NATO STANDARD

AATMP-03

AIRFIELD DAMAGE REPAIR (ADR) CAPABILITY

Edition A Version 1

MAY 2016

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED AIR TRAFFIC MANAGEMENT PUBLICATION

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NATO LETTER OF PROMULGATION

30 May 2016

1. The enclosed Allied Air Traffic Management Publication AATMP-03, Edition A, Version 1, AIRFIELD DAMAGE REPAIR (ADR) CAPABILITY, has been approved by the nations in the AIR TRAFFIC MANAGEMENT – COMMUNICATIONS, NAVIGATION AND SURVEILLENCE ADVISORY GROUP, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 2929.

2. AATMP-03, Edition A, Version1, is effective upon receipt.

3.

4. This publication shall be handled in accordance with C-M(2002)60.

Edvardas MAŽEIKIS
Major General, LTUAF
Director, NATO Standardization Office

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Documents Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[Nation]	[Detail of Reservation]
POL	Poland reserves the right to determine its own national indicators describing the range of restoring operational capabilities of airfield surfaces.
Note: The reservations listed on this page include only those that were recorded at time of promulgation and may not be complete. Refer to the NATO Standardization Documents Database for the complete list of existing reservations.	

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CHAPTER 1 OVERVIEW

1.1. PURPOSE

ADR is a multifaceted undertaking involving a wide range of activities from EOD to crater repair. This document provides a method for determining the required ADR capability based on key factors surrounding any given mission. It specifically focuses on Repair of Airfield Operating Surfaces (RAOS).

1.2. COMPONENTS OF ADR

ADR includes all efforts to establish, sustain or recover an airfield surface for a full spectrum of operations including humanitarian and NRF for both kinetic and non-kinetic damage. ADR encompasses the following:

a. Damage Assessment;

b. Explosive Ordnance Reconnaissance (EOR): When necessary, damage assessment will include EOR;

c. Explosive Ordnance Disposal (EOD): As required;

d. Repair of Airfield Operating Surfaces (RAOS): Repair of runways, taxiways, and parking aprons;

e. Repair of Essential Services and Facilities (RESF): This encompasses services (e.g. CFR) and facilities (e.g. airfield lighting, arresting systems, etc.);

f. Airfield Certification: Certification by the airfield manager (or other appointed authority), with assistance from subject matter experts (e.g. engineer, communications officer, etc.), that the airfield is operational; and

g. Airfield Monitoring and Maintaining: Once airfield operating surfaces, essential services, and facilities are repaired and the airfield certified operational, they must be monitored and maintained. This can be especially important for expedient repairs which may be more prone to degradation.

1.3. DAMAGE MODELING

1.3.1. General

The requirements for a RAOS capability are driven by damage, both kinetic and non-kinetic. Damage encompasses existing damage and potential future damage. Conditions and situations may change throughout an operation, driving the need to re-calculate the required capability (e.g. if a large-scale repair effort is made prior to the initial start of operations, the required follow-on repair capability might be small).

1.3.2. Diagrams

Before addressing the details of determining capability, the following six figures help explain the interactions between damage and repair, and set up a conceptual framework on which the methodology in this STANAG is based. They illustrate time versus cumulative damage for:

- existing damage
- future damage
- the summation of existing and future damage
- repair capability
- overall view of damage versus repair capability, and the net result
- overall activation and sustainment stages of a mission

a. Existing Damage. This chart shows how existing damage would look versus time if no repairs were made–e.g. the damage would simply remain.

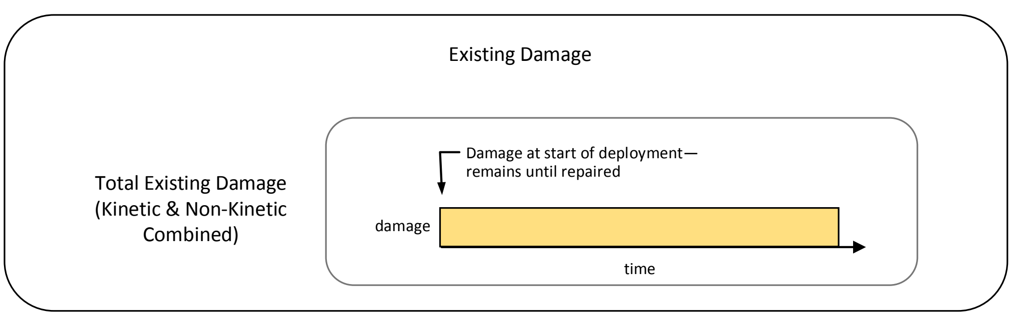

Figure 1-1. Existing Damage

b. Future Damage. This chart shows how cumulative future damage would look versus time if no repairs were made–i.e. damage would continue to accumulate. Note that the cumulative Kinetic Future Damage abruptly increases with each attack.

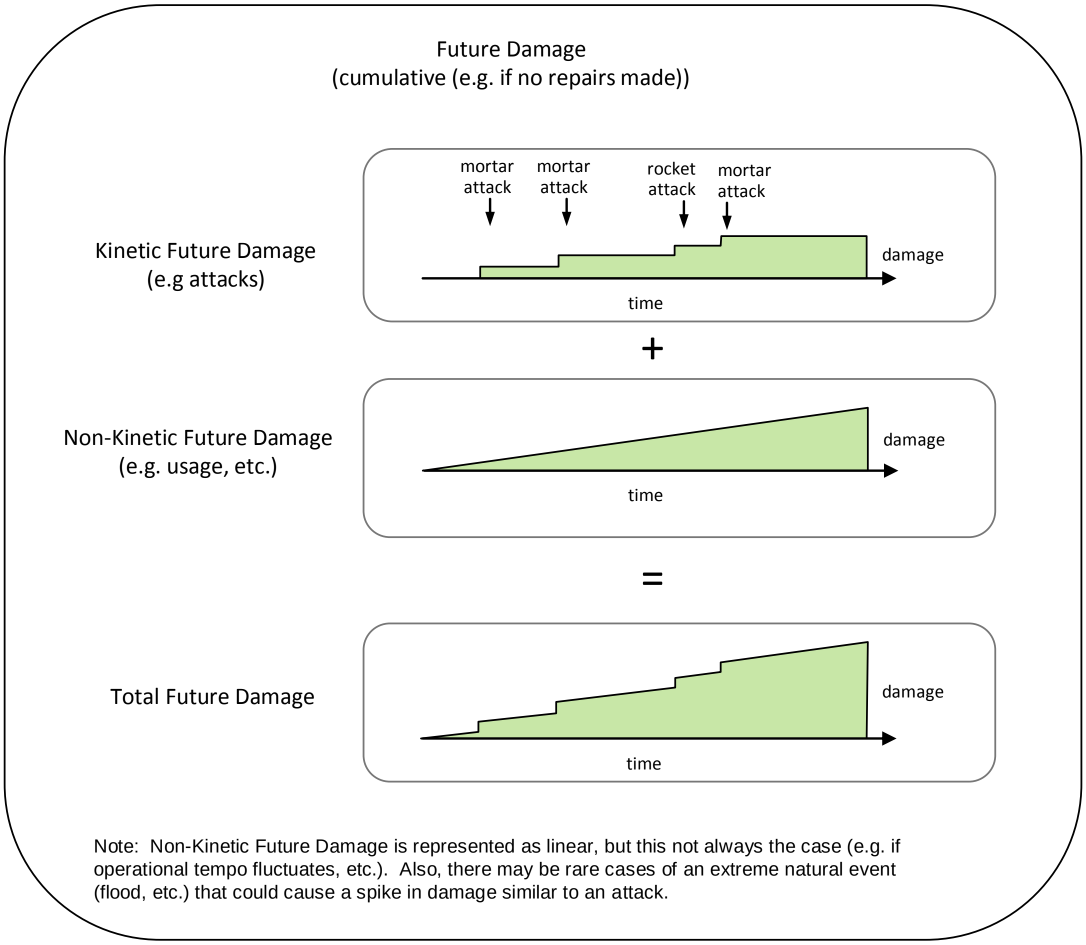

Figure 1-2. Future Damage

c. Total Damage. This chart shows how the combined existing and future damage would look cumulatively if no repairs were made. Notice the damage starts at the level of existing damage, than increases as future damage (both kinetic and non-kinetic) accumulates.

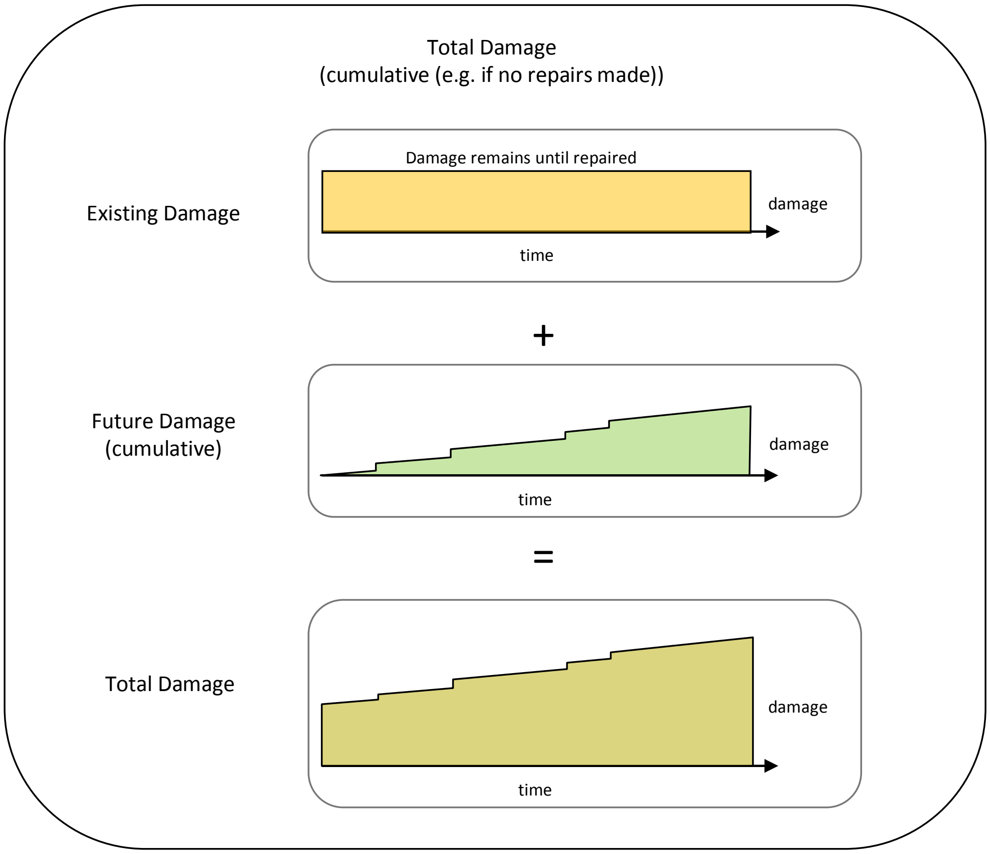

Figure 1-3. Total Damage

d. Repair Capability. This chart shows the cumulative amount of damage a given team can repair theoretically over time if they had full access to the airfield. For the sake of simplicity, it is assumed to be linear–that is, each day, a set amount of damage can be repaired. As noted in the chart, the slope of the line depends on the repair capability of the team/ organization–the greater the capability, the steeper the slope.

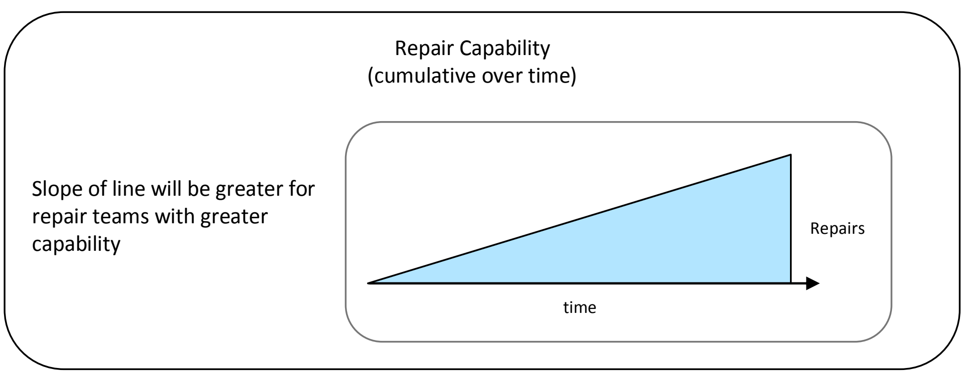

Figure 1-4. Repair Capability

e. Overall View. This chart shows the result when the repair efforts are applied to the cumulative total damage ("subtracting" the repairs from the damage). If the repair capability is sufficient to out pace future damage accumulation, damage to the airfield decreases. Notice the abrupt changes in the result due to attacks.

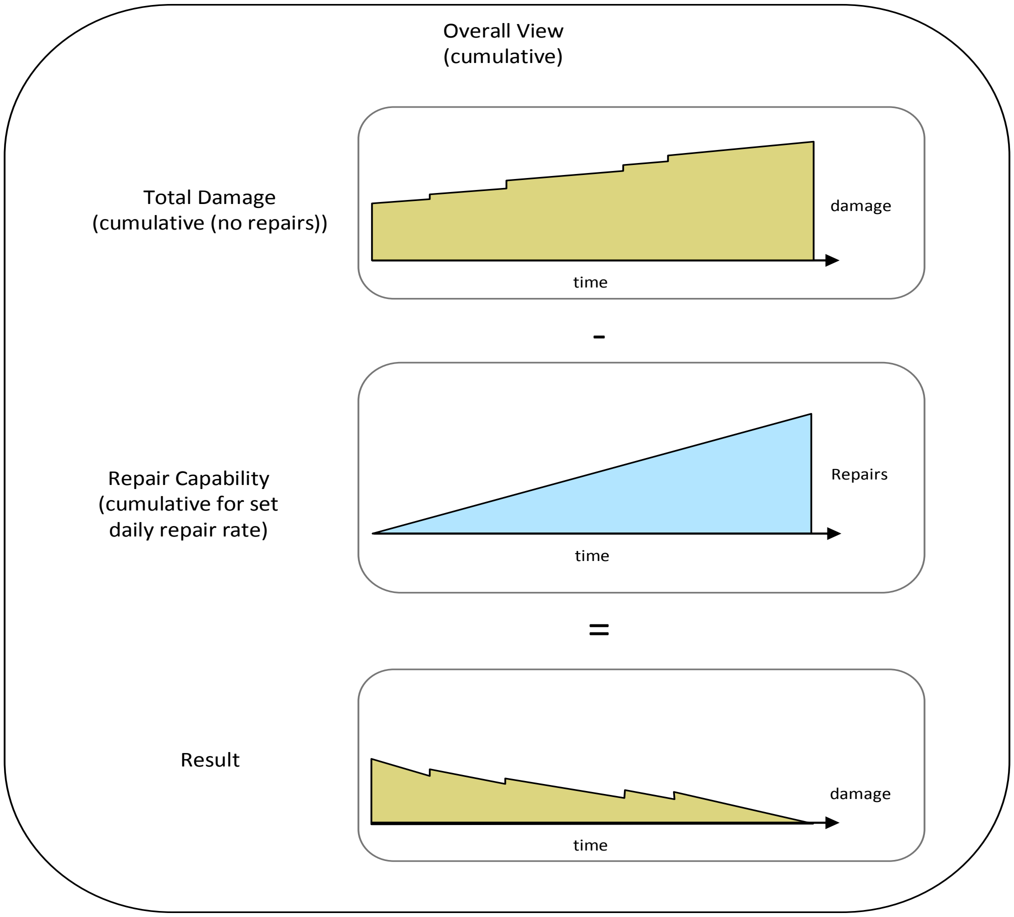

Figure 1-5. Overall View

f. Activation and Sustainment Example. This chart shows an example of overall damage to the airfield during activation and sustainment depending on how frequently repairs can be made.

(1) During the activation, it is assumed repairs are made almost daily, hence the daily decrease in damage. During that time, both the existing damage and the accumulating future damage (whether due to attacks or sorties during activation) are repaired.

(2) The figure also shows two example sustainment scenarios. The first shows repairs every week to ten days. The second shows

letting damage accumulate for several weeks, then having one week of access to the airfield to repair it.

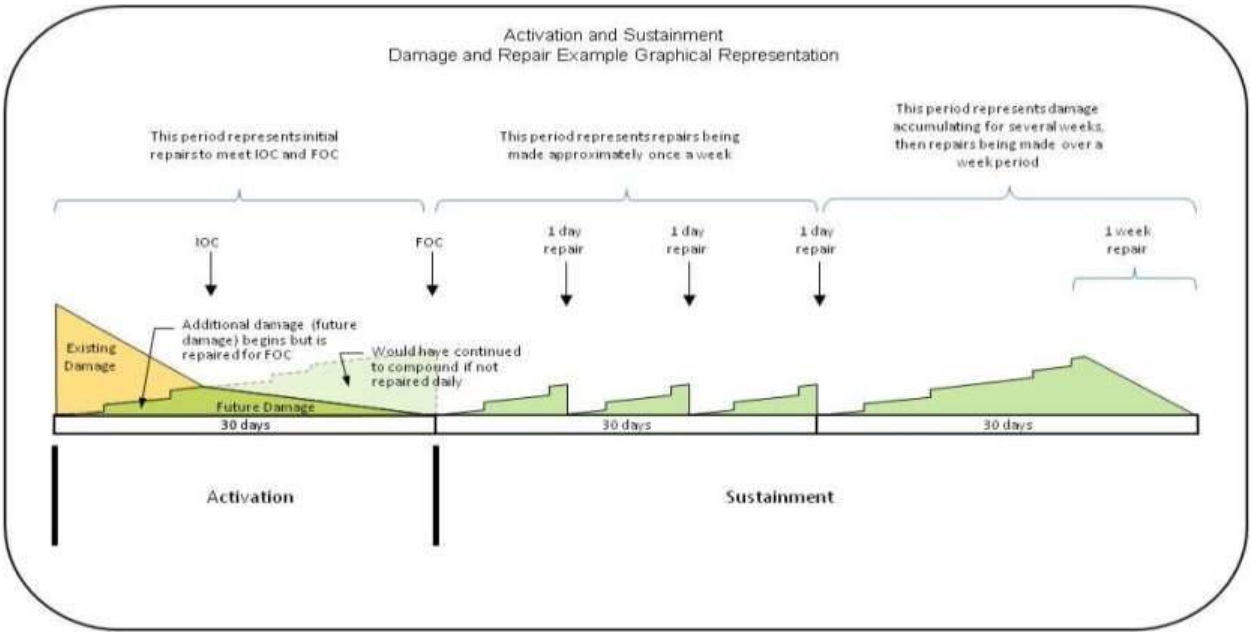

Figure 1-6. Activation and Sustainment

1.4. TYPES OF DAMAGE

1.4.1. Kinetic

Kinetic damage, in general, is damage caused by weapons.

a. Spall: A spall does not penetrate through the pavement surface to the underlying layers. Spalls may be up to 1.52 m (5 ft) in diameter.

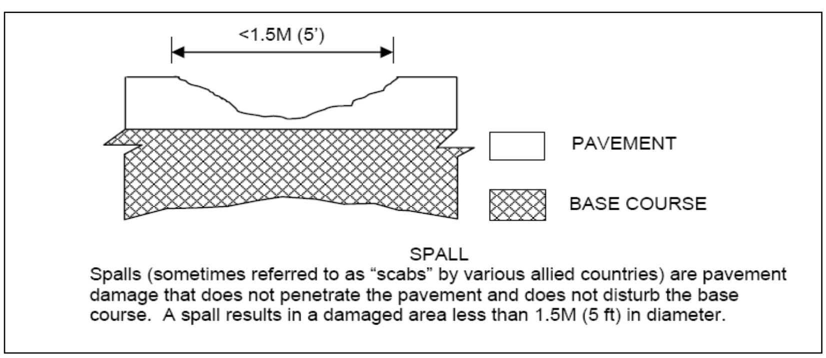

Figure 1-7. Spall

b. Crater: Craters represent much more severe damage than spalls. The damage penetrates through the pavement surface into the underlying base and subgrade soil, uplifting the surrounding pavement and ejecting soil, rock, and pavement debris around the impact area.

Type and size:

- <u>Camouflet</u>: Craters with relatively small apparent diameters but deep penetration and subsurface voids. Penetration-type projectiles with time-delay fuses normally cause camouflets.

- <u>Small Crater</u>: Small craters are considered to have a diameter less than 4.57 m (15 ft).

- <u>Large Crater</u>: Large craters are considered to have a diameter equal to or greater than 4.57 m (15 ft).

- <u>Uncleared UXO</u>: an Unexploded Ordnance that cannot be cleared should be considered as a crater, small or large depending on the type of ordnance and blast potential.

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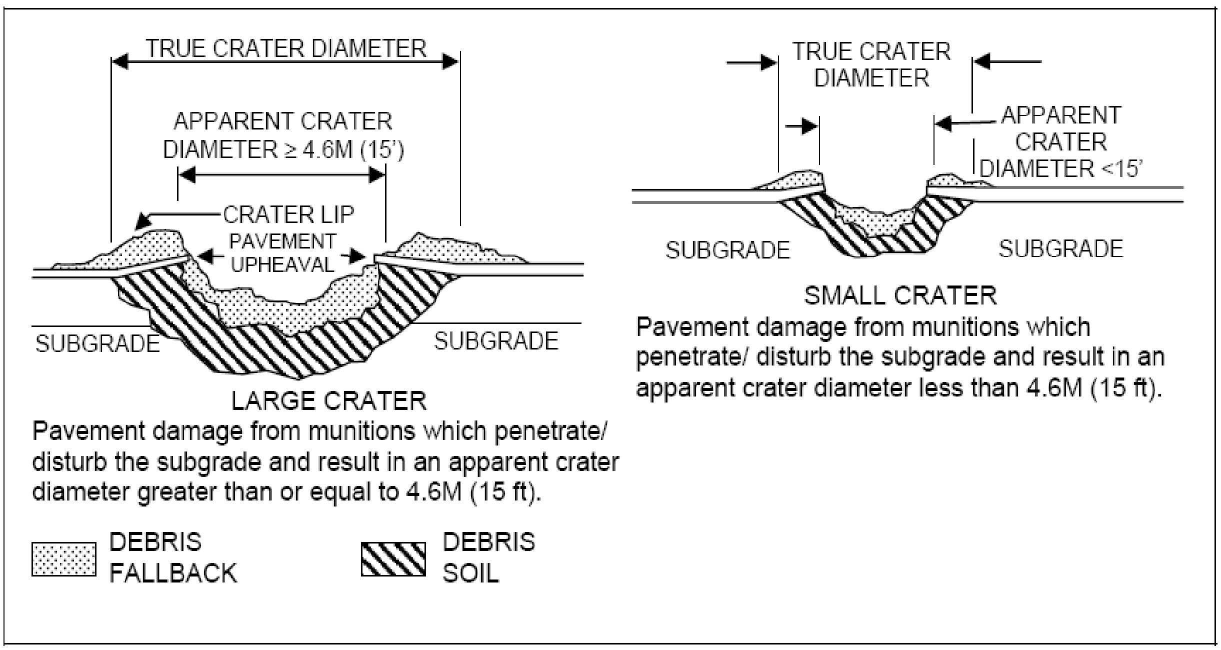

Figure 1-8. Crater

1.4.2. Non-Kinetic

Non-Kinetic: Damage is not only caused by kinetic weapons, but by age, use, and weather. In terms of the level of effort and type of equipment required to make repairs, non-kinetic damage can be separated into two categories: non-structural and structural.

a. Non-Structural Damage: The damage is confined to the surface layer of the pavement structure and although it can have FOD (Foreign Object Debris) potential, it typically does not reduce the load-bearing capacity of the pavement structure. Non-structural damage is generally caused by environmental conditions, age, or the use of poor quality materials. Permanent repair techniques, if required to reduce the risk of FOD, involve repair of the surface layer only and generally with the use of light equipment and minimal effort. Examples of non-structural damage in asphalt pavements include longitudinal and transverse cracking, joint reflection cracking and patching. Examples in concrete pavements include minor cracking, joint seal damage, joint and corner spalling, shrinkage cracking, and patching.

Normal maintenance generally involves repair of the following common non-structural distresses:

- Cracks: Cracks can exist in both concrete and asphalt pavement and can vary in width and length and FOD potential depending on severity; cracks may or may not penetrate the pavement surface layer.

- Joint Spalls: A joint spall is the breakdown of the slab edge along the joint in concrete pavement; it usually does not extend vertically through the slab but intersects the joint at an angle. A joint spall can vary in width and length and FOD potential depending on severity.

- Patches: A patch is an area where the original pavement has been removed and replaced by a filler material. A patch can exist in both concrete and asphalt pavement and can vary in size and FOD potential depending on severity.

b. Structural Damage: Although it manifests as surface deterioration, the damage extends below the pavement surface to the underlying base and subgrade soil. There is a loss of strength in the entire pavement structure which may result in a reduction in loading capacity and/or ability to withstand repeated load without significant degradation. Structural damage is generally caused by repeated heavy loading, the use of poor quality materials or improper construction methodologies, or excessive moisture in the pavement structure. Permanent repair techniques generally involve repair or reconstruction of the pavement surface and underlying base and subgrade layers with the use of heavy machinery and extensive effort. Examples of structural damage in asphalt pavements include alligator (fatigue) cracking, rutting, swelling, and depressions. Examples in concrete pavements include shattered slabs, blow-ups, and settlement/faulting.

c. Extensive repaving (e.g. asphalt milling and resurfacing) and/or reconstruction efforts are not considered normal ADR activities and are therefore not covered by the procedures outlined in this STANAG.

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CHAPTER 2 AIRFIELD ASSESSMENT

2.1. SCOPE AND METHODOLOGY

This STANAG outlines a methodology for determining ADR capability requirements for a wide array of operations, including establishing a DOB as part of a NRF, sustaining a DOB, or recovering a MOB. The basic steps are:

a. Gather data. The first step in the process is gathering applicable data. This includes sources such as site surveys, airfield pavement condition reports, and intelligence reports;

b. Determine threat. Threat refers to anything that may cause damage. Threats are existing or future and broken into kinetic (weapon related damage—e.g. rocket attack) and non-kinetic damage (environmental and usage—e.g. weather, high sortie rate, etc.);

c. Determine Damage. Damage encompasses existing damage and potential damage in the future based on threat. This damage may be to Aircraft Operating Surfaces or Essential Services and Facilities. The threat, in light of various factors, drives the probability of future damage; and

d. Determine EOD Requirements. Depending on whether UXOs exist or are expected, EOD support may be required. The assessment must identify whether or not EOD support is required.

2.2. DATA GATHERING

Before beginning the process to determine required repair capabilities, information regarding the operating location must be gathered. Note that data gathering is an iterative process throughout the course of an operation as factors and conditions can change.

a. Data Sources: There are many sources of information available, including:

(1) Site Surveys;

(2) Pavement Evaluations;

(3) Intelligence Reports;

(4) Construction Drawings; and

(5) General sources such as Flight Supplements, Google Earth, etc.

b. <u>Data Types</u>: In order to follow the methodology outlined in this publication, at a minimum, the information listed below must be gathered. If the information is not available or questionable, it may be necessary to conduct a site survey or pavement evaluation to provide an accurate assessment of the capability required.

Table 2-1. Minimum Data Collection Requirements

Site Data • Mapping, imagery, and drawings • Airfield data (airfield surface lengths, widths, elevations, etc.) • Environmental conditions (temperatures, precipitation, etc.) • Other site survey information • Information on previous repairs, planned repairs, local contractors used	Operational Requirements • Length of Mission • Timelines: (e.g. Initial Operating Capability (IOC), Final Operating Capability (FOC), end of mission, etc.) • Constraints on availability of surfaces for repair and maintenance • Aircraft • Aircraft Classification Number (ACN) • Number of operations, sortie rate • How teams will be inserted
Pavement • General: Type, Thickness, Age • Pavement Classification Number (PCN) • Pavement Condition Index (PCI) • Redundancy (alternate runway, taxiways, etc) • Semi-Prepared Runway Operations (SPRO) Data	Essential Airfield Components • Airfield lighting • Aircraft arrestor systems
Intelligence • Intelligence (e.g. MC 161. See note 1) • Vulnerability assessments • Permissive, Non-permissive • Chemical Biological Radiological Nuclear (CBRN) Environment	Logistics and Engineering Resources • Local construction materials availability • Local equipment availability • Local labour skill and availability • Distance to source of material and equipment • Availability of adequate contractor augmentation

NOTE:
1. The basic and most comprehensive intelligence assessment will be MC 161 – the General Intelligence Assessment. This Level 1 approved document comprises three separate papers:
    a. MC 161 A – NATO Strategic Intelligence Estimate (NSIE);
    b. MC 161 B – Armed Forces Intelligence Assessment (AFIA); and
    c. MC 161 C – NATO Intelligence Proliferation Assessment (NIPA).

Localized intelligence information must also be taken into account when determining the level of kinetic threat.

2.3. THREAT ASSESSMENT

2.3.1. Threat type

Threats can be both kinetic (i.e. weapons) and non-kinetic (e.g. usage, weather, etc.). The data gathered above and the information below must be considered in order to establish existing and future damage. Some of the information will directly affect capability adjustment factors addressed in later chapters.

(1) Kinetic. Delivery methods of weapons can be by ground or airborne systems (including missiles). Effects are broken down into conventional and CBRN. Conventional effects include blast and fragmentation. CBRN weapons can cause physical damage to some systems (e.g. EMP, radiological, severe corrosion, and obviously blast from a nuclear weapon). Depending on threat, personnel must have the ability to operate in a CBRN environment. Such conditions can significantly impact ADR operations. Factors affecting the impact of the kinetic threat:

- (1) Redundancy of systems (multiple runways, airfield lighting, etc.);
- (2) Robustness of systems (thickness of concrete, hardening, etc.);
- (3) Defence measures (physical, procedural, etc.);
- (4) Capacity of enemy;
- (5) Capacity of friendly forces;
- (6) Geographic location (proximity to threat); and
- (7) Mission criticality (how valuable is the base (desire of the enemy to attack the base)).

(2) Non-kinetic. This analysis estimates the extent of future damage due to normal degradation from natural causes and operations. It is to be based on operational plans including estimated duration of operations, types of aircraft, and number and frequency of sorties. Factors affecting non-kinetic threat include:

- (1) Redundancy of systems (AOS, systems, etc.); and

(2) Robustness of systems (thickness of concrete, hardening, etc.)

2.3.2. Threat Assessment

The kinetic and non-kinetic threat assessments will form the basis for determining the likelihood and extent of future damage to the airfield, and can affect required capability for RAOS, RESF, and EOD.

2.4. DETERMINE DAMAGE

Quantification of damage will be based on existing damage and potential damage based on the threat assessment and used to determine whether damage is considered low, moderate, or high based on the definitions in this chapter.

2.4.1. Estimate Existing Damage (EKD & ENKD)

1. Estimate Existing Kinetic Damage (EKD) and Existing Non-Kinetic Damage (ENKD) based on existing conditions. Damages are rated as low, moderate, or high and have corresponding numeric values of 1, 3, and 5, which will be used in formulas. Definitions for each are defined in Table 2-2. Note: as PCI provides the most accuracy, obtaining a PCI for ENKD is preferable to determine the condition of the airfield surface.

2. Pavement Condition Index (PCI): The PCI is defined as "A numerical rating resulting from an airfield condition survey that represents the severity of surface distresses”. A detailed methodology for determining PCI can be found in AEP-56 (Study Draft) (STANAG 7181 (Ed 1)) Standard Method for Airfield PCI Surveys.

Table 2-2. EKD and ENKD Definitions

Low (value = 1)	EKD	A maximum of 1 large crater or 1 camouflet or 2 small craters and 100 spalls at key locations on the airfield such as the runway or primary taxiways. (Count unexploded ordnance that cannot be cleared as a crater.)
	ENKD	When PCI is available: Area weighted Pavement Condition Index (PCI) greater than 55 as defined in STANAG 7181 (AEP 56). When PCI is not available: Normal maintenance and repair issues with isolated areas of distresses at key locations on the airfield such as the runway keel/hammerhead and primary taxiways.
Moderate (value = 3)	EKD	A maximum of 3 large craters or 3 camouflets or 6 small craters and 200 spalls at key locations on the airfield such as the runway or primary taxiways. (Count unexploded ordnance that cannot be cleared as a crater.)
	ENKD	When PCI is available: Area weighted PCI between 55 and 40 as defined in STANAG 7181 (AEP 56). When PCI is not available: Significant areas of distresses at key locations on the airfield such as the runway keel and primary taxiways. These distresses pose a FOD hazard and/or a tire or gear hazard due to roughness.
High (value = 5)	EKD	A maximum of 7 large craters or 7 camouflets or 14 small craters and 300 spalls at key locations on the airfield such as the runway or primary taxiways. (Count unexploded ordnance that cannot be cleared as a crater.)
	ENKD	When PCI is available: Area weighted PCI less than 40 as defined in STANAG 7181 (AEP 56). When PCI is not available: Widespread areas of distresses at key locations on the airfield such as the runway keel and primary taxiways. These distresses pose a significant hazard that would limit operations due to FOD and/or a tire or gear hazard due to roughness.

2.4.2. Multiple airfield operating surfaces (i.e. multiple runways, taxiways, aprons):

1. EKD: Simply add the kinetic damage of each individual airfield operating surface.

2. ENKD:

(1) In cases of multiple runways, taxiways, and parking aprons, a weighted PCI average should be calculated. A = Area.

$$\textbf{PCI weighted average} = \frac{(PCI_1 \times A_1 + PCI_2 \times A_2 + PCI_3 \times A_3 \ldots)}{(A_1 + A_2 + A_3 \ldots)}$$

(2) If PCIs are unavailable, ENKDs can be determined for each surface and a weighted ENKD can be calculated in a similar manner.

$$\textbf{ENKD weighted average} = \frac{(ENKD_1 \times A_1 + ENKD_2 \times A_2 + ENKD_3 \times A_3 \ldots)}{(A_1 + A_2 + A_3 \ldots)}$$

(3) Consideration should also be given to the importance of runway surfaces as compared to taxiways and aprons.

2.4.3. Estimate Future Damage (FKD & FNKD)

1. Estimate Future Kinetic and Non-Kinetic Damage: This is the damage that can be expected in the future over any given 30 day period. Damages are rated as low, moderate, or high and have corresponding numeric values of 1, 3, and 5, which will be used in formulas.

2. FKD (Future Kinetic Damage): Based on the threat to a given airbase, an estimate of the cumulative level (low, moderate, or high) of future kinetic damage over 30 days.

3. FNKD (Future Non-Kinetic Damage): Based on pavement type and condition, ops tempo, and environmental factors (weather, etc.), an estimate (low, moderate, or high) of future non-kinetic damage over 30 days. Note that pavement evaluation ratings such as PCI, PCN, ACN and Allowable Gross Load (AGL) are very useful tools in estimating future non-kinetic damage.

a. ACN: a number that expresses the relative structural effect of an aircraft on different pavement types for specified standard subgrade strengths in terms of a standard single-wheel load.

b. PCN: a number that expresses the relative load-carrying capability of a pavement in terms of a standard single-wheel load.

(1) How to use ACN/PCN: The PCN value of the pavement is compared to the ACN of the aircraft, using the appropriate pavement type and subgrade strength. If the ACN/PCN ratio is equal to or less than 1.0, the aircraft can safely operate for unlimited passes. A detailed discussion and list of ACNs can be found in AEP-46(B) ACN/PCN (STANAG 7131 (Ed 3)).

(2) Overload Guidance: If the ACN is greater than the PCN, the pavement will be overloaded and pavement life reduced. However, there are situations such as contingencies and emergencies when it is acceptable to overload the pavement. The following general guidelines in Table 2-3 can be used to determine the extent of operations in an overload situation.

Table 2-3. ACN / PCN Guidance

ACN / PCN	**Guidance**
< 1.0	Unlimited Passes
1.0 - 1.25	Continue Operations but Monitor Distress
1.25 - 1.5	Limited to 10 Passes or conduct structural evaluation if contingency operations required
> 1.5	Emergencies only or conduct structural evaluation if contingency operations required

c. AGL and Allowable Passes: This method evaluates the subgrade, base course, and pavements to determine the allowable passes a pavement system can sustain for a given gross aircraft load.

Table 2-4. Threat of Future Kinetic and Non-Kinetic Damage Definitions (30 day period)

Low (value = 1)	FKD	A threat of mortar or rocket attack over a 30 day period resulting in a maximum of 1 large crater or 1 camouflet or 2 small craters and 100 spalls at key locations on the airfield such as the runway or primary taxiways.

	FNKD	Minimal degradation due to usage and environmental factors over a 30 day period resulting in normal maintenance and repair issues with isolated areas of distresses at key locations on the airfield such as the runway keel/hammerhead and primary taxiways. A pavement with an ACN/PCN ratio <1.0 and an area weighted Pavement Condition Index (PCI) greater than 55 as defined in STANAG 7181 (AEP 56) would fall in this category.
Moderate (value = 3)	FKD	Limited missile or aircraft threat over a 30 day period resulting in a maximum of 3 large craters or 3 camouflets or 6 small craters and 200 spalls at key locations on the airfield such as the runway or primary taxiways.
	FNKD	Moderate degradation due to usage and environmental factors over a 30 day period resulting in significant areas of distresses at key locations on the airfield such as the runway keel and primary taxiways. These distresses pose a FOD hazard and/or a tire or gear hazard due to roughness. A pavement with an ACN/PCN ratio from 1.0-1.25 or an area weighted PCI between 55 and 40 as defined in STANAG 7181 (AEP 56) would fall in this category.
High (value = 5)	FKD	Robust missile or aircraft threat over a 30 day period resulting in a maximum of 7 large craters or 7 camouflets or 14 small craters and 300 spalls at key locations on the airfield such as the runway or primary taxiways.
	FNKD	Significant degradation due to usage and environmental factors over a 30 day period resulting in widespread areas of distresses at key locations on the airfield such as the runway keel and primary taxiways. These distresses pose a significant hazard that would limit operations due to FOD and/or a tire or gear hazard due to roughness. A pavement with an ACN/PCN ratio >1.25 or an area weighted PCI less than 40 as defined in STANAG 7181 (AEP 56) would fall in this category.

d. Multiple Airfield Operating Surfaces

(1) FKD: Simply add up the estimated future damage.

(2) FNKD: As noted, there are often multiple airfield operating surfaces (runways, taxiways, ramps, etc.), each sometimes having a different conditions. A weighted area average should again be used to estimate future non-kinetic damage. Since precisely

estimating future PCIs would be questionable (though a range could be estimated), FNKD values should be estimated for each surface (1, 3, or 5), and then an area weighted average FNKD calculated.

FNKD weighted average =

$$\frac{(FNKD_1 \times A_1) + (FNKD_2 \times A_2) + (FNKD_3 \times A_3) + \ldots}{(A_1 + A_2 + A_3 + \ldots)}$$

As with the ENKD, engineering judgement should be used when considering if aprons and taxiways should be weighted the same as runways.

2.4.4. Determine Damage Rating

Use the formula and chart below to determine the overall damage rating.

a. For each of the below, assign a numeric value: Low = 1, Moderate = 3, High = 5 (for no damage, assign a value of 1)

(1) EKD = Existing Kinetic Damage

(2) ENKD = Existing Non-Kinetic Damage

(3) FKD = Future Kinetic Damage

(4) FNKD = Future Non-Kinetic Damage

b. Determine the Damage Rating Numeric Value (DRNV) using the following formula:

$$DRNV = \frac{(EKD + ENKD + FKD + FNKD)}{4}$$

Table 2-5. DRNV Numeric Ranges

Damage Rating	DRNV Numeric Range
Low	1 to 1.4
Moderate	1.5 to 3.4
High	3.5 or greater

c. Note that future damage is based on a 30 day period. As such, the amount of future damage at any given time is approximated as proportional to the number of days since previous damage was repaired.

Table 2-6. Damage Rating Definitions

Low (0.0 to 1.4)	Indicates that there is some kinetic or non-kinetic damage or threat of future damage that pose a FOD Hazard or the potential of tire or gear damage due to roughness that would negatively impact safe aircraft operations. In the worst case, this translates to a maximum of low damage for all factors (existing and future, kinetic and non-kinetic). For example: • Low EKD: Max of 1 large (or 2 small craters) and 100 spalls • Low ENKD: Normal maintenance with isolated areas of distresses • Low FKD: Max of 1 large (or 2 small craters) and 100 spalls • Low FNKD: Normal maintenance with isolated areas of distresses Combined, the damage would be: • Existing: 1 large (or 2 small craters), plus 100 spalls and normal maintenance with isolated areas of distresses • Additional damage expected over a 30-day period: 1 large (or 2 small craters) plus 100 spalls and normal maintenance with isolated areas of distresses.

<table>
<tr>
<td>Moderate
(1.5 to 3.4)</td>
<td>There is significant kinetic and/or non-kinetic damage that must be repaired prior to aircraft operations, damage that poses a significant FOD Hazard or the potential of tire or gear damage due to roughness that would negatively impact safe aircraft operations and/or a significant threat of future damage.

In the worst case scenario, it translates to a maximum of two high damages and two low damages. For example:

• High EKD: Max of 7 large (or 14 small craters) and 300 spalls
• Low ENKD: Normal maintenance with isolated areas of distresses
• High FKD: Max of 7 large (or 14 small craters) and 300 spalls
• Low FNKD: Normal maintenance with isolated areas of distresses

Combined, the damage would be:

• Existing: 7 large (or 14 small craters), plus 300 spalls and normal maintenance with isolated areas of distresses.
• Additional damage expected over a 30-day period: 7 large (or 14 small craters) plus 300 spalls and normal maintenance with isolated areas of distresses.</td>
</tr>
<tr>
<td>High
(≥3.5)</td>
<td>There is a high level of kinetic and/or non-kinetic damage that must be repaired prior to aircraft operations, widespread damage that poses a High FOD Hazard or the potential of tire or gear damage due to roughness that would negatively impact safe aircraft operations, and/or a high threat of future damage.

In the worst case, this translates to a maximum of high damage for all factors (existing and future, kinetic and non-kinetic), all of which affect MOS and/or required taxiways and aprons. For example:

• High EKD: Max of 7 large or 14 small craters, 300 spalls
• High ENKD: Widespread areas of distresses at key locations
• High FKD: Max of 7 large or 14 small craters, 300 spalls
• High FNKD: Widespread areas of distresses at key locations

Combined, the damage would be:

• Existing: 7 large (or 14 small craters), plus 300 spalls and widespread areas of distress at key locations.
• Additional damage expected over a 30-day period: 7 large (or 14 small craters), plus 300 spalls and widespread areas of distress at key locations.</td>
</tr>
</table>

2.5. DETERMINE EOD REQUIREMENTS

2.5.1. EOD Capability Requirement

The requirement for an EOD capability, including Explosive Ordnance Reconnaissance (EOR), related to RAOS and RESF is driven primarily by kinetic damage, whether current and/or estimated future damage, since non-kinetic damage does not involve any type of weapons. However, there may be legacy issues such as mine fields and existing munitions storage that must be addressed as part of activation and sustainment. As with RAOS capability, conditions and situations may change throughout an operation, driving the need to re-determine the required capability (e.g. a large EOD capability may be required at the start of an operation to address wide-spread UXOs, but if the future kinetic threat is low, only a small capability may be required thereafter). In general, UXO clearance will impact overall airfield repair timelines given the nature, frequency and severity of the clearance required. Steps for determining required EOR and EOD capability include:

a. Determine EOD Task Load.

b. Determine required EOD Team Size

2.5.2. EDs and VBIEDs (Vehicle Born IEDs)

Other than initial activation workloads, this standard does not cover IEDs and VBIEDs (e.g. an IED or VBIED at the gate of a DOB, etc.), nor any other workload (e.g. non-airfield related workload, off-base patrols). Additional workload must be taken into consideration separately.

2.5.3. EOD Capability References

Note that there are several NATO documents that address EOD capability and requirements, including STANAG 2143 EOD and EOR, STANAG 2897 Standardization of EOD Equipment, AEODP-7 EOD Equipment and Requirements and AEODP-10 EOD Principles and Minimum Standards of Proficiency.

2.6. EOD RESPONSE FACTORS AND DETERMINATION

2.6.1. Airfield Assessment

When UXOs are suspected (whether legacy or due to recent enemy activity), EOD personnel will assess the airfield and any critical areas related to airfield repair (e.g. access routes).

2.6.2. Determining Required Response

Upon a UXO incident, the EOD Commander will determine the required EOD response size and scope based on EOD reconnaissance. The time associated with clean-up of the incident will vary based upon numerous factors. Some of the factors noted in Table 3-3 in Chapter 3 that affect RAOS may also affect EOD efforts (operation type, CBRN, environmental conditions, airfield size, pavement thickness, AOS redundancy, logistical factors, repair time, etc.) In addition, there are other factors specific to EOD that would be considered when determining required EOD capability.

Table 2-7. Additional EOD Considerations

Consideration	Description
UXO Type	Different types of UXOs will require different times and types of equipment to clear. For simplicity, large bombs could be classified as Major UXOs, RPGs classified as Minor UXOs, and bomblets classified as Dispersed Munitions. Depending on the complexity of the UXOs, additional time may be required to clear.
Spacing of incidents	The EOD Group capabilities were developed assuming each UXO is outside the safety radius of another. Meaning EOD teams can work independent of each other without causing a hazard for the other team. If UXOs are within the safety radius of each other, then UXOs will need to be cleared one at a time versus simultaneously (unless in all out war). Also, adjustments will need to be applied to the time or team size. For multiple instances, multiple adjustments will need to be applied.
Accessibility of UXO	The EOD Group capabilities were developed assuming UXOs are at or near the surface with good accessibility. The deeper or more inaccessible the UXO, the more time is required for EOD efforts. On airfields, as a worse cast scenario, assume large ordnance could penetrate 3 meters below the surface.
Equipment available	The EOD Group capabilities were developed assuming adequate equipment availability. However, workload varies greatly depending on equipment (e.g. clearing bomblets via a blade on an armoured vehicle versus not having an armoured vehicle available). Adjust time required to complete the task depending on equipment availability.

2.6.3. Execution Timeline

Execution timelines are highly dependent on a large range of factors—explosive quantity, dispersal pattern, trigger mechanism, terrain, weather, equipment, material, personnel as well as team experience. Therefore, EOD experts should be consulted for size and scope of EOD response necessary and estimated completion times for a particular incident.

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CHAPTER 3 DETERMINING REQUIRED RAOS CAPABILITY

3.1. SCOPE AND METHODOLOGY

Once the airfield assessment is complete, the capability required to make the repairs is determined. The basic steps are:

a. MOS and MAOS selection. Damage may be widespread throughout the airfield; however, by selecting a Minimum Operating Strip (MOS) and the Minimum Airfield Operating Surface (MAOS), repairs can be focused on the most essential areas necessary for mission operation;

b. Determine appropriate repair criteria. Repair criteria specify the quality of the repairs and time available for executing the repairs for a given situation and mission, and are typically categorized as expedient, temporary, and permanent;

c. Determine the required repair capability;

d. Adjust repair capability requirements based on additional factors. There are several factors that can further influence the required repair capability (e.g. operation type, environmental); and

e. Complete Required Repair Capability Template.

3.2. MOS AND MAOS SELECTION

When assessing the damage, select the best airfield surfaces to repair based on those areas that require the least repair time while still providing adequate launch and recover surfaces for the mission aircraft. When a MOS is combined with essential access taxiways from aircraft staging areas such as shelters and parking aprons, the entire area can be termed the Minimum Airfield Operating Surface (MAOS). The length of the MOS will depend on the take-off or landing distance of the mission aircraft, whichever is greater. (See Annex D for additional information.) When the MAOS is damaged and mission operations impacted, damage and repair capabilities need to be determined.

3.3. CRITERIA FOR RAOS REPAIR

In this phase of the process, the criteria below are determined. These criteria, along with previously determined levels of damage, will be used to determine the final required capability:

a. Repair Time: Repair time does not include time required for EOD, EOR or movement of personnel, materials and equipment. In the case of sustainment, the Repair Time is the scheduled repair increment (e.g. routine maintenance is scheduled for every 10 days, 30 days, etc.).

b. Type of aircraft (Fighter, Cargo or Tanker)

c. Repair type: This is based on the number of passes the repair can sustain, see table below. (Note: it is assumed that all repairs will be flush.)

Table 3-1. Repair Type Definitions

Repair Type	Typical # Passes	Definition
Expedient	<100	Repairs intended for a small number of operations (typically < 100 passes) of either fighter or military cargo aircraft. These repairs must meet specific quality (load bearing and roughness (e.g. RQC)) criteria and will require monitoring and maintenance. The life of these repairs can be extended beyond 100 passes with maintenance if required.
Temporary	≤3,000	Also known as sustainment repairs. Repairs intended to sustain up to 3,000 passes of specified aircraft. Repairs must meet specific quality criteria (load bearing and roughness) and do not require significant monitoring and maintenance. The life of these repairs can be extended beyond 3,000 passes with maintenance if required.
Permanent	>10,000	Repairs intended for a large number of passes (typically > 10,000) of specific aircraft under normal operations. Specific criteria for permanent repairs are outlined in NATO and ICAO guidance (specifically STANAG 7208).
Phased		Includes a combination of expedient, temporary, and/or permanent repairs based on equipment, material, and time available. For example, a team may make permanent asphalt repairs to an airfield but must make temporary concrete repairs because there is not sufficient time for the concrete to gain adequate strength to sustain aircraft operations.

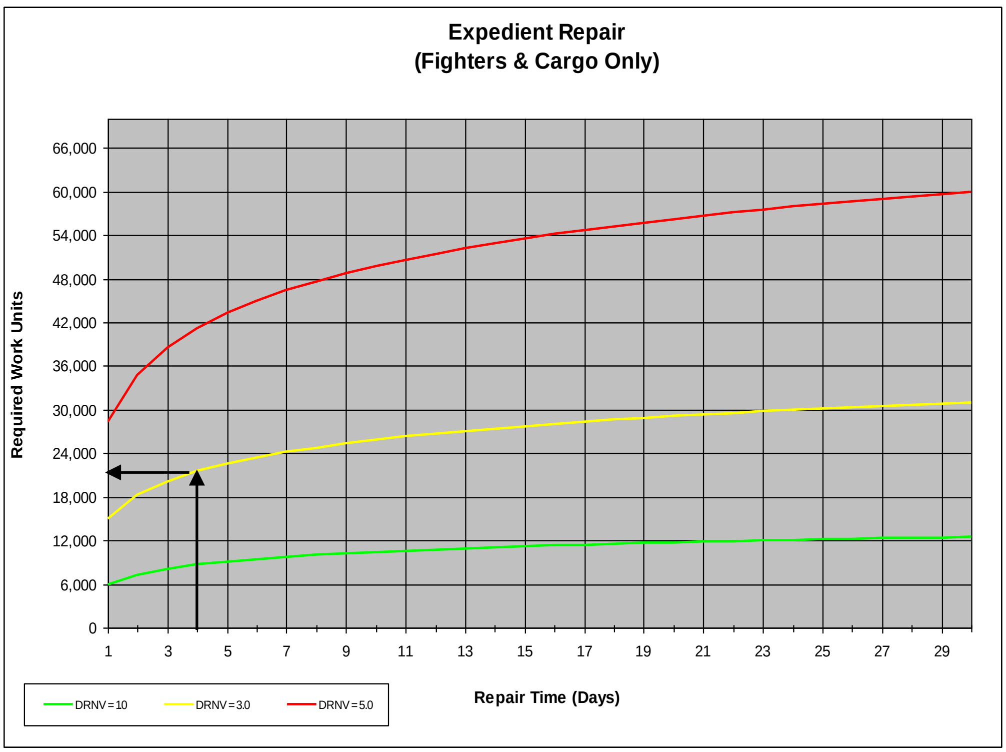
3.4. DETERMINE REQUIRED REPAIR CAPABILITY

Determining the Required Repair Capability is a two-part process. First, determine the required Work Units to accomplish the repairs. Then knowing the required Work Units, determine the required Repair Capability.

3.4.1. Determine the Required Work Units

Work Units are not a measure of time or resources, but rather a measure of effort to repair various types of damage. Select the graph in Annex G for the type of repair to be accomplished (Expedient, Temporary or Permanent). From this graph, determine the Work Units required. To use the graph, the below must be known:

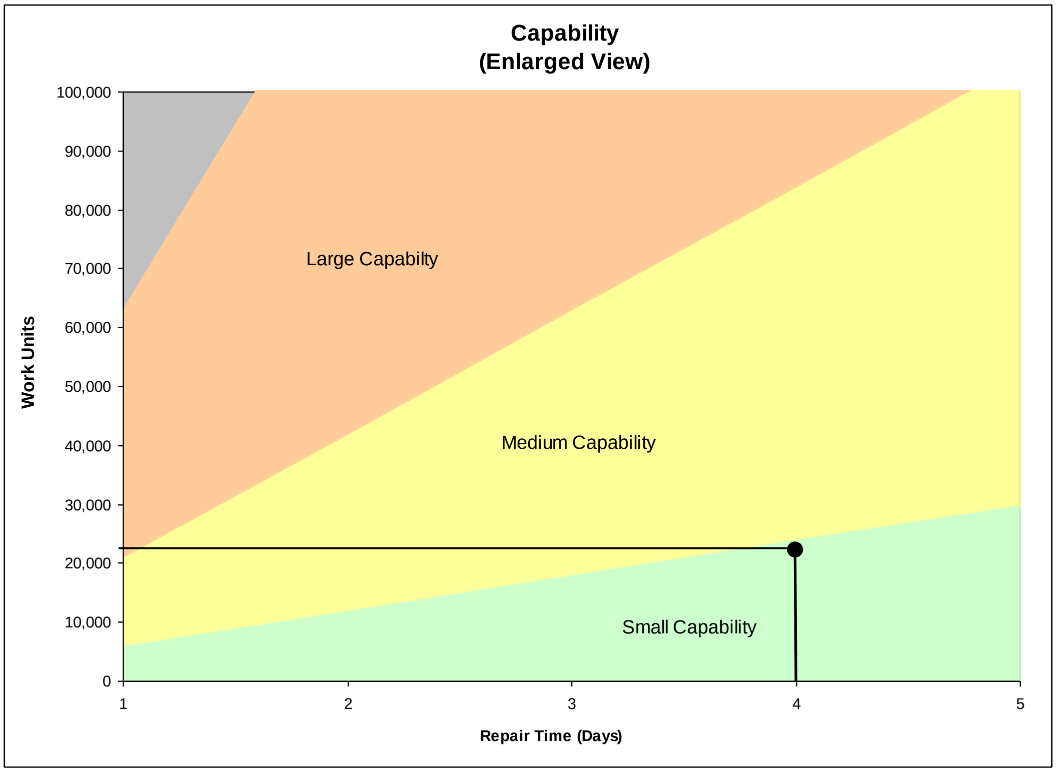
- a Type of repair (Expedient, Temporary, or Permanent)
- b DRNV
- c Available time for repair
- d Type of aircraft



Example

3.4.2. Determine the Required Capability

Use the Capability Graph in Annex G to determine the Required Capability.



Example

3.4.3. Capability Example Scenarios

The following pages contain generic descriptions and some basic examples of damage that could be expected to be repaired by the Small, Medium and Large capabilities. As there are an infinite number of combinations of damage that could be encountered, only a few examples are provided below to give a basic understanding of what could be expected from a particular capability.

Table 3-2. Repair Capability Definitions

<table>
<tr><th>Repair Capability</th><th>Description and Assumptions</th></tr>
<tr><td>Small</td><td>
A team with a small capability is one with sufficient equipment and manpower to make a limited number of expedient or temporary repairs to the primary surfaces of an airfield to accept a limited number of aircraft operations (typically less than 100 passes). With enough time and limited damage, a small-capability team could make permanent repairs. Alternatively, the team could be tasked to sustain an airfield that is in relatively good condition over an extended period of time.
Example scenarios are as follows:
<table>
<tr><th>Possible Damage for Low, Moderate or High</th><th>Repair Time*</th><th>Method</th><th>Type of Aircraft</th></tr>
<tr><td>Low (2 SC, 20 spalls)</td><td>4 hrs</td><td>Expedient</td><td>Fighters & Cargo only</td></tr>
<tr><td>Low (1 LC, 100 spalls, NMx1)</td><td>1 day</td><td>Expedient</td><td>Fighters & Cargo only</td></tr>
<tr><td>Moderate (2 LC, 2 SC, 500 spalls, NMx2)</td><td>5 days</td><td>Expedient</td><td>Fighters & Cargo only</td></tr>
<tr><td>Moderate (8 LC, 6 SC, 800, spalls, NMx10)</td><td>15 days</td><td>Temporary</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>Low (15 LC, 10 SC, 800 spalls, NMx15)</td><td>30 days</td><td>Permanent</td><td>Fighters, Cargo & Tankers</td></tr>
</table>
*Reminder: Repair time is inclusive of all damage that could occur in a particular timeframe (i.e. damage could occur on any given day during the repair time and could occur in the same location).

SC = Small Crater
LC = Large Crater
NM = Normal Maintenance:

25 patches < 0.5 SM each, and
25 joint spalls < 600 mm long each with broken or missing fragments with considerable FOD or tire damage potential, and
150 m of cracks < 2.5 cm in width

</td></tr>
</table>

Table 3-2. Repair Capability Definitions (continued)

<table>
<tr><th>Repair Capability</th><th>Description and Assumptions</th></tr>
<tr><td>Medium</td><td>
A team with a medium capability is one with sufficient manpower and equipment to make a large number of expedient or sustainment repairs to the primary surfaces of an airfield to accept a large number of aircraft operations (up to 3,000 passes). Alternatively, the medium-capability team could be tasked to sustain a small airfield that is in relatively poor condition or a large airfield in relatively good condition over an extended period of time.
Example scenarios are as follows:
<table>
<tr><th>Damage rating
(either Low, Moderate or High)</th><th>Repair Time*</th><th>Method</th><th>Type of Aircraft</th></tr>
<tr><td>Moderate (1 LC, 2 SC, 100 spalls)</td><td>4 hrs</td><td>Expedient</td><td>Fighters & Cargo only</td></tr>
<tr><td>Moderate (5 LC, 7 SC, 200 spalls, NMx2)</td><td>1 day</td><td>Temporary</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>High (15 LC, 15 SC, 700 spalls, NMx12)</td><td>5 days</td><td>Temporary</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>Moderate (20 LC, 40 SC, 2000 spalls, NMx48)</td><td>15 days</td><td>Permanent</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>Moderate (20 LC, 45 SC, 1500 spalls, NMx58)</td><td>30 days</td><td>Permanent</td><td>Fighters, Cargo & Tankers</td></tr>
</table>
*Reminder: Repair time is inclusive of all damage that could occur in a particular timeframe (i.e. damage could occur on any given day during the repair time and could occur in the same location).

SC = Small Crater
LC = Large Crater
NM = Normal Maintenance:

25 patches < 0.5 SM each, and
25 joint spalls < 600 mm long each with broken or missing fragments with considerable FOD or tire damage potential, and
150 m of cracks < 2.5 cm in width

</td></tr>
</table>

Table 3-2. Repair Capability Definitions (continued)

<table>
<tr><th>Repair Capability</th><th>Description and Assumptions</th></tr>
<tr><td>Large</td><td>
A team with a large capability is one with sufficient manpower and equipment to make a large number of repairs to a severely damaged airfield for either short term (100 - 3,000 passes) or long term (over 3,000 passes) operations. These repairs may be expedient, temporary, or permanent based on the situation. Alternatively, the large-capability team could be tasked to sustain a large airfield in relatively poor condition over an extended period of time.
Example scenarios are as follows:
<table>
<tr><th>Damage rating (either Low, Moderate or High)</th><th>Repair Time*</th><th>Method</th><th>Type of Aircraft</th></tr>
<tr><td>High (2 LC, 3 SC, 200 spalls)</td><td>4 hrs</td><td>Expedient</td><td>Fighters & Cargo only</td></tr>
<tr><td>Moderate (4 LC, 8 SC, 300 spalls)</td><td>1 Day</td><td>Temporary</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>Moderate (20 LC, 40 SC, 900 spalls, NMx31)</td><td>5 days</td><td>Permanent</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>High (50 LC, 80 SC, 3000 spalls, NMx59)</td><td>15 days</td><td>Permanent</td><td>Fighters, Cargo & Tankers</td></tr>
<tr><td>High (60 LC, 90 SC, 4000 spalls, NMx10)</td><td>30 days</td><td>Permanent</td><td>Fighters, Cargo & Tankers</td></tr>
</table>
*Reminder: Repair time is inclusive of all damage that could occur in a particular timeframe (i.e. damage could occur on any given day during the repair time and could occur in the same location).

SC = Small Crater
LC = Large Crater
NM = Normal Maintenance:

25 patches < 0.5 SM each, and
25 joint spalls < 600 mm long each with broken or missing fragments with considerable FOD or tire damage potential, and
150 m of cracks < 2.5 cm in width

</td></tr>
</table>

3.5. ADJUST CAPABILITY BASED ON ADDITIONAL FACTORS

Due to the imprecision of the additional factors, it is recommended to first determine the required capability without any additional factors, then to re-calculate the required capability considering the additional factors.

Table 3-3. Additional RAOS Factors

	Description	Adjustment Factor (AF)
Operation Type1	The capability matrix was developed for a permissive insertion for a team to go into a relatively stable threat condition environment. If the operation is in a non-permissive environment where the team will have to seize and protect the airfield or if there is significant risk of manpower or equipment attrition, then the team capability should be increased.	+ 25%
UXO clearance	See Chapter 2	See Chapter 2
CBRN Environment[1]	The capability matrix was developed for a non-CBRN environment. If the team is to go into a CBRN environment or if there is a significant threat of the use of CBRN weapons, then the team capability should be increased. The adjustment factor is based on the assumption that team performance will be degraded and additional time required when team members use CBRN protective equipment, the team rotates shifts for rest periods, and potential attrition.	+ 50%
Environmental Conditions[1]	Temperature, humidity, elevation, wind, and lightning should be assessed. The capability matrix was developed for a temperate environment (0-37 degrees C / 32-100 degrees F). If the temperatures are above or below these conditions, if high humidity, wind or lightning is a factor, or if the elevation if over 1828 m (6,000 ft), then team performance may be impacted and the team capability should be increased. Tie downs and lightning protection may also need repaired or installed; which could increase workload and potentially team size or repair time.	+ 25%
Airfield Size[1]	The capability matrix was developed for an airfield ranging in size from approximately 0.5 – 1.4 km2 (5 to 15 million SF). If the area is significantly above or below these values, then the team capability can be reduced or increased accordingly.	< 0.5 -10% > 1.4 +10% > 2.3 +25%

	Description	Adjustment Factor (AF)
Pavement Thickness [1,2]	The capability matrix was developed for un-surfaced or semi-prepared surfaces, asphalt (AC) pavement less than 15 cm (6 in), and/or Portland Cement concrete (PCC) or Composite (AC/PCC) pavements from 15-30 cm (6 to 12 in). If the pavement is thicker than these values, then the team capability can increased accordingly.	AC > 15 cm +10% AC > 30 cm +20% PCC 30-45 cm +10% PCC 45-60 cm +20%
AOS Redundancy	The capability matrix was developed assuming no redundancy. Redundancy allows for flexibility in routing aircraft and in coordinating repair efforts. If there is at least one alternate runway, then team capability may be decreased 5%. If at least one alternate runway, one alternate ramp, and multiple taxiways exist, then team capability may be decreased 10%.	- 5% or 10%
Airfield Lighting	The capability matrix was developed assuming no issues with lighting. If mission driven and required for initial operation, the team capability may be increased to repair or install lighting. See also STANAG 3534 for detailed guidance.	+ 5%
Aircraft Arrestor Gear	The capability matrix was developed assuming no issues with aircraft arrestor gear. If mission driven and required for initial operation, the team capability may be increased to repair or install arrestor gear. See also STANAG 3697 for detailed guidance.	+ 5 to10%
Logistics Factors	The capability matrix was developed based on the assumption that a logistics line is established to insert adequate materials and equipment to support repair operations. If the equipment and/or materials available are restricted based on logistical limitations, then team capability may be increased to provide additional manual labour to acquire local equipment and materials or to perform repairs with light equipment.	+ 15 to 25%

Table 3-3. Additional RAOS Factors (continued**)**

	Description	Adjustment Factor (AF)
Required Repair Time	Expedient repairs are more maintenance intensive and must be accounted for when determining workload. Note this can be compounded with mixed aircraft operations (e.g. fighter and cargo aircraft).	+10 to 25% depending on quantity of expedient repairs
Duration of Operation	For long operations, team capacity may need to be increased to account for mid-tour leaves of absence, etc.	+ 10 to 20%

NOTES:

1. Execution timelines may be extended if team capability cannot be increased. Timelines are highly dependent on available equipment and material as well as team experience. However, in general, the team capability adjustment factors can be applied to the timeline to get a good approximation of the impact of the consideration factors on repair execution.

2. Changes in equipment should be considered rather than increases in team capability when dealing with very thick pavements especially with light equipment packages. The team may find that if the pavements are very thick, they may not be able to make repairs efficiently even when give extended timelines and more manpower.

3.5.1. Adjusting capability

a. Once adjustment factors (AFs) have been determined, adjust the Damage Rating Numeric Value (DRNV) and then determine the adjusted Damage Rating.

$$\textbf{DRNV (adjusted) = DRNV (original) x } (1+AF_1+AF_2+AF_3\ldots.\text{etc.})$$

b. Then determine the required Repair Capability using the adjusted damage rating (low, moderate, high) and the repair capability graphs in Annex G.

3.5.2. Multiple Scenarios

As noted before, since conditions and situations change throughout a mission, determining capability is an iterative process and should be done whenever there are significant changes. Even in the initial planning stages, it is suggested that, at a minimum, the following scenarios are analyzed:

a Activation: From start to Full Operational Capability (FOC).

b Sustainment: After FOC is reached.

c Post-Attack Recovery: If there is a kinetic threat (e.g. rocket attack, etc.), or in some cases even a non-kinetic threat that may require periodic recovery efforts, such scenarios should be analyzed to ensure team capabilities are sufficient to meet mission requirements. There may be situations where team capabilities may be sufficient for sustainment, but insufficient for post-attack recovery.

3.6. MAOS DAMAGE & REPAIR ASSESSMENT TEMPLATE

After the assessment is complete including data gathering, threat assessment, damage assessment, and EOD requirement determination, the nation performing the assessment shall generate a report documenting the information obtained and complete the standardized MAOS Damage & Repair Assessment template in Annex H. Both documents shall be sent to the NATO agency who requested the assessment.

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CHAPTER 4 DECLARING CAPABILITY

4.1. ADR CAPABILITY MATRIX

1. Per the Agreement clause in STANAG 2929 paragraph 3, nations are required to determine and declare their overall total or partial ADR capability. Nations should expect to provide updates every 3 years or per the timeframe specified in SHAPE ACE Directive 80-15 Airfield Damage Repair Certification.

2. In order to declare capability, the relationships between repair time, repair type, aircraft type and DRNV for any given scenario must be understood. As DRNV has specific value ranges that dictate Low, Moderate and High damage, a Capability Matrix can be extrapolated for Small, Medium and Large Capability and types of repair (Expedient, Temporary and Permanent) for different durations of repair time. This matrix is provided in Table 4.2 ADR Capability Matrix. It shows the minimum capability required and the maximum amount of damage in terms of Work Units for each scenario.

3. As defined in Chapter 3, Work Units are a measure of effort to make repairs to various types of damage. Values are assigned below to the different types of damage.

Table 4-1. Assigned Work Unit Values

Type of Damage to be Repaired	Work Units
Large crater	3,000
Small crater	1,500
100 Spalls	2,500
Normal Maintenance: • 25 patches < 0.5 SM each; and • 25 joint spalls < 600 mm long each with broken or missing fragments with considerable FOD or tire damage potential; and • 150 m of cracks < 2.5 cm in width	500

4. For example, consider the following scenario: 1 day repair time, expedient type repair, low damage rating, for fighter and cargo aircraft.

From Table 4.2, ADR Capability Matrix, the minimum required capability is Small and the maximum amount of damage is 6,000 Work Units under the Low Damage category. As the Small capability can perform 6,000 units of expedient type repair in 1 day, it could perform any combination of repairs that would add up to 6,000 Work Units or less:

a. 2 Large craters, or
b. 4 Small craters, or
c. 1 Large crater, 100 spalls and Normal Maintenance, or
d. Other combinations adding up to 6,000 Work Units or less.

Table 4.2. ADR Capability Matrix

Repair Time	Repair Type	(Minimum) Capability Required (Maximum Possible Work Units)*			Aircraft
		Low Damage	Moderate Damage	High Damage	
4 hrs	Expedient	Small (3,500)	Medium (8,500)	Large (15,500)	Fighters & Cargo only
≤ 1 day:	Expedient	Small (≤ 6,000)	Medium (≤ 15,000)	Large (≤ 28,000)	Fighters & Cargo only
	Temporary	Medium (≤ 12,500)	Large (≤ 31,500)		Fighters & Cargo & Tanker
	Permanent	NA	NA	NA	NA
2-5 days	Expedient	Small (≤ 9,000)	Small (≤ 22,500)	Medium (≤ 43,000)	Fighters & Cargo only
	Temporary	Small (≤ 19,000)	Medium (≤ 47,500)	Large (≤ 91,000)	Fighters & Cargo & Tanker
	Permanent	Medium (≤ 63,500)	Large (≤ 158,000)	NA	Fighters & Cargo & Tanker
6-15 days	Expedient	Small (≤ 11,000)	Small (≤ 27,500)	Small (≤ 53,500)	Fighters & Cargo only
	Temporary	Small (≤ 23,500)	Small (≤ 58,000)	Medium (≤ 112,500)	Fighters & Cargo & Tanker
	Permanent	Medium (≤ 78,000)	Medium (≤ 194,000)	Large (≤ 374,500)	Fighters & Cargo & Tanker
16-30 days	Expedient	Small (≤ 12,500)	Small (≤ 31,000)	Small (≤ 60,000)	Fighters & Cargo only
	Temporary	Small (≤ 26,000)	Small (≤ 65,000)	Small (≤ 126,000)	Fighters, Cargo & Tankers
	Permanent	Small (≤ 87,500)	Medium (≤ 217,000)	Large (≤ 420,000)	Fighters, Cargo & Tankers

* The values in the table account for fatigue, labour, material & equipment limitations as repair time increases and have been rounded to the nearest 500 work units.

Repair	Work Units
Large crater	3,000
Small crater	1,500
100 Spalls	2,500
Normal Maintenance	500

Legend	
(green)	Small Capability
(yellow)	Medium Capability
(red)	Large Capability

The ADR Capability Matrix indicates the <u>minimum</u> capability required (Small, Medium or Large) and the <u>maximum</u> work units possible for each repair type, time and damage rating.

4.2. NATIONAL ADR CAPABILITY DECLARATION

1. To declare ADR capability, nations shall submit the following:

   a. Completed National ADR Capability Declaration (Annex I)

   b. Supplementary narrative further detailing capabilities and limitations

   c. Training and Certification Plan

2. Capabilities may include contractor augmentation and multi-national agreements.

3. Updating your National ADR Capability Declaration: As stated in 4.1.1, <u>Nations should expect to provide updates to their capability approximately every 3 years or per the timeframe specified in SHAPE ACE Directive 80-15 Airfield Damage Repair Certification.</u>

4.3. NATIONAL ADR CAPABILITY DECLARATION TEMPLATE

1. From the ADR Capability Matrix, a template was developed for the nations to use when declaring their ADR capability to NATO. The template is located in Annex I. An example completed template is provided in the following pages. Instructions for completing the template are as follows. Using the ADR Capability Matrix as a guide, enter into each block on the template your nation's capability:

   a. Capability Size

      (1) Small, or

      (2) Medium, or

      (3) Large

   b. Method of execution. If repairs exceed the nation's in-house military capability (work that can be done by the nation's own military forces) for a particular block and the nation is willing to repair by another means, list what alternate method of execution will be used. Alternative methods of execution can be a contract or an agreement with another nation such as an MOU (Memorandum of Understanding). When contracts or MOUs are declared as a capability, nations must have the ability and willingness to execute using those methods. If repairs will be made by either or contract or MOU, enter into the block along with the capability:

(1) Contract, or

(2) MOU

c. No capability. If your nation has no repair capability using its own military forces and no ability or willingness to contract or partner with another nation to execute the repair, enter 'NC' for No Capability' into the block.

(1) NC

2. Exceptions: A separate page is provided for nations to list any exceptions to their capability declaration. For example, if a nation cannot repair craters, then use the exception page to document that craters cannot be repaired or document under what circumstances craters could be repaired.

3. The template, once completed, shall be classified 'NATO SECRET' and submitted to agencies according to ACE Directive 80-15. The template is located in Annex I and a completed example is provided in the following pages for reference.

NATIONAL ADR CAPABILITY DECLARATION
EXAMPLE

Nation:_____XYZ___________ Date:__ 20 May 2014____

Repair Time	Repair Type	Capability			Aircraft
		Low Damage	Moderate Damage	High Damage	
4 hrs	Expedient	Small	Medium	NC	Fighters & Cargo only
≤ 1 day:	Expedient	Small	Medium	NC	Fighters & Cargo only
	Temporary	Medium	NC	NA	Fighters & Cargo & Tanker
	Permanent	NA	NA	NA	NA
2-5 days	Expedient	Small	Small	Medium	Fighters & Cargo only
	Temporary	Small	Medium	NC	Fighters & Cargo & Tanker
	Permanent	Medium (Contract)	NC	NA	Fighters & Cargo & Tanker
6-15 days	Expedient	Small	Small	Small	Fighters & Cargo only
	Temporary	Small	Small	Medium	Fighters & Cargo only
	Permanent	Medium (Contract)	Medium (Contract)	NC	Fighters & Cargo & Tanker
16-30 days	Expedient	Small	Small	Small	Fighters & Cargo only
	Temporary	Small	Small	Small	Fighters, Cargo & Tankers
	Permanent	Small (Contract)	Medium (Contract)	NC	Fighters, Cargo & Tankers

ADR Repair Capability per Damage Type				
Damage Type		Pavement Surface Type		
		Asphalt	Concrete	Semi-Prepared
Kinetic	Large Crater(s)	❑	❑	❑
	Small Crater(s)	❑	❑	❑
	Camouflet(s)	❑	❑	❑
	Spall(s)	☑	☑	☑
Non-Kinetic	Structural Damage	❑	❑	❑
	Non-Structural Damage	☑	☑	☑

Instructions

1. Specify Capability (Small, Medium or Large) for each block
2. Specify Method of Execution if other than by nation's own military forces (Contract or MOU)
3. Enter 'NC' in blocks where there is No Capability for repair
4. Check the boxes at the left to specify your nation's repair capability for each damage type
5. List exceptions or provide further details on the following page. Use additional pages as necessary.

ADR CAPABILITY DECLARATION EXCEPTIONS AND OTHER DETAILS:

1	Crater Repair: Nation XYZ does not train or certify in crater repair and cannot repair craters of any size with its own military forces. Nation XYZ could perform crater repair if a contract were established. Nation XYZ is willing and able to establish a contract on a case by case basis. However, contract procurement would exceed 30 days.
2	Permanent Repair: Nation XYZ cannot perform permanent repairs with its own military forces. Nation XYZ is willing and able to establish a contract for specific missions as needed if required by NATO.
3	Structural Damage: Nation XYZ does not train or certify in contingency structural damage repair.
4	
5	
6	
7	

ANNEX A LEXICON

A.1. TERMS AND DEFINITIONS

Camouflet
The resulting cavity in a deep underground burst when there is no rupture of the surface.
[AAP-061]
NATO Agreed

Hammerhead
The area near the threshold of a runway used by an aircraft for turning around.
Not NATO Agreed

Keel
The centre line section of a runway from end to end; the primary part of the runway supporting the actual landing gear wheel traffic. For example, if a runway is 60 m (196 ft) wide, the keel may be considered the centre 30 m (98 ft) width wise, running the length of the runway.
Not NATO Agreed

Spall
Material, especially small pieces of rock, detached from a surface by passage of a shock.
[AOP-38]
NATO Agreed

A.2. ABBREVIATIONS AND FULL FORMS

AC
Asphalt

ACN
Aircraft Classification Number

ADR
Airfield Damage Repair

AF
Adjustment factors

AFIA
Armed Forces Intelligence Assessment

AGL
Allowable Gross Load

AOS
Airfield Operating Surfaces

CBRN
Chemical, Biological, Radiological, and Nuclear

CFR
Crash, Fire, and Rescue

DOB
Deployed Operating Base

DRNV
Damage Rating Numeric Value

EKD
Existing Kinetic Damage

EMP
Electronic Magnetic Pulse

ENKD
Existing Non-Kinetic Damage

EOD
Explosive Ordnance Disposal

EOR
Explosive Ordnance Reconnaissance

FFM
Folded Fibreglass Mat

FKD
Future Kinetic Damage

FNKD
Future Non-Kinetic Damage

FOC
Full Operational Capability

FOD
Foreign Object Damage

FRP
Fibreglass Reinforced Plastic

IED
Improvised Explosive Devices

IOC
Initial Operational Capability

ISTAR
Intelligence, Surveillance Target Acquisition and Reconnaissance

MAOS
Minimum Airfield Operating Surface

MOB
Main Operating Base

MOS
Minimum Operating Strip

MRBM
Medium Range Ballistic Missile

N/A
Not applicable

NIPA
NATO Intelligence Proliferation Assessment

NOTAM
Notice to Airmen

NRF
NATO Reaction Force

NSIE
NATO Strategic Intelligence Estimate

PCC
Portland Cement concrete

PCI
Pavement Condition Index

PCN
Pavement Classification Number

RAOS
Repair of Airfield Operating Surfaces

RESF
Repair of Essential Services & Facilities

RPG
Rocket Propelled Grenade

RQC
Repair Quality Criteria

SF
Square Feet

SNIC
Snow and Ice Removal

SPRO
Semi-Prepared Runway Operations

TACEVAL
Tactical Evaluation

TBD
To be determined

UXO
Unexploded ordnance

VBIED
Vehicle-Borne Improvised Explosive Device

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ANNEX B EXAMPLE OF DETERMINING RAOS CAPABILITY

B.1. OVERVIEW

B.1.1. In this Annex, examples are given for the three key scenarios during an operation*:*

a. Activation

b. Sustainment

c. Post-Attack Recovery

B.1.2. There may be multiple scenarios within these three, especially during sustainment. As noted, determining capability needs to be an iterative process through the operation. A large capability may be needed initially, then during the first half of an operation a small capability may be required, and then for the second half, for example due to a change in ops tempo, a medium capability may be required. Last, it is important to check capability against post-attack requirements. A small capability may be sufficient for activation and sustainment, but, for example, due to the high risk of attack and very short timelines for repairs, a medium capability may be necessary to meet post-attack recovery requirements.

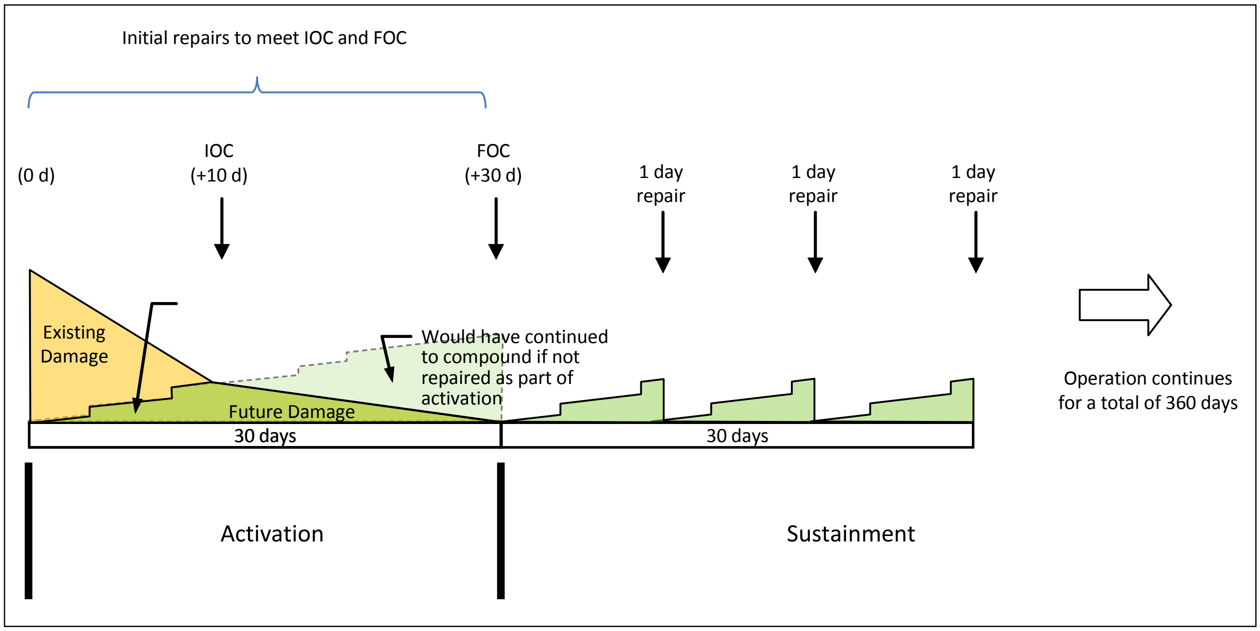

Figure B-1. Example Scenario

B.2. SCENARIO 1: ACTIVATION

B.2.1. Data Gathering

1. Airfield Operating Surfaces

Table B-1. Airfield Operating Surfaces

Surface	Area (x1000 m2)	PCI	PCN	Pavement Thickness (cm)	Notes
Runways					
R1	190	65	55 RAWT	35	Thresholds are 35 cm thick
Taxiways					
T1	50	50	54 FAWT	15	
T2	40	50	39 FAWT	10	
T3	40	70	54 FAWT	15	
T4	50	70	39 FAWT	10	
Parking Aprons					
PA	150	60	41 RAWT	25	
PB	150	70	35 RAWT	20	

NOTE: Pavement type is identified by the first letter in PCN (F = flexible (e.g. asphalt), R = rigid (e.g. concrete)).

2. Mission

a. Aircraft

Table B-2. Aircraft Operating Surface Requirements

Qty of Aircraft	Aircraft	ACN (Rigid)	ACN (Flexible)	Sorties/Month (total)	Notes
Cargo					
transient	C-17	51	50	30	
transient	C-130	30	27	30	
transient	A400M	20	19	30	
Refueling and ISTAR					
2	Sentry E3D	40	39	60	
1	A310MRTT	45	47	60	
1	Tristar	57	66	60	
Fighter					

8	Tornado	28	26	240	
8	Typhoon	21	20	240	
8	Rafale	26	24	240	

b. IOC - + 10 days

c. FOC = +30 days

d. Duration = 360 days

3. Environment: Temperature and precipitation

Table B-3. Average Temperature and Precipitation

Month	Average High	Average Low	Average Precipitation
January	26.0° C	17.0° C	1.27 cm
February	26.0° C	18.0° C	2.54 cm
March	30.0° C	21.0° C	1.52 cm
April	35.0° C	25.0° C	1.78 cm
May	40.0° C	29.0° C	0.76 cm
June	40.0° C	31.0° C	0.00 cm
July	39.0° C	30.0° C	0.00 cm
August	36.0° C	28.0° C	0.00 cm
September	36.0° C	28.0° C	0.00 cm
October	35.0° C	25.0° C	0.00 cm
November	31.0° C	21.0° C	0.76 cm
December	27.0° C	19.0° C	1.27 cm

4. Intelligence

a. Permissive (perimeter established and secured), though base will likely come under frequent mortar and rocket attacks—estimate 200 hits on airfield operating surfaces per 30 days in light of all offensive and defensive factors.

b. Potential for occasional Medium Range Ballistic Missile (MRBM) attacks exist—estimate possibility of 3 hits per 30 days on airfield operating surfaces in light of all offensive and defensive factors.

c. Areas adjacent to ramp have munitions storage areas with old HN munitions that must be addressed.

d. CBRN: No threat.

5. RESF, Airfield Lighting, Arrestor Gear

a. Arrestor Gear: No gear available.

b. Airfield lighting non-functional

c. No accommodations available

6. Logistics

a. Local material availability: Local quarries available, but limited availability of asphalt and concrete. Recommend bringing mobile batch plants.

b. Local equipment: Limited local heavy equipment.

c. Deep water ports: 70 km (43 miles) away.

d. No local labour available to work on base due to security concerns.

7. Kinetic threat

a. Redundancy of systems:

(1) Airfield Operating Surfaces

(a) Parking Aprons: Some redundancy—ramp fairly large so parking can be reconfigured or compacted if needed.

(b) Taxiways: At least two taxiways exist per ramp.

(c) Runway: Minimal redundancy

(2) RESF, Airfield Lighting, Arrestor Gear

(a) Arrestor gear: None currently.

(b) Airfield lighting: Only one existing system but it is non-functional.

b. Robustness of systems: Airfield Operating Surfaces thicknesses: See AOS Table.

c. Defensive Measures: The effectiveness of defensive measures was considered under the intelligence information.

d. Capacity of Enemy: Covered under intelligence.

e. Capacity of friendly forces: Covered by Operations (S3)

f. Geographic Location: Covered under intelligence.

g. Mission criticality: Covered under intelligence.

B.2.2. Threat Assessment

1. Future Kinetic Threat Assessment: Covered under Intelligence.

2. Future Non-Kinetic Threat Assessment

a. Runway: As noted, the runway is 35 years old with a PCI of 65.

(1) Usage: Runway is suitable for all operations as the ACN/PCN ratio is 1.0 or less for all assigned aircraft. Some initial maintenance will be required to increase the PCI to acceptable levels. After initial repairs, only normal maintenance should be required despite a high sortie rate for some aircraft.

(2) Environmental conditions (natural causes): During the rainy season, the flooding will significantly increase the damage to due to flooding (increased spalling, degradation of subbase). The assumption is that during the first 30 days, there will be minimal rainfall. However, the following month will be in the rainy season.

(3) Summary: Low threat of future non-kinetic damage.

b. Taxiway 1: As noted, the taxiway is 35 years old with PCI of 50.

(1) Usage: Taxiway is suitable for all operations, except for Tristar. For the Tristar, the ACN/PCN ratio is 1.2 so there is the potential for increased load related distresses. 35 years far exceeds the expected life of pavement. Both initial and future maintenance will be high.

(2) Environmental conditions (natural causes): Same as runway.

(3) Summary: Moderate threat of future non-kinetic damage.

c. Taxiway 2: As noted, the taxiway is 35 years old with PCI of 50

(1) Usage: Taxiways are suitable for all operations, except for Tristar and A310-MRTT. For the Tristar, the ACN/PCN ratio is 1.7 so there is significant potential for increased load related distresses. For the A310-MRTT, the ACN/PCN ratio is 1.2 so there is the

potential for increased load related distresses. 35 years far exceeds the expected life of pavement. Both initial and future maintenance will be high.

(2) Environmental conditions (natural causes): Same as runway.

(3) Summary: High threat of future non-kinetic damage.

d. Taxiway 3: As noted, the taxiway is 35 years old with PCI of 70

(1) Usage: Taxiways are suitable for all operations, except for Tristar. For the Tristar, the ACN/PCN ratio is 1.2 so there is the potential for increased load related distresses. 35 years far exceeds the expected life of pavement. Both initial and future maintenance will be high.

(2) Environmental conditions (natural causes): Same as runway.

(3) Summary: Moderate threat of future non-kinetic damage.

e. Taxiway 4: As noted, the taxiway is 35 years old with PCI of 70

(1) Usage: Taxiways are suitable for all operations, except for Tristar and A310-MRTT. For the Tristar, the ACN/PCN ratio is 1.7 so there is significant potential for increased load related distresses. For the A310-MRTT, the ACN/PCN ratio is 1.2 so there is the potential for increased load related distresses. 35 years far exceeds the expected life of pavement. Both initial and future maintenance will be high.

(2) Environmental conditions (natural causes): Same as runway.

(3) Summary: High threat of future non-kinetic damage.

f. Parking Apron A:

(1) Usage: Parking Apron A is suitable for specified aircraft (tanker and cargo aircraft). The ACN/PCN ratio is approximately 1.0 so there is minimal potential for increased load related distresses. Minimal initial and future maintenance will be minimal.

(2) Environmental conditions (natural causes): Same as runway.

(3) Summary: Low threat of future non-kinetic damage.

g. Parking Apron B:

(1) Usage: Parking Apron B is suitable for specified aircraft (fighters). The ACN/PCN ratio is > 1.0 so there is minimal potential for increased load related distresses. Minimal initial and future maintenance will be minimal.

(2) Environmental conditions (natural causes): Same as runway.

(3) Summary: Low threat of future non-kinetic damage.

B.2.3. Determining Required RAOS Capability

1. <u>Determine Damage</u>

a. Existing Kinetic Damage (EKD): Per the site survey, the following damage exists:

(1) Craters: 2 small

(2) Spalls: 100

Overall Existing Kinetic Damage: Low (1)

b. Non-Kinetic Damage (ENKD): Per the site survey, the individual surface non-kinetic damages are:

(1) Runway: Existing Non-Kinetic Damage: Low

(2) Taxiways 1 and 2: Existing Non-Kinetic Damage: Med

(3) Taxiways 3 and 4: Existing Non-Kinetic Damage: Low

(4) Parking Aprons 1 and 2: Existing Non-Kinetic Damage: Low

However, for multiple surfaces, as explained in Chapter 3, calculate overall ENKD using PCI weighted averages.

Table B-4. ENKD Calculations

Designator	PCI	Area (x1000 m2)	PCI x A
R1	65	190	12350
T1	50	50	2500
T2	50	40	2000
T3	70	40	2800
T4	70	50	3500

Designator	PCI	Area (x1000 m2)	PCI x A
PA	60	150	9000
PB	70	150	10500

Sum of Areas		670	
Summation of PCI x A			42650
PCI weighted average	64		

Thus, overall ENKD is low (1).

c. Future:

(1) Kinetic Damage (FKD): Per the threat analysis, the following future damage is estimated to occur over any given 30 day period:

(a) Craters: 3 large

(b) Spalls: 200

(c) Overall Future Kinetic Damage: Moderate (3)

(2) Non-Kinetic Damage (FNKD): Per the threat analysis, including a comparison of ACN versus PCN and sortie rates, the following future non-kinetic damage is estimated to occur over any given 30 day period:

(a) Runway: Low (value = 1)

(b) Taxiways 2 and 4: High (value = 5)

(c) Taxiways 1 and 3: Moderate (value = 3)

(d) Parking Aprons A and B: Low (value = 1)

(3) Overall: As explained in Chapter 3, when estimating FNKD for multiple operating surfaces, calculated a FNKD weighted average based on area.

Table B-5. FNKD Calculations

Designator	FNKD value	Area (x1000 m2)	PCI x A
R1	1	190	190
T1	3	50	150
T2	5	40	200
T3	3	40	120
T4	5	50	250
PA	1	150	150
PB	1	150	150
Sum of Areas		670	
Summation of FNKD x A			1210
FNKD weighted average value	1.8		

d. Overall Damage Rating:

Damage Rating Numeric Value = (EKD + ENKD + FKD + FNKD) /4
= 1 + 1 + 3 + 1.8) / 4 = 1.70

Table B-6. Overall Damage Rating

Damage Rating	DRNV Numeric Range
Low	1 to 1.4
Moderate	1.5 to 3.4
High	3.5 or greater

2. <u>Determine Criteria</u>

a. Time Constraints: IOC must be met in 10 days and FOC in 30 days.

b. Type of Aircraft: Fighter, Cargo, and Tanker

c. Number of passes: It is assumed that repairs made early in the activation process must withstand at least 30 days of operations so that the repair will still be sound at the time of FOC. There will be heavy initial airlift leading up to IOC, and probably through to FOC, though the sortie rate of fighter and ISR aircraft will be less than normal until FOC. Once at FOC, there will be 800 passes every 30 days. During activation, it is assumed there will be at least half of that in light of the additional airlift—400 passes.

d. Type of Repair: In light of the above information, repair type is Temporary. Note that because there are refuelers operating, expedient repair methods cannot be used even if they met number of passes criteria.

3. <u>Determine Capability</u>

a. From the Repair Capability graphs in Annex G & the below known information:

(1) Known information:

(a) DRNV = 1.7

(b) Repair time of 30 Days (the scenario could be further split into the time period from activation start to IOC, and then IOC to FOC; for simplicity, this example considers the full 30 days of activation)

(c) Type of Aircraft: Fighter, Cargo and Tanker

(d) Type of Repair: Temporary

(2) Required Work Units = approximately 40,000 (from Temporary Repair Graph)

(3) Required Repair Capability: Small (for FOC of 30-day repair time)

b. Additional RAOS factors

(1) Operation Type: Permissive environment, no adjustment required.

(2) UXO Clearance: N/A.

(3) CBRN Environment: N/A.

(4) Environmental Conditions: High temperature (55 degrees C / 130 degrees F) and high humidity—increase capability 25%.

(5) Airfield Size: Size less than 1.4 km2. No adjustment.

(6) Pavement Thickness: Runway thickness exceeds 30 cm (12 inches)—increase capability 10% to account for increase time to repair thicker concrete.

(7) AOS Redundancy: Alternate runway (taxiway) and alternate taxiways—reduce capability required by 10%.

(8) Logistical Factors: No adjustment required.

(9) Net result:

25% + 10% - 10% = 25% increase required;

Next, apply this percentage to the Damage Rating to determine an adjusted damage rating called the Adjusted DRNV:

Adjusted DRNV = 1.70 x 1.25 = 2.125

c. Adjusted Capability (based on Adjusted DRNV)

(1) Known information

(a) Adjusted DRNV = 2.125

(b) Repair Time = 30 days

(c) Type of Aircraft: Fighter, Cargo and Tanker

(d) Type of Repair: Temporary

(2) Work Units (from Temporary Graph): approximately 48,000

(3) Capability Required = Small

(The capability remains Small even after adjusting DRNV.)

B.3. SCENARIO 2: SUSTAINMENT

B.3.1. General

1. The previous scenario continues, but now operations have moved from activation to sustainment. It is assumed that due to operational tempo, maintenance crews are only given approximately 8 hours every 10 days for any significant maintenance. (It is understood that scenarios can vary greatly. Maintenance crews will generally have multiple and varying time periods each week in which to do repair work. This is dependent on airfield ops tempo. Close coordination between maintenance personnel and airfield ops is required.)

2. Repair of Existing Damage during Activation: While significant repairs were made during activation to make the airfield operational, the overall PCNs and PCIs of surfaces were not significantly improved.

B.3.2. Data Gathering

1. Airfield: Same as Scenario 1.

2. Mission: Same as Scenario 1.

3. Environment:: Same as Scenario 1.

4. Intelligence: Same as Scenario 1, except that legacy issues have been resolved.

5. RESF, Airfield Lighting and Arrestor Gear: Same as Scenario 1.

6. Logistics: Same as Scenario 1.

7. Kinetic threat: Same as Scenario 1.

B.3.3. Threat Assessment

Same as Scenario 1.

B.3.4. Determining Required RAOS Capability

1. Determine Damage

    a. Existing: All essential repairs were made during activation. PCNs and PCIs were not changed significantly, so EKD and EKND remain Low.

b. Future: Estimate 30 days worth of damage (regardless of repair time constraints. The graph curves factor in & adjust for damage time).

(1) Kinetic Damage (FKD):

(a) 30 day period: Per the threat analysis in Scenario 1, the following future damage is estimated to occur over any given 30 day period:

- Craters: 3 large
- Spalls: 200
- Overall Future Kinetic Damage: Moderate

(2) Non-Kinetic Damage (FNKD):

(a) 30-day Period: Per the threat analysis, the future non-kinetic damage was estimated to be 1.8.

c. Overall Damage Rating:

DRNV = (EKD + ENKD + FKD + FNKD) / 4
= (1 + 1 + 3 + 1.8)/4
= 1.7

2. Determine Criteria

a. Repair Time: 10 days (scheduled repair increment)

b. Type of Aircraft: Fighter, Cargo, and Tanker

c. Repairs must last at least 10 days. In 10 days of full operations there will be approximately 260 passes. Therefore, the repair type must be at least Temporary.

d. Type of Repair: Temporary

3. Determine Capability.

a. From the Repair Capability graphs in Annex G & the below known information:

(1) Known information:

(a) DRNV = 1.7

(b) Repair time: 10 days (scheduled repair increment)

(c) Type of Aircraft: Fighter, Cargo and Tanker

(d) Type of Repair: Temporary

(2) Required Work Units = approximately 32,000 (from Temporary Repair Graph)

(3) Required Repair Capability: Small (Since the crew is only able to work 8 hours every 10 days, engineering judgement must be made to determine if a Small capability will be sufficient.)

b. Additional RAOS factors

(1) Operation Type: Permissive environment, no adjustment required.

(2) UXO Clearance: N/A.

(3) CBRN Environment: N/A.

(4) Environmental Conditions: High temperature (55 degrees C / 130 degrees F) and high humidity—increase capability 25%.

(5) Airfield Size: Size less than 1.4 km2. No adjustment.

(6) Pavement Thickness: Runway thickness exceeds 30 cm (12 inches)—increase capability 10% to account for increase time to repair thicker concrete.

(7) AOS Redundancy: Alternate runway (taxiway) and alternate taxiways—reduce capability required by 10%.

(8) Logistics Factors: No adjustment required.

(9) Net result:

25% + 10% - 10% = 25% increase required;

Next, apply this percentage to the Damage Rating to determine an adjusted damage rating called the Adjusted DRNV:

Adjusted DRNV = 1.7 x 1.25 = 2.125

c. Adjusted Capability (based on Adjusted DRNV)

(1) Known information

(a) Adjusted DRNV = 2.125

(b) Repair Time = 10 days

(c) Type of Aircraft: Fighter, Cargo and Tanker

(d) Type of Repair: Temporary

(2) Work Units (from Temporary Graph): approximately 36,000

(3) Capability Required = Small

(The capability remains Small even after adjusting DRNV.)

B.4. SCENARIO 3: POST-ATTACK RECOVERY

B.4.1. General

1. One last scenario will be considered—post-attack recovery. There may be situations in which constraints on repair times and the severity of a single attack could warrant a greater capability than sustainment.

2. In this example, operations dictate that the airfield must be functional (MOS) within 6 hrs after an attack.

B.4.2. Data Gathering

1. Airfield: Same as Scenario 1.

2. Mission: Same as Scenario 1.

3. Environment: Same as Scenario 1.

4. Intelligence: Same as Scenario 1, except that legacy issues have been resolved.

5. RESF, Airfield Lighting and Arrestor Gear: Same as Scenario 1.

6. Logistics: Same as Scenario 1.

7. Kinetic threat: Same as Scenario 1.

B.4.3. Threat Assessment

Same as Scenario 1.

B.4.4. Determining Required RAOS Capability

1. Determine Damage

   a. Existing: All essential repairs were made during activation. PCNs and PCIs were not changed significantly, so EKD and ENKD is Low.

   b. Future: In this scenario, only kinetic damage caused by an attack will be considered. (There may be rare cases where a natural event (severe flooding, etc.) may cause a similar scenario.) Based on intelligence reports, a worse case scenario of attacks resulting in 2 large craters will be used. This equates Moderate damage.

c. Overall Damage Rating (assuming the attack has not yet occurred):

Damage Rating Numeric Value = (EKD + ENKD + FKD + FNKD) / 4
= (1 + 1 + 3 + 1)/4
= 1.5

2. Determine Criteria.

a. Time Constraints: Time constraints are fairly severe in this case—6 hours. However, it can be assumed that this would be a one time effort and not have to be sustained.

b. Type of Aircraft: Fighter, Cargo, and Tanker

c. Number of passes: Assume repairs have to last at least 10 days, the typical scheduled time between repairs in the sustainment scenario. This would mean the repairs would have to sustain approximately 260 passes. Therefore, the repair type must be at least temporary. Also because tankers are operating, expedient repairs are not sufficient.

d. Type of Repair: Temporary.

3. Determine Capability.

a. From the Repair Capability graphs in Annex G & the below known information:

(1) Known information:

(a) DRNV = 1.5

(b) Repair Time: < 1 day

(c) Type of Aircraft: Fighter, Cargo, and Tanker

(d) Type of Repair: Temporary

(2) Required Work Units = approximately 18,000 (from Temporary Repair Graph)

(3) Required Repair Capability: Medium (from the Enlarged View Capability Graph)

(4) So, in this particular scenario, even though the sustainment load only requires a Small capability, if there was moderate damage from a post-attack, the required capability would be Medium (this is due mostly because of the temporary repair requirement of the tankers).

b. Additional RAOS factors

(1) Operation Type: Permissive environment, no adjustment required.

(2) UXO Clearance: N/A.

(3) CBRN Environment: N/A.

(4) Environmental Conditions: High temperature (55 degrees C / 130 degrees F) and high humidity—increase capability 25%.

(5) Airfield Size: Size less than 1.4 km2. No adjustment.

(6) Pavement Thickness: Runway thickness exceeds 30 cm (12 inches)—increase capability 10% to account for increase time to repair thicker concrete.

(7) AOS Redundancy: Alternate runway (taxiway) and alternate taxiways—reduce capability required by 10%.

(8) Logistics Factors: No adjustment required.

(9) Net result:

25% + 10% - 10% = 25% increase required;

Next, apply this percentage to the Damage Rating to determine an adjusted damage rating called the Adjusted DRNV:

Adjusted DRNV = 1.5 x 1.25 = 1.875

c. Adjusted Capability (based on Adjusted DRNV)

(1) Known information

(a) Adjusted DRNV = 1.875

(b) Repair Time = < 1 day

(c) Type of Aircraft: Fighter, Cargo and Tanker

(d) Type of Repair: Temporary

(2) Work Units (from Temporary Graph): approximately 22,000

(3) Capability Required = Medium/Large

(In this case, applying additional factors and adjusting DRNV changed the required capability from Medium to Medium/Large (on the dividing line).

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ANNEX C RESF: REPAIR OF ESSENTIAL SERVICES AND FACILITIES

In addition to aircraft operating surfaces, essential facilities and services may need to be repaired to ensure continued operation. Examples of essential services and facilities are listed below along with corresponding Working Groups or Panels and relevant STANAGs. The RESF list will vary from location to location depending on aircraft and mission.

Service / Facility	Working Group or Panel	Standardization Agreements (STANAGs)
Facilities and Systems		
Operational Facilities	Military Engineering Working Group	STANAG 7131 – Aircraft Classification Number (ACN) - Pavement Classification Number (PCN) - AEP-46
Communications	Communication and Identification Services Capability Panel	STANAG 4606 – Super High Frequency (SHF) Medium Data Rate (MDR) Military Satellite Communications Jam-Resistant Modem Interoperability Standards STANAG 5068 – Secure Communications Interoperability Protocol (SCIP)
Airfield Lighting and Aircraft Arrestor Systems	Airfield Marking, Lighting and Infrastructure Panel (AMLIP)	STANAG 3316 – Airfield Lighting (permanent) STANAG 3534 – Airfield Lighting (non-permanent) STANAG 3346 – Marking and Lighting of Airfield Obstruction STANAG 3697 – Airfield Aircraft Arresting Systems
Air Traffic Control Facilities	Airfield Services Procedures Panel (ASPP)	STANAG 7025 – Air Traffic Management and Control of Minimum Operating Strips (MOS) Operations STANAG 3758 – Signals Used by Air Traffic Service Units for Control of Pedestrian and Vehicular Traffic in the Manoeuvring Area of Airfields
Ammunition / Weapons Storage Facilities	Explosives Safety/Munitions Risk Management ALP D Panel (ESMRM ALP D Panel); Logistic Storage & Disposal	STANAG 4440 – Manual of NATO Safety Principals for the Storage of Military Ammunition and Explosives STANAG 4442 – Application of Risk Analysis to the Storage and Transport of Military Ammunition and Explosives - AASTP-4 STANAG 4657 – NATO Guidelines for the Storage, Maintenance and Transport of Ammunition on Deployed Missions or Operations

Fuel Storage and Distribution	Military Engineering Working Group	STANAG 3747 – Minimum POL Standards STANAG 3784 – POL Facilities on NATO Airfields STANAG 3609 – Standards for Maintenance of Fixed Aviation Fuel receipt, Storage and Dispensing Systems STANAG 3756 – Facilities and Equipment for Receipt and Delivery of Aviation Kerosene and Diesel Fuels STANAG 3784 – Technical Guidance for the Design and Construction of Aviation and Ground Fuel Installations on NATO Airfields STANAG 3609 – Standards for Maintenance of Fixed Aviation Fuel Receipt, Storage and Dispensing Systems STANAG 4712 – Standards for Maintenance of Deployable Fuel, Receipt, Storage and Dispensing Systems
Electrical Power Plants and Distribution	Military Engineering Working Group	STANAG 4133 – Method of Specifying Electrical Power Supplies
Water Supply and Distribution	Military Engineering Working Group	STANAG 2136 – Min Standards of Water Potability during Field Operations and Emergency Situations
Liquid Oxygen Storage and Distribution	Aircraft Gaseous Systems Panel	STANAG 7175 – Definition of Safety Zones and Minimum Separation Distances for Use with Liquid Oxygen
Personnel Shelters and Decontamination Facilities	Military Engineering Working Group	STANAG 2528 – Allied Joint Force Protection STANAG 2280 – Design Threat Levels and Handover Procedures for Temporary Protective Structures STANAG 2873 – Concept of Operations of Medical Support in CBRN Environments - AMedP-07(D) STANAG 4192 – Design Criteria and Construction Parameters for Collective Protection (COLPRO) Facilities on Land
Critical Medical Facilities	Mil Eng WG; Military Medical Structures, Operations and Procedures Working Group (MMSOPWG)	STANAG 2584 – Civil-Military Planning Process on Oral Health Care and Deployment of Dental Capabilities in Humanitarian Operations STANAG 2598 – Allied Joint Medical Doctrine for Military Health Care STANAG 7212 – Aerospace Medical Doctrine

Key Access Routes	Military Engineering Working Group	STANAG 2010 – Military Load classification Markings STANAG 2021 – Military Load Classification of Bridges, Ferries, Rafts and Vehicles
Services		
Crash, Fire, and Rescue Services	Crash Fire-Fighting and Rescue Panel (CFRP)	STANAG 3712 – ARFF Services Identification Categories STANAG 3896 – Aerospace Emergency Rescue and Mishap Response Information (Emergency Services) STANAG 3929 – Evaluation Guide for NATO Crash/Fire/Rescue Services STANAG 7048 – Crash, Fire-Fighting and Rescue (CFR) Response Readiness STANAG 7051 – Minimum Requirements for CFR Operations in Support of Home Station and Deployed Operations STANAG 7133 – Minimum Level of CFR for Deployed Fixed & Rotary Wing Aircraft

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ANNEX D RAOS PROCESS AND METHODS OF REPAIR

D.1. RAOS PROCESS

a. Damage Assessment: The first step in the RAOS process is assessing the damage. Depending on the situation, expedient methods may be used (e.g. expedient assessment after an attack on an airfield, simply plotting spalls, craters, and UXOs) or, if time permits, more detailed assessment (core samples, etc.).

b. MOS selection: select the best airfield surfaces to repair based on those areas that require the least repair time while still providing adequate launch and recover surfaces for the mission aircraft. The length of a Minimum Operating Strip (MOS) can vary considerably depending on the aircraft, altitude, temperature, and surface condition of the runway as well as whether the aircraft will be taking off, landing, or making a landing using an arresting gear, In general, the higher the altitude and greater the temperature, the longer the required MOS will be. While some nations have charts that engineers can use to determine MOS lengths, usually the information on the required MOS length will be obtained from the operational (Wing) Commander or their representative. The Commander will also provide the MOS width although in general, it will usually be 15 meters (50 feet for US) for fighters, 27 meters (90 feet for US) for cargo aircraft, and full width of the runway for tanker aircraft.

c. Repair: The final step is the repair of the airfield.

D.2. METHODS OF REPAIR

Note that the demarcations between expedient, temporary, and permanent are not exact. For example, the slab method can be considered expedient or temporary.

a. Expedient

(1) Crushed Stone with Foreign Object Damage (FOD) Cover: This method consists of a compacted crush stone base with a FOD cover.

(2) Crushed Stone without FOD Cover: This method consists of a compacted crush stone base without a FOD cover.

(3) Sand Grid with FOD Cover: This method consists of a rigid grid (e.g. honeycomb) filled with sand to form a load-distributing base, with a FOD cover on top.

(4) AM-2 Mat: This method consists of an aluminum mat over a compacted base. It is used primarily for taxiways or aprons. .

(5) Slab Method: This consists of pre-cast concrete slabs on a compacted base.

(6) FOD Covers: Folded Fibreglass Mat (FFM)/Fibreglass Reinforced Plastic (FRP) and Class 60 track way are common FOD covers.

b. Temporary

(1) Stone and Grout: This method consists of a stone and grout cap over a compacted crushed stone base.

(2) Concrete Cap: This method consists of a concrete cap over a compacted base.

(3) Rapid Set Materials: For example, quick setting concrete over a compacted base.

c. Permanent Asphalt: This consists of asphalt over a compacted base.

d. Note: There are several experimental methods under development now.

D.3. SELECTION

Typical expedient and sustainment repair methodologies for MOS/AOS are shown in Table D-1 and include repair options, applicability of Foreign Object Damage (FOD) covers, and use of unsurfaced and stabilized soils. Notes at the bottom of Table D-1 indicate constraints based on a number of aircraft types. The selection of a repair method should consider the following factors:

a. Aircraft Type and Load. Each aircraft has distinct characteristics (e.g. wing span, tire pressure, load capacity, braking mechanism) that must be known when choosing the type of repair to accomplish.

b. Available Material. The type and quantity of material (e.g. backfill, crushed stone, fibreglass mat, spall, repair material, soil stabilization agents) available for a repair.

c. Available Equipment. The type and quantity of various pieces of construction equipment (e.g., dozer, front-end loader, roller, concrete mixing equipment) available for a repair.

d. Repair Quality Criteria (RQC). A single number representing the maximum allowable repair height in inches that various aircraft can tolerate on a MOS/MAOS.

e. Existing Pavement Structure. The configuration of the current pavement layers (e.g. concrete, asphalt over concrete, asphalt, compacted earth, etc.).

f. Time Constraints. The time allotted to accomplish the repairs before the first aircraft arrival or departure.

g. Repair Crew Capability/Equipment/Manpower. The repair crew's capacity for the task (e.g. experience, number of repair personnel, resource availability).

Table D-1. Repair Methods and Application

Current Repair Methods	**Runway Repair**		**Taxiway/Apron Repair**		**Taxiway/Apron Expansion**	
	Expedient	**Sustain**	**Expedient**	**Sustain**	**Expedient**	**Sustain**
Crater Repair						
Crushed stone with FOD cover	X (1)		X (1)			
Crushed stone without FOD cover	X (2)		X (2)			
Sand grid with FOD cover	X (1)		X (1)			
Stone and grout		X		X		
AM-2 mat	X (3)	X (3)	X	X	X	X
Rapid-set materials	X	X	X	X	X	X
Concrete cap		X		X		X
Asphalt		X		X		X
FOD Covers						
FRP/FFM	X (1)		X (1)			
Semi-prepared Surfaces						
Unsurfaced					X (4)	X (4)
Stabilized surface	X (4)		X (4)		X (4)	X (4)

NOTES:

1. Folded fibreglass mat (FFM)/fibreglass reinforced plastic (FRP) foreign object damage (FOD) covers are suitable only for fighter aircraft and some smaller tactical airlift aircraft

(e.g. C-130). These FOD covers are not approved for larger aircraft, including the C-17, C-5, C-141, KC-10, and KC-135.

2. Crushed stone repairs without FOD covers are approved for C-130, C-17, C-5, , and KC-10 operations.
3. AM-2 mat is suitable as a runway surface only for fighter and airlift aircraft , and then only if accomplished as a flush repair and installed and certified in accordance with set directives. .
4. Unsurfaced and/or stabilized surfaces are suitable for some aircraft (e.g. C-130 and C-17) See additional notes in Table D-1.

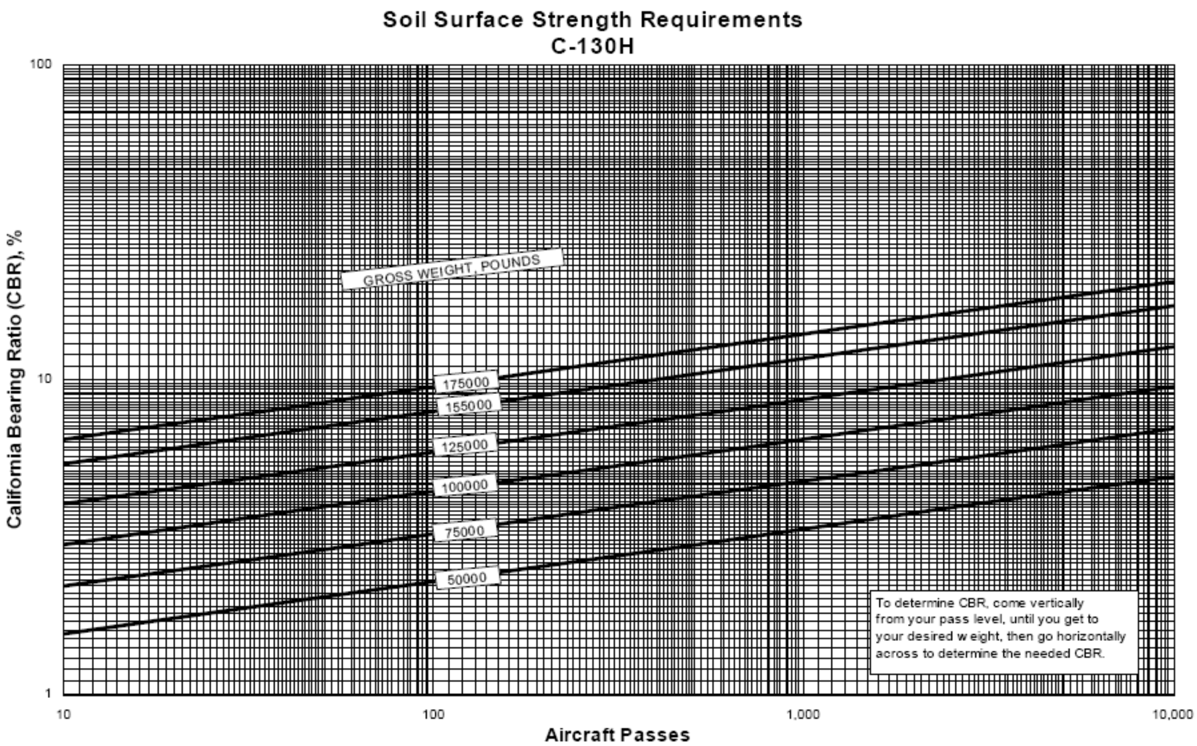


Figure D-1. Example Soil Surface Strength Requirement Chart

D.4. REPAIR QUALITY CRITERIA (RQC)

Personnel should attempt to make repairs flush with the original pavement surface; however, flush repairs are difficult to achieve under stringent time constraints. The RQC guidance should address whether or not non-flush repairs are usable and provide limits to indicate when repair maintenance is required.

a. Since different aircraft can withstand varying levels of runway roughness and weather and runway conditions may affect an aircraft's performance, a RQC system of charts and tables should be provided to allow quick and accurate determination of allowable crater repair roughness. An example chart is below.

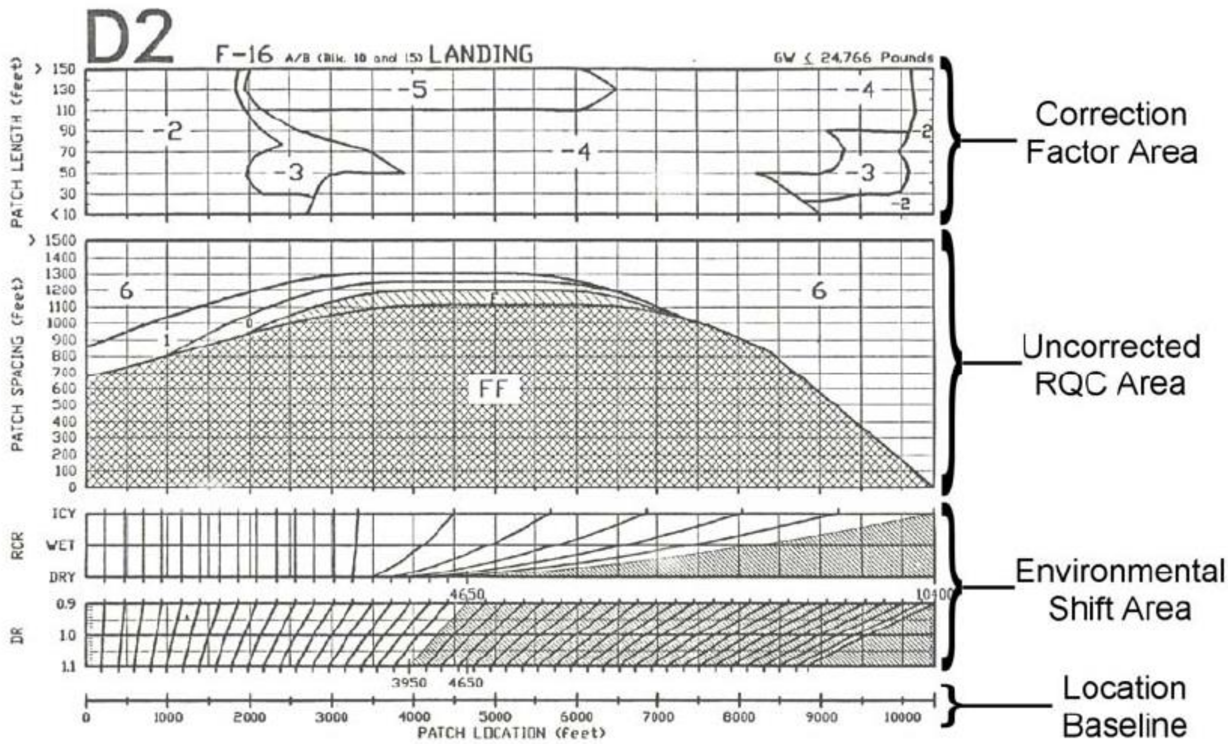


Figure D-2. Example RQC chart

b. All spall repairs are generally considered to be flush repairs. The allowable repair height should be determined from a specific RQC chart for a specific aircraft under specific operating and weather conditions. The actual crater repair height, measured as the difference between the height of the crater repair surface and the undamaged pavement surface, cannot exceed the maximum allowable value. Pertinent RQC features of a repaired crater are shown in Figure D-3. Critical values are:

(1) Repair height

(2) Sag depth

(3) Repair slope

c. Sag is defined as the maximum amount, in inches, that a repair surface drops below the maximum repair height. Allowing sag permits a repair to degrade with aircraft traffic without requiring excessive maintenance during sortie operations.

d. An expedient method of determining the height of a crater repair above the undamaged pavement is the use of stanchions and an elevation target. The crater height is the difference between the elevation rod readings at the top of the repair and on the undamaged pavement.

e. The maximum allowable repair slope is 5.0 percent change with respect to the undamaged pavement surface except when located in the landing touchdown zone where the maximum allowable repair slope is 3.4 percent.

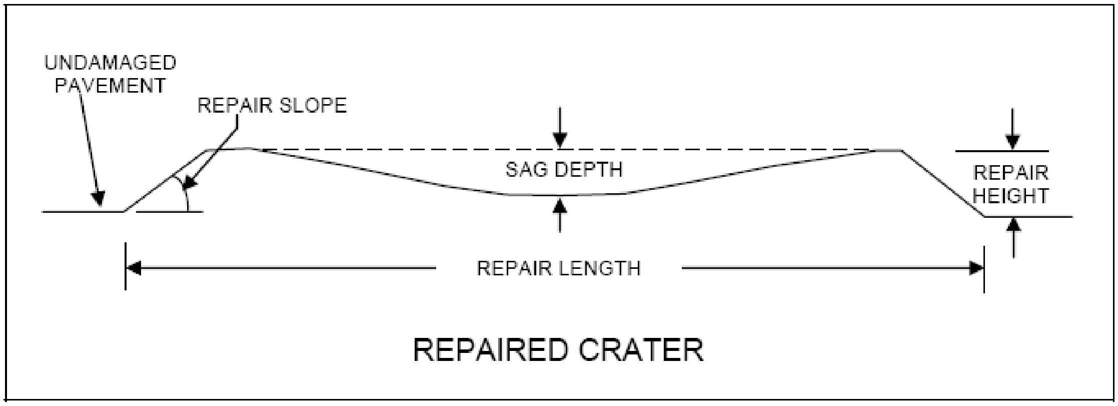


Figure D-3. Crater Repair Diagram

D.5. BACKFILL STRENGTH/COMPACTION

Guidance on backfill compaction can be found in U.S. Unified Facilities Criteria 03-270-07, Airfield Damage Repair or equivalent publication from other nations.

D.6. REPAIR EVALUATION METHODS

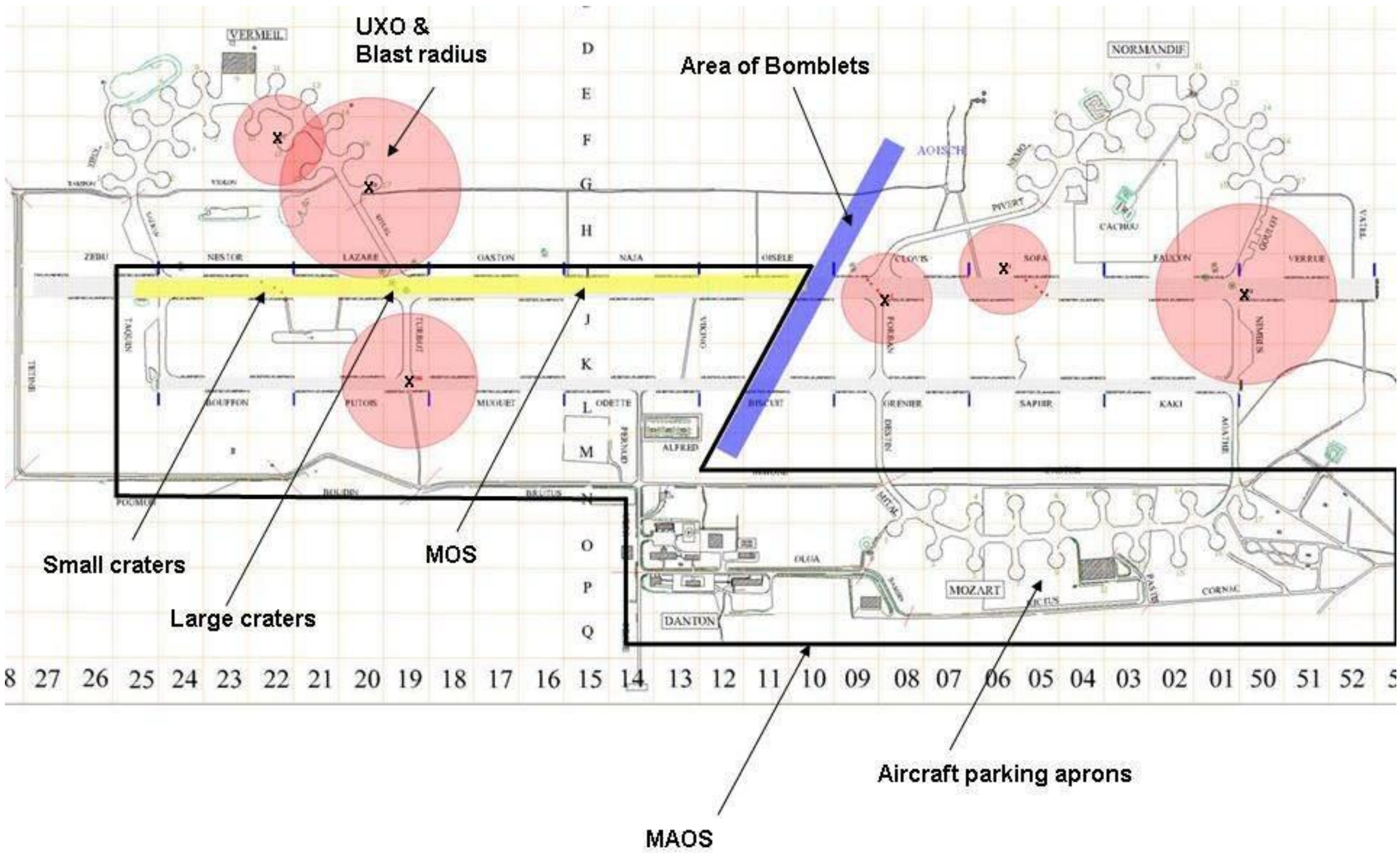
Crater repairs must be evaluated by a qualified individual before acceptance for aircraft.

D.7. AIRFIELD CERTIFICATION

An engineer should certify that the repairs were accomplished in accordance with the established procedures and should document the information in an ADR log. The log should then be updated to reflect subsequent aircraft traffic and required maintenance throughout the history of the repair. If another repair team replaces the initial team, the log should be given to the follow-on team to aid in planning or performing any further maintenance and/or upgrade of the repairs. The status of the airfield/repairs should be provided to the airfield manager, or other individuals authorized to monitor and control on-site aircraft operations, and a NOTAM should be issued with any changes in the airfield status.

ANNEX E AIRFIELD DAMAGE DIAGRAM & AVERAGE CONTINGENCY FOOTPRINTS

E.1. EXAMPLE AIRFIELD DAMAGE DIAGRAM



E.2. AVERAGE FOOTPRINT FOR CONTINGENCY AIRFIELDS

Average Footprint for Contingency airfields									
	Airfield Description	Function	Length (Feet)	Width (Feet)	Area (Square Ft)	Length (Meter)	Width (Meter)	Area (Square Meter)
Forward operating Airfield for Mobility Operations Runway with no taxiways or aprons just hammerheads (buttons) to turn aircraft	C-130 Minimum Length	Runway	3,500	60	210,000	1,067	18	19,510
		Overrun 1	500	60	30,000	152	18	2,787
		Overrun 2	500	60	30,000	152	18	2,787
		Hammerhead 1	110	35	3,850	34	11	358
		Hammerhead 2	110	35	3,850	34	11	358
		Total			**277,700**			**25,799**
	C-17 Minimum Length	Runway	6,000	90	540,000	1,829	27	50,168
		Overrun 1	500	90	45,000	152	27	4,181
		Overrun 2	500	90	45,000	152	27	4,181
		Hammerhead 1	165	50	8,250	50	15	766
		Hammerhead 2	165	50	8,250	50	15	766
		Total			**646,500**			**60,062**
	Optimum Runway Length Air Mobility Operations	Runway	10,000	150	1,500,000	3,048	46	139,355
		Overrun 1	1,000	150	150,000	305	46	13,935
		Overrun 2	1,000	150	150,000	305	46	13,935
		Hammerhead 1	275	50	13,750	84	15	1,277
		Hammerhead 2	275	50	13,750	84	15	1,277
		Total			**1,827,500**			**169,780**
Turnaround (or Hammerhead): An operational surface with dimensions to allow an aircraft to execute 180-degree turns without using reverse operations. Turnarounds can provide loading/off-loading capability on LZs with a parking MOG of one. See Attachment 1								

	Airfield Description	Function	Length (Feet)	Width (Feet)	Area (Square Ft)	Length (Meter)	Width (Meter)	Area (Square Meter)
Mission Beddown Airfield for fighter operations and Mobility Operations	Runway with parallel taxiway and an apron for mobility Ops and one for fighter Ops	Runway	10,000	150	1,500,000	3,048	46	139,355
		Overrun 1	1,000	150	150,000	305	46	13,935
		Overrun 2	1,000	150	150,000	305	46	13,935
		Parallel Taxiway	11,000	75	825,000	3,353	23	76,645
		Mobility Apron	500	300	150,000	152	91	13,935
		Fighter Apron	300	200	60,000	91	61	5,574
		Total			**2,775,000**			**257,806**

	Airfield Description	Function	Length (Feet)	Width (Feet)	Area (Square Ft)	Length (Meter)	Width (Meter)	Area (Square Meter)
Mission Beddown Airfield with multiple runways for fighter operations and Mobility Operations	Runway with parallel taxiway and an apron for mobility Ops and one for fighter Ops	Runway 1	10,000	150	1,500,000	3,048	46	139,355
		Overrun 1-1	1,000	150	150,000	305	46	13,935
		Overrun 1-2	1,000	150	150,000	305	46	13,935
		Runway 2	10,000	150	1,500,000	3,048	46	139,355
		Overrun 2-1	1,000	150	150,000	305	46	13,935
		Overrun 2-2	1,000	150	150,000	305	46	13,935
		Parallel Taxiway	11,000	75	825,000	3,353	23	76,645
		Ladder Taxiways	4,000	75	300,000	1,219	23	27,871
		Apron Taxiways	3,000	75	225,000	914	23	20,903
		Mobility Apron	1,000	300	300,000	305	91	27,871
		Fighter Apron	1,000	200	200,000	305	61	18,581
		Total			**5,250,000**			**487,741**

Note: A major operational base ranges in size from approximately 8 M SF (740 K SM) to approximately 15 M SF (1400 K SM) for Major installation. In some cases we may use large airports as strategic hubs. These airports can have 3 or more runways and multiple aprons and taxiways with, 20 M SF (1,800 SM) of pavement or more

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ANNEX F STEPS FOR DETERMINING ADR CAPABILITY

Below is a summary of the steps to determine the capability required to repair damage to an airfield. They are described in detail in Chapters 2 and 3.

Airfield Assessment

1. Gather Data: site data, pavement information, operational requirements, intelligence information, logistical and engineering resources

2. Determine Threat: kinetic (damage expected from weapons) and non-kinetic (damage expected from normal degradation)

3. Determine Damage: existing and future; kinetic (craters, spalls and camouflets) and non-kinetic (damage caused by usage, weather and time)

   a. Existing (EKD and ENKD): assign values from Table 2-2

      For multiple surfaces, use either:

      $$\text{PCI weighted average} = \frac{(PCI_1 \times A_1 + PCI_2 \times A_2 + PCI_3 \times A_3 \ldots)}{(A_1 + A_2 + A_3 \ldots)}$$

      $$\text{ENKD weighted average} = \frac{(ENKD_1 \times A_1 + ENKD_2 \times A_2 + ENKD_3 \times A_3 \ldots)}{(A_1 + A_2 + A_3 \ldots)}$$

   b. Future (FKD and FNKD): assign values from Table 2-4

      For multiple surfaces, use FNKD weighted average:

      $$\text{FNKD weighted avg} = \frac{(FNKD_1 \times A_1 + FNKD_2 \times A_2 + FNKD_3 \times A_3 \ldots)}{(A_1 + A_2 + A_3 \ldots)}$$

   c. Calculate DRNV (Only required if requesting additional support or determining own mission size capability)

      DRNV = (EKD + ENKD + FKD + FNKD) / 4

4. Determine EOD Requirements

Determine Required RAOS Capability

5. MOS and MAOS Selection

6. Determine Repair Criteria

a. Repair Time (not including time for EOD or movement of materials and equipment to site)

b. Repair Type (Expedient, Temporary, Permanent) from Table 3-1

c. Aircraft Type (Fighter, Cargo, Tanker)

7. Determine Required Repair Capability

a. Required Work Units (using graphs in Annex G)

b. Required Capability (Small, Medium, Large) using graphs in Annex G

8. Adjust for Additional Factors (from Table 3-3)

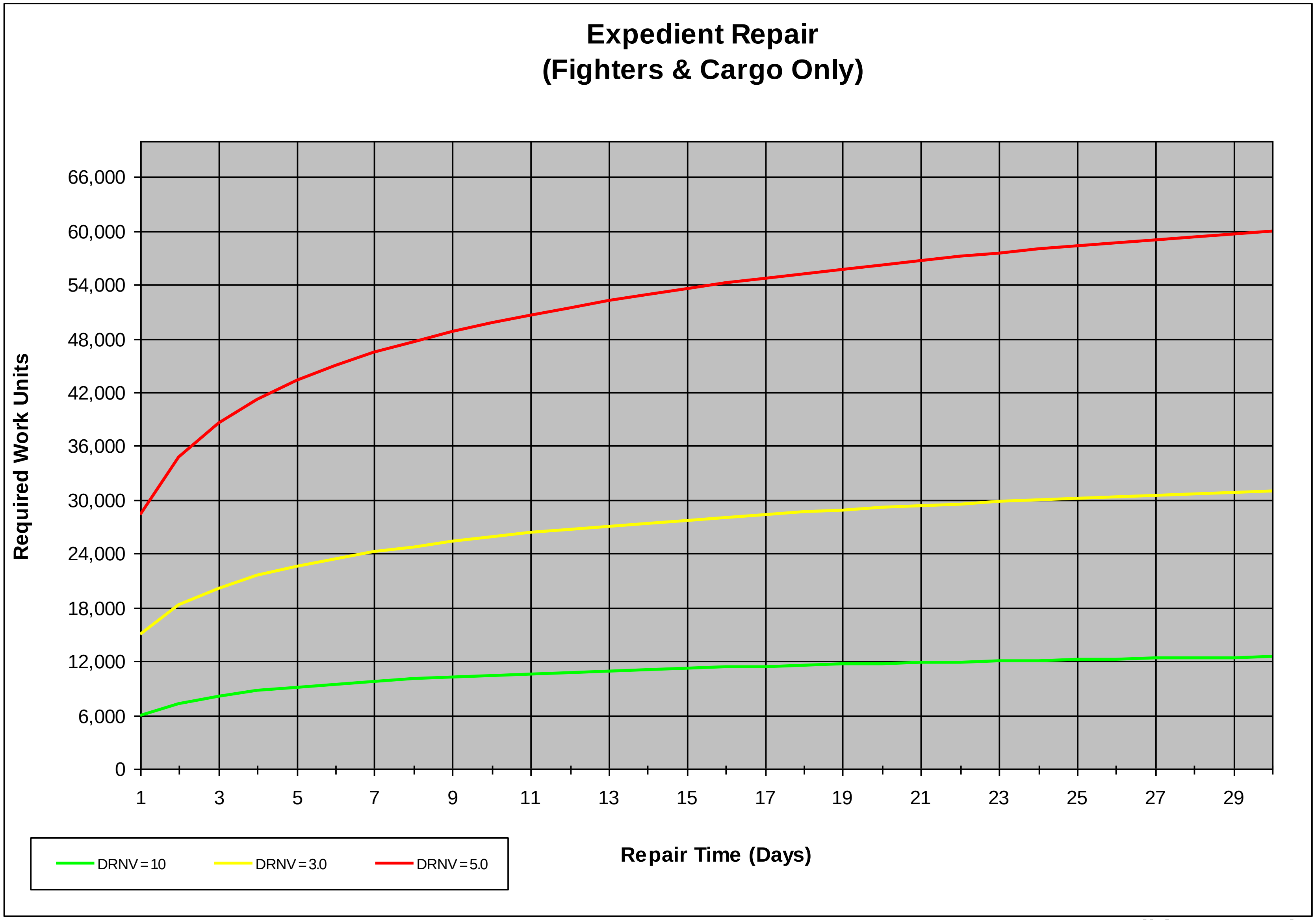
a. Adjust DRNV Based on Applicable Additional Factors

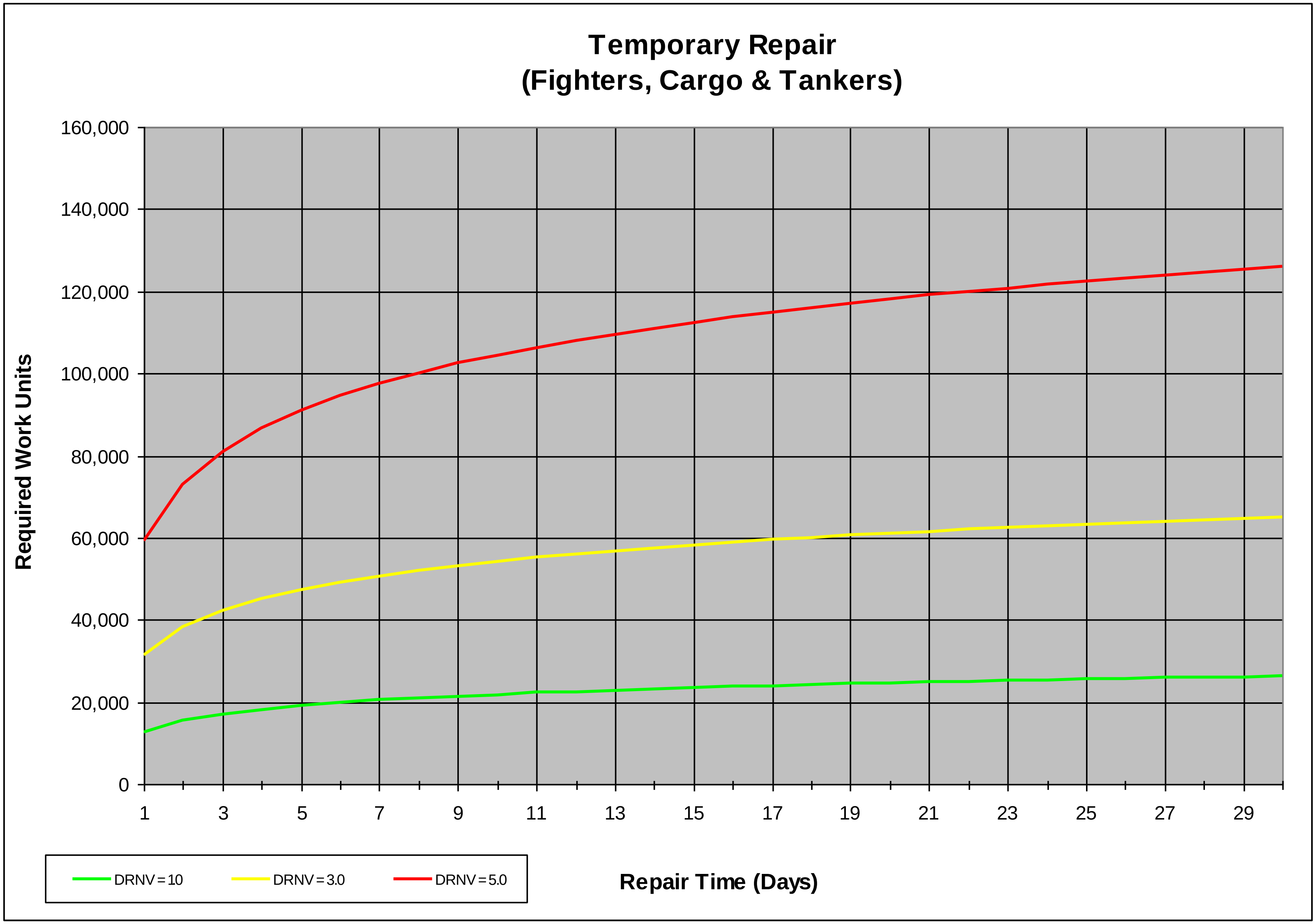
DRNV (adjusted) = DRNV (original) x $(1+AF_1+AF_2+AF_3$….etc.)

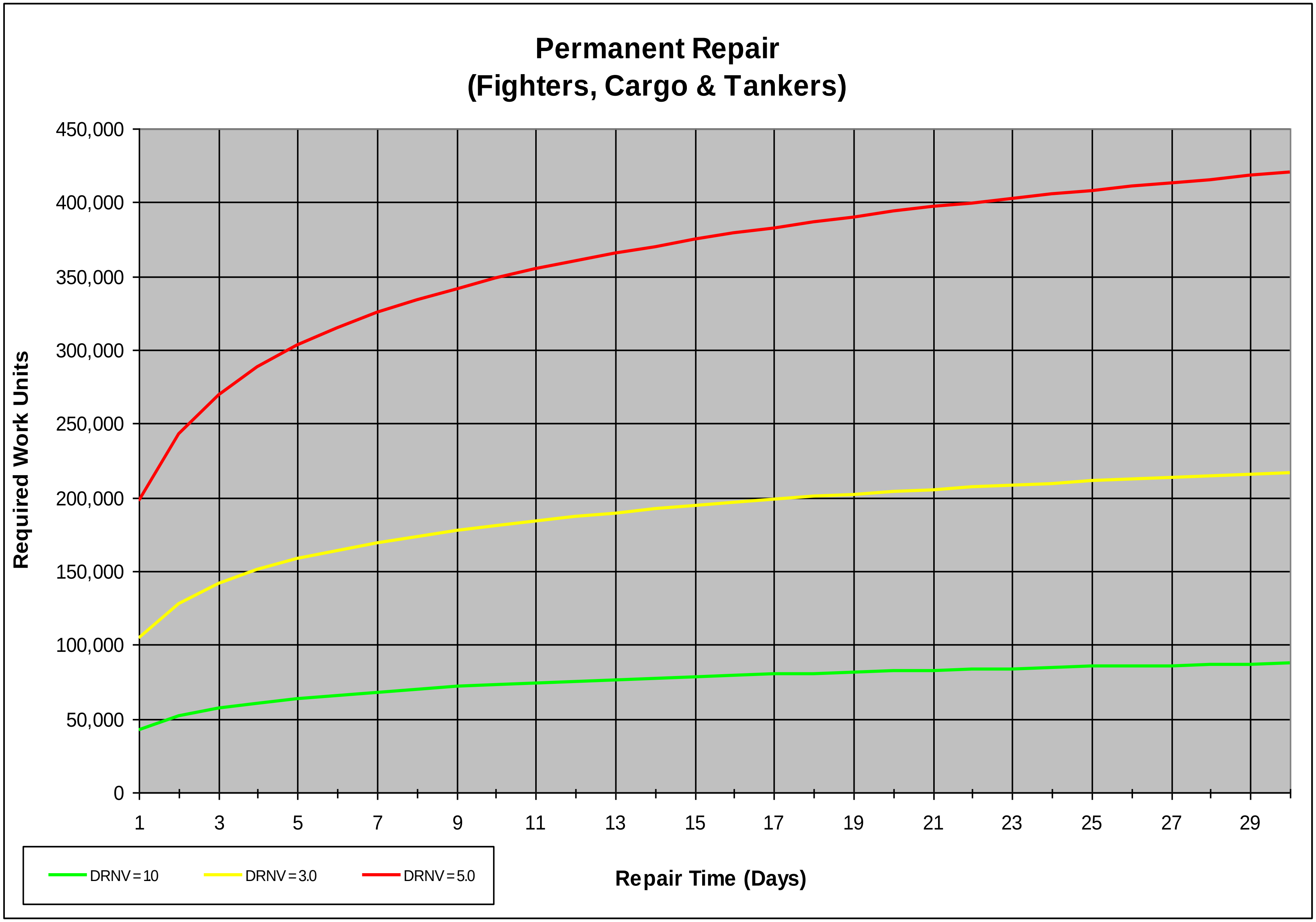
b. Determine Adjusted Required Capability using Adjusted DRNV and graphs in Annex G

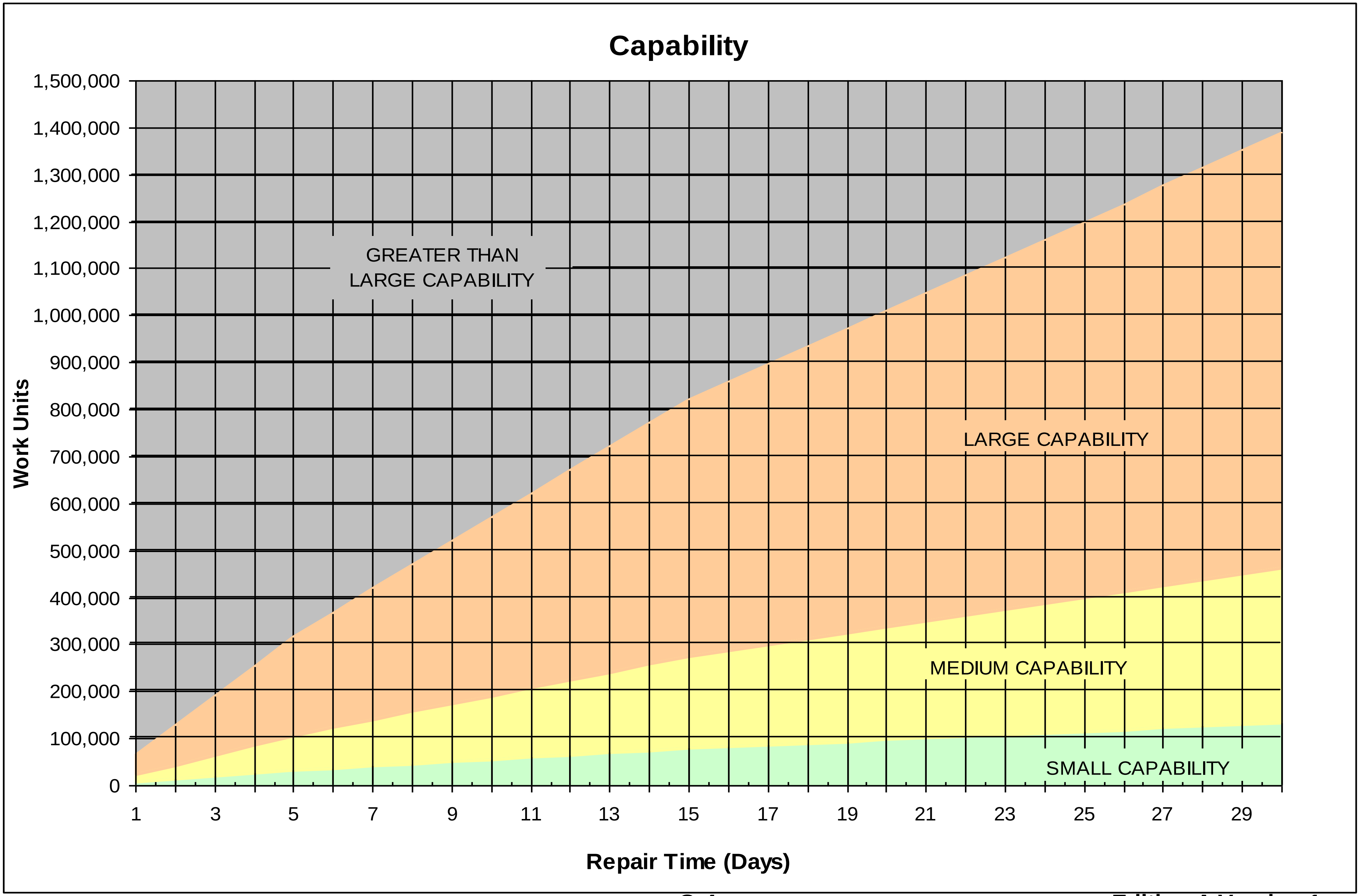
9. Complete MAOS Damage & Repair Assessment template (Annex H)

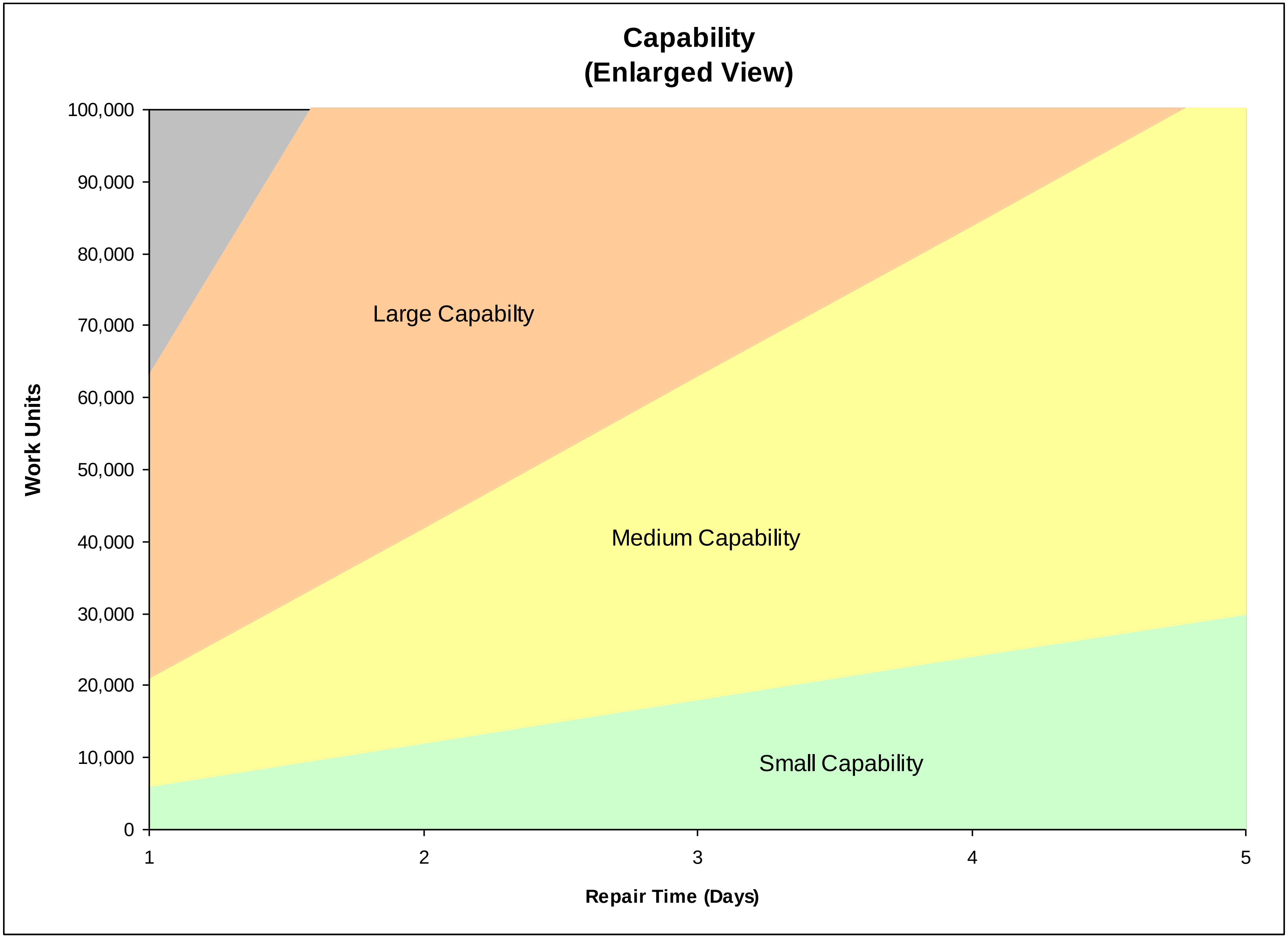
ANNEX G CAPABILITY GRAPHS




Temporary Repair
(Fighters, Cargo & Tankers)
Required Work Units
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
DRNV=10
DRNV=3.0
DRNV=5.0
Repair Time (Days)


Permanent Repair
(Fighters, Cargo & Tankers)
Required Work Units
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
Repair Time (Days)
DRNV=10
DRNV=3.0
DRNV=5.0


Capability
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Work Units
GREATER THAN
LARGE CAPABILITY
LARGE CAPABILITY
MEDIUM CAPABILITY
SMALL CAPABILITY
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
Repair Time (Days)


Capability
(Enlarged View)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Work Units
Large Capabilty
Medium Capability
Small Capability
1
2
3
4
5
Repair Time (Days)

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ANNEX H MAOS DAMAGE & REPAIR ASSESSMENT

Damage Assessment Summary				
Damage Type		**Pavement Surface Type**		
		Asphalt	**Concrete**	**Semi-Prepared**
Kinetic (enter # of each)	Large Crater(s)			
	Small Crater(s)			
	Camouflet(s)			
	Spall(s)			
Non-Kinetic (enter Low, Moderate or High)	Structural Damage: e.g. alligator cracking, rutting, shattered slab(s)			
	Non-Structural Damage: e.g. thermal cracking, joint seal damage, material-related damage			

Quantification of Damage			
EKD = _________	ENKD = _________	FKD = _________	FNKD = _________

Determine Damage Rating: $DRNV = \frac{(EKD + ENKD + FKD + FNKD)}{4} =$ _______

Additional Factors	AF (%)	Additional Factors	AF (%)
1. Operation Type	_____	7. AOS Redundancy	_____
2. UXO Clearance	_____	8. Airfield Lighting	_____
3. CBRN Environment	_____	9. Aircraft Arrestor Gear	_____
4. Environmental Conditions	_____	10. Logistics Factors	_____
5. Airfield Size	_____	11. Required Repair Time	_____
6. Pavement Thickness	_____	12. Duration of Operation	_____

Adjusted DRNV = DRNV (original) x $(1+AF_1 + AF_2 + AF_3 \ldots)$ = _______________

Mission Criteria for MAOS Repair				
Repair Time (Days) (not including transit or set up time)	**Repair Type** (Expedient, Temporary or Permanent)	**Aircraft Type**		
		Fighter	**Cargo**	**Tanker**
		❑	❑	❑
		❑	❑	❑

Required Airfield Repair Capability for Mission			
Size	Small ❑	Medium ❑	Large ❑
EOD Requirement	Yes ❑	No ❑	

Current Capability
Use the space below to annotate your current capability to make the MAOS repairs for the specific mission above. Enter information in the format of EKD-ENKD-FKD-FNKD under the applicable aircraft headings. Use the below color coding to address any capability restrictions/limitations.

	Full Capability	No restrictions
x	Partial Capability	Example restrictions: - contractor assistance required - cannot repair large craters
	No capability	Cannot make any of the required repairs

An example is provided below.

Example:

Repair Time (Days) (not including transit or set up time)	**Repair Type** (Expedient, Temporary or Permanent)	**Aircraft Type**		
		Fighter	**Cargo**	**Tanker**
(same # of days as above)	(same type as above)	3-3-1-1	3-3-1-1	1-1-1-1
Restrictions: 1. Contractor assistance needed for FOD cover 2. Cannot repair large craters				

Current Capability				
Repair Time (Days) (not including transit or set up time)	**Repair Type** (Expedient, Temporary or Permanent)	**Aircraft Type**		
		Fighter	**Cargo**	**Tanker**

Restrictions:

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

ANNEX I NATIONAL ADR CAPABILITY DECLARATION

Nation:________________________ Date:______________________

Repair Time	Repair Type	Capability			Aircraft
		Low Damage	Moderate Damage	High Damage	
4 hrs	Expedient				Fighters & Cargo only
≤ 1 day:	Expedient				Fighters & Cargo only
	Temporary			NA	Fighters & Cargo & Tanker
	Permanent	NA	NA	NA	NA
2-5 days	Expedient				Fighters & Cargo only
	Temporary				Fighters & Cargo & Tanker
	Permanent			NA	Fighters & Cargo & Tanker
6-15 days	Expedient				Fighters & Cargo only
	Temporary				Fighters & Cargo only
	Permanent				Fighters & Cargo & Tanker
16-30 days	Expedient				Fighters & Cargo only
	Temporary				Fighters, Cargo & Tankers
	Permanent				Fighters, Cargo & Tankers

ADR Repair Capability per Damage Type

Damage Type		Pavement Surface Type		
		Asphalt	Concrete	Semi-Prepared
Kinetic	Large Crater(s)	❑	❑	❑
	Small Crater(s)	❑	❑	❑
	Camouflet(s)	❑	❑	❑
	Spall(s)	❑	❑	❑
Non-Kinetic	Structural Damage	❑	❑	❑
	Non-Structural Damage	❑	❑	❑

Instructions

1. Specify Capability (Small, Medium or Large) for each block
2. Specify Method of Execution if other than by nation's own military forces (Contract or MOU)
3. Enter 'NC' in blocks where there is No Capability for repair
4. Check the boxes at the left to specify your nation's repair capability for each damage type
5. List exceptions or provide further details on the following page. Use additional pages as necessary.

ADR CAPABILITY DECLARATION EXCEPTIONS AND OTHER DETAILS:

1	
2	
3	
4	
5	
6	
7	

ANNEX J SAFETY CONSIDERATIONS IN IMPLEMENTING STANAG 2929 - AIRFIELD DAMAGE REPAIR CAPABILITY

Introduction:
This Annex is intended for NATO Led Service Providers in implementing this STANAG at existing or planned airfields as well as during deployed operations.

It includes general considerations such as the suitability of the STANAG/AATMP for the required operations, currency with regard to edition number and amendments, applicability of related documents, nations ratifying and reservations.

Specific safety considerations are identified by the custodian of the STANAG/AATMP and national SMEs along with consequences and possible mitigations.

Custodian POC. For users to provide any comments and lessons learned: **Maj Linda Schmidt (Canada) Linda.Schmidt@forces.gc.ca**
.

General:
In the implementation of any STANAG/AATMP, the NATO Led Service Provider should verify the items listed below using the NATO Standardization Agency (NSA) pass word protected Website https://nsa.nato.int/nsa/

A. Suitability	Review STANAG 7210 (AEP-68) *Guidance in the Selection of STANAGs for Deployed Operations, to determin*e if the STANAG/AATMP is suitable for the type of operation required.
B. Currency	Ensure that STANAG/AATMP Edition and any Amendments are the most current as shown on the NSA website.
C. Related Documents	Obtain related documents cited in the STANAG/AATMP and, in particular, review those documents where criteria as been adopted. STANAGs are available on the NSA Website whereas civilian documents, such as ICAO, may be available from your Aviation or Engineering Commands.
D. Implementation Status	Review the ratification status along with any reservations to the STANAG/AATMP on the NSA Website and, in particularly, the status for those for nations taking part in the operation.
E. Compliance	For existing airfield facilities and procedures, determine if they are in compliance with the criteria and standards specified in the STANAG/AAMTP.

Specific:
The safety considerations, consequences and possible mitigations listed below by the STANAG/AATMP Custodian assisted by Subject Matter Experts are by no means exhaustive or fully applicable to all environments or situations.

Full safety surveys in accordance with STANAG 4720 *NATO Standard for Air Traffic Management (ATM) Safety Management System (SMS)*, shall still be carried out.

Safety Considerations	Consequences	Possible Mitigations

EOD considerations are complex and requirements vary with each scenario	Underestimating EOD requirements could significantly delay ADR efforts	Maintain close coordination with EOD commander for up to date information and anticipated EOD completion timelines
Adjustment factors could be over or under applied	Under or over applying adjustment factors to compensate for less than ideal conditions could result in too large or too small a capability being determined and either applying too much effort or too little to a given situation. If too small of a capability is applied, it could result in increased repair times and a delay in mission readiness of the airfield. If too large of a capability is applied, it may result in an overage of resources assigned to the given task.	Using engineering judgment along with information from other specialists as necessary (EOD, arrestor gear, intelligence, etc) when applying adjustment factors and to overall capability determined.
Type of repair selected not compatible with mission requirement	Selecting a lower standard of repair could result in premature failure of the pavement.	Ensure mission requirements clearly understood and applied to the ADR capability determination process.
An unqualified member performs the ADR Capability determination procedure	A member unfamiliar with airfield pavements and terminology of ACN, PCN and PCI may not calculate the damage rating correctly.	Ensure competent members knowledgeable in airfield pavements are involved in the ADR capability determination process.
An unqualified recce team performs the recce assessment	Damage could be under estimated which could lead to an underestimate of EKD and ENKD values. Underestimating existing damage could lead to too small of a capability being determined and not enough resources being applied to the repair effort.	Ensure competent members trained in airfield recce perform the recce assessment.

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