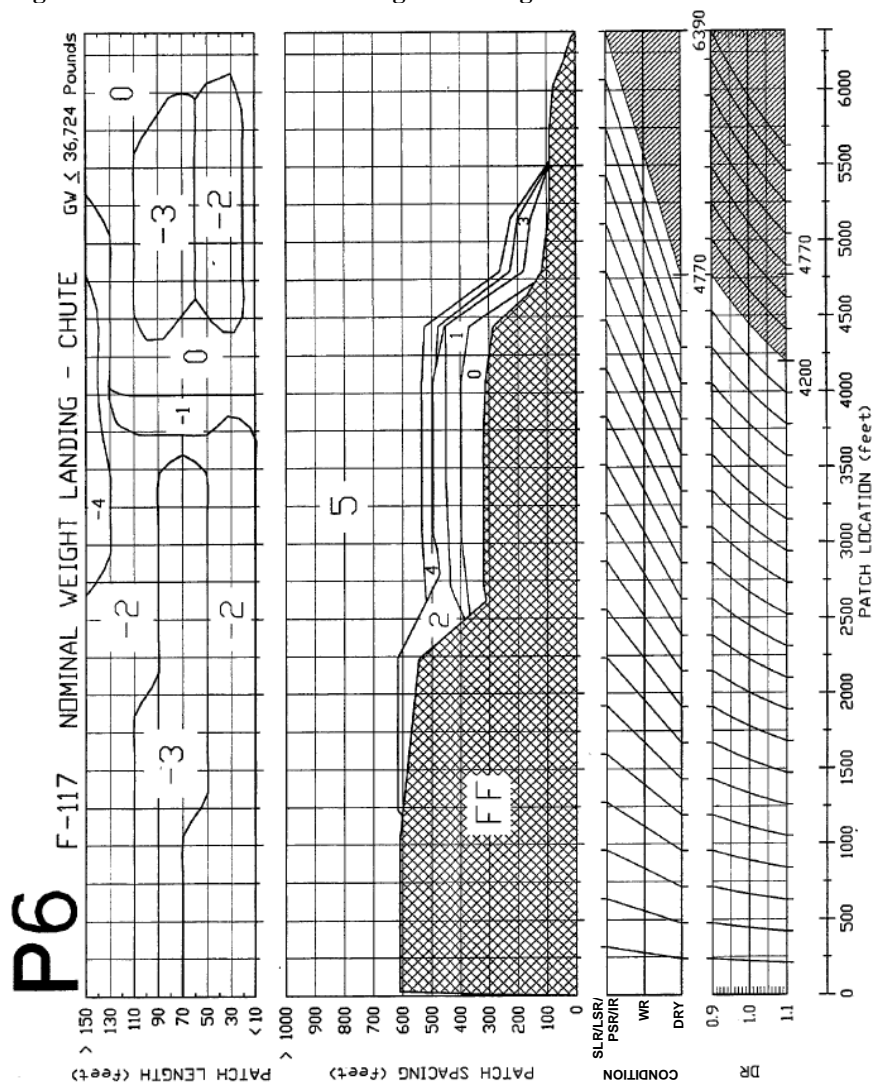


Figure A3.76. F-117 Heavy Weight Landing – No Chute.

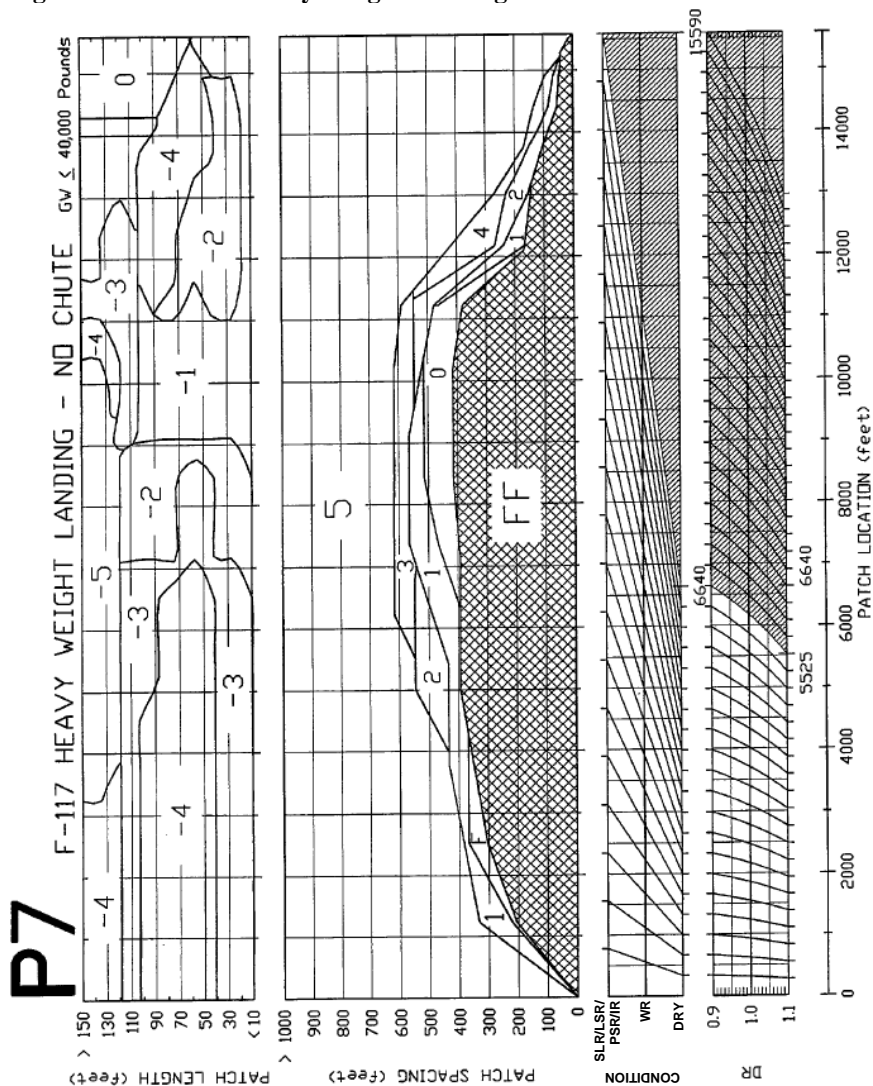


Figure A3.77. f-117 Heavy Weight Landing – Chute.

