NATO STANDARD

ATP-3.3.4.7

AIR-TO-AIR REFUELLING SIGNAL LIGHTS IN HOSE AND DROGUE SYSTEMS

Edition A Version 1

MARCH 2013

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED TACTICAL PUBLICATION

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NATO LETTER OF PROMULGATION

27 March 2013

1. The enclosed Allied Tactical Publication ATP-3.3.4.7 Edition A Version 1, SIGNAL LIGHTS IN DROGUE AIR-TO-AIR REFUELLING SYSTEMS, which has been approved by the nations in the MCASB, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 7215.

2. ATP-3.3.4.7 Edition A Version 1 is effective upon receipt.

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

Dr. Cihangir Aksit, TUR Civ
Director NATO Standardization Agency

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATIONS BY NATIONS
General	FRA, USA
1	FRA, ITA, USA
2	FRA, USA
3	FRA, USA
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 Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

NATION	SPECIFIC RESERVATIONS
FRA	- This STANAG will be implemented for new equipment. - Non-implementation of paragraph 1.3.2 on the upgrade of existing equipement. - Non-implementation, as far as “buddy pods” are concerned, of paragraphs 2.1.3, 2.1.4, 2.1.5, 2.2.1, 2.2.2, 2.2.3 and of chapter 3, mainly because of size and weight constraints.
ITA	ATP-03.3.4.7 Paragraph 1.3.2 "Nations are recommended to update their Signal Lights in current drogue equipped tanker fleets in order to assume maximum interoperability". ITA does not plan to update the current fleet due the very high number of no compliances; nevertheless ITA recognizes the high technical level of the STANAG to be used as a reference for future AAR platforms.
USA	The USA has reservations about the designation of ATP-3.3.4.7 as an Allied Tactical Publication when its content is more a matter of materiel engineering and technical requirements. This publication should be an AEP (Allied Engineering Publication) to make it clearly recognizable to the acquisition and engineering community that should be using it. While the USA agrees with the principles of ATP-3.3.4.7 and STANAG 7215 the USA has reservations as to the implementation of the agreement. The USA will use this STANAG for new design AAR system purchases. The USA will not upgrade current AAR systems to meet this STANAG. The USA will also not meet this STANAG when purchasing an existing AAR system already in use or when purchasing services that use an older aircraft with an AAR system made prior to the promulgation of this STANAG; an example would be purchasing a KC-130J with the FR300 hose system or using a KC-10 equipped with WARPS for a service contract. Chapter 1, Part 1.3, Para 2: The USA will use this STANAG for all new design AAR system purchases. The USA will not upgrade current AAR systems to meet this STANAG. The USA will also not meet this STANAG when purchasing an existing AAR system already in use or when purchasing services that use an older aircraft with an AAR system made prior to the promulgation of this STANAG; an example would be purchasing

NATION	SPECIFIC RESERVATIONS
	a KC-130J with the FR300 hose system or using a KC-10 equipped with WARPS for a service contract. Chapter 2, Part 2.2, Para 4: USA will not commit to compliance with this design feature as there may be tanker mission requirements which dictate that a particular drogue system must still be able to pass fuel to the receiver given a failure of the drogue system's hose response (as would be indicated by a steady RED light). Chapter 3, Section I, Part 3.3, Para 4: USA will not commit to compliance with this design feature as there may be tanker mission requirements which dictate that a particular drogue system must still be able to pass fuel to the receiver given a failure of the drogue system's hose response (as would be indicated by a steady RED light). Chapter 3, Section II, Part 3.4: The USA will not be using the lighting system described in Section II and will not refuel with any tanker that uses this system. The system has not been tested and is too complicated for actual operational use. Chapter 3, Section II, Part 3.5: The USA will not be using the lighting system described in Section II and will not refuel with any tanker that uses this system. The system has not been tested and is too complicated for actual operational use.

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 Database for the complete list of existing reservations.

TABLE OF CONTENTS

		Page N°
CHAPTER 1.	INTRODUCTION	1-1
1.1.	RELATED DOCUMENTS	1-1
1.2.	AIM	1-1
1.3.	AGREEMENT	1-1
1.4.	GENERAL	1-2
1.5.	IMPLEMENTATION OF THE NATO STANDARD	1-2
CHAPTER 2.	SIGNALLING PRESENTED TO RECEIVER AIRCRAFT BEING OPERATED WITHOUT THE USE OF NVG	2-1
2.1.	TYPE, NUMBER AND DISPOSITION OF LIGHTS	2-1
2.2.	SIGNAL INDICATIONS AND MEANINGS	2-4
CHAPTER 3.	SIGNALLING PRESENTED TO RECEIVER AIRCRAFT BEING OPERATED WITH THE USE OF NVG	3-1
3.1.	APPLICABILITY	3-1
3.2.	TYPE, NUMBER AND DISPOSITION OF LIGHTS	3-1
3.3.	SIGNAL INDICATIONS AND MEANINGS	3-4
3.4.	TYPE, NUMBER AND DISPOSITION OF LIGHTS	3-5
3.5.	SIGNAL INDICATIONS AND MEANINGS	3-9
ANNEX A	SIGNAL LIGHTS DISPLAY	A-1
ANNEX B	SIGNALS AND MEANINGS – NON NVG	B-1
ANNEX C	SIGNALS AND MEANINGS – NUMERICAL BASED SYSTEM	C-1
ANNEX D	SIGNALS AND MEANINGS – POSITION BASED SYSTEM	D-1

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CHAPTER 1 INTRODUCTION

1.1. RELATED DOCUMENTS

STANAG 3224	-	Aircraft Interior and Exterior Lighting Night Vision Goggle (NVG) and NON-NVG Compatible
ATP-3.3.4.2	-	Air-To-Air Refuelling
AAP-6	-	NATO Glossary of Terms and Definitions
STANAG 3447	-	Air-To-Air Refuelling Equipment: Probe-Drogue Interface Characteristics
SAE AS25050A	-	Colors, Aeronautical Lights and Lighting Equipment

1.2. AIM

The aim of this document is:

a. To standardize the signal lights displayed to a receiver aircraft during probe and drogue air-to air-refuelling operations.

b. To display suitable signal lights to receiver aircraft being operated by crews[1] who are operating either with or without the use of night vision goggles (NVG).

1.3. AGREEMENT

1. Participating nations agree to use the Signal Lights display, meanings and principles established in this NATO STANDARD document and its ANNEXES as a reference.

2. This NATO STANDARD is implemented when a nation has issued instructions that all future drogue refuelling equipment developed or services contracted will be in accordance with the requirements detailed in this document. Any nation procuring tanker aircraft, which existed prior to promulgation of this document, shall identify any and all exceptions to the requirements detailed herein for said aircraft. Any nation which modifies an aircraft platform with drogue refuelling equipment, which existed prior to the promulgation of this document, shall identify any and all exceptions to the requirements detailed herein for said aircraft. Nations are recommended to update their Signal Lights in current drogue-equipped tanker fleets in order to

[1] *The term "crew" shall refer to those persons in the receiver aircraft who are required to observe, monitor and interpret the signal lights during air-to air refuelling operations.*

assure maximum interoperability. Individual nations may introduce compliance dates on a progressive basis.

1.4. GENERAL

1. Applicability. This NATO STANDARD is applicable to all podded store and integral systems; it shall not apply to Boom Drogue Adapter systems. The different types of systems currently used by the NATO nations are described in STANAG 3971 (ATP-56 Air-to-Air Refuelling)[2].

2. Scope. This NATO STANDARD shall apply to signal lights associated with drogue refuelling equipments of individual nations and shall not cover signal lights used for either formation control or rendezvous.

3. Use of Terminology. Throughout this NATO STANDARD, unless otherwise defined, terms written with the first letter being capitalised shall have the meaning given to them in STANAG 3971 (ATP-56 Air-to-Air Refuelling).

1.5. IMPLEMENTATION OF THE NATO STANDARD

This NATO STANDARD is considered to be implemented when a nation has issued the necessary orders/instructions to the forces concerned by putting the signal lights, displays, meanings and principles detailed in this document in any new drogue air-to-air refuelling system that they procure or introduce into the field in the future.

[2] For example such systems may include integral systems, WARPS, MPRS and IARS.

CHAPTER 2 SIGNALLING PRESENTED TO RECEIVER AIRCRAFT BEING OPERATED WITHOUT THE USE OF NVG

2.1. TYPE, NUMBER AND DISPOSITION OF LIGHTS

1. Colours. Signals are to be displayed to a receiver crew by the use of coloured lights; the colours used are to be RED[3], AMBER[4] and GREEN[5].

2. Intensity. The RED, AMBER and GREEN lights are to appear to be of equal intensity when in the ON state when at full intensity (see paragraph 2.1. - 5.) as viewed by the receiver crew. All lights are to continue to be harmonised in intensity when dimmed (see paragraph 2.1. – 7.).

3. Number. Two sets of lights are to be fitted each containing a RED, AMBER and GREEN light. A signal is to comprise 2 sets of lights of the appropriate colour illuminated simultaneously in order to:

a. Provide system redundancy in case of the failure of a single light.

b. Reduce the risk of disorientation.

c. Increase the probability of the receiver crew being able to see at least one full set of lights when required to deviate from the centreline.

4. Positioning. The two sets of lights are to be positioned symmetrically such that there is one set either side of the refuelling hose, each set mirroring the other about the vertical axis as follows:

a. Vertical Light Design.
   (1) Upper light: RED.
   (2) Middle light: AMBER.
   (3) Lower light: GREEN.

b. Horizontal Light Design.
   (1) Inner light: GREEN.
   (2) Middle light: AMBER.
   (3) Outer light: RED.

[3] *RED shall mean Aviation Red as defined in STANAG 3224.*
[4] *AMBER shall mean Aviation Yellow as defined in SAE AS25050A.*
[5] *GREEN shall mean Aviation Green as defined in STANAG 3224.*

c. Diagonal[6] Light Design. For design purposes, in this NATO STANDARD the term "**Reference Set**" is defined as the left-hand set of signal lights as viewed by the receiver crew (see Figure A-1). For lights positioned diagonally on the refuelling equipment or aircraft structure, the position of GREEN light in the Reference Set is to be determined by the angle between the vertical axis and an imaginary line drawn between the GREEN and RED lights, and by the direction of rotation of such a line, starting in the position described in paragraph 2.1. – 4.a. above, as follows:

(1) Anticlockwise. The GREEN light is to remain in the lower position for rotation of the set from 0 to 90 degrees.

(2) Clockwise. The GREEN light is to remain in the lower position until the imaginary line drawn between the GREEN and RED lights reaches 60 degrees from the vertical as described in paragraph 2.1. – 4.a. above. For rotation greater than 60 degrees and up to 90 degrees, priority is to be given to positioning the GREEN light at the inner position, with the RED light at the outer position as described in paragraph 2.1. – 4.b. (See Annex A).

5. Light Status. Each coloured light is to have one of 3 states as appropriate to the signalling requirements as follows:

a. ON. The lights are to be of constant intensity appropriate to their dimmed or undimmed setting.

b. Flashing[7]. Two rates of flashing are to be used for the signal lights as described in this paragraph. RED lights are to flash to gain the immediate attention of the receiver crew; AMBER lights are to flash to provide cautionary information to the receiver crew; GREEN lights are to flash to provide advisory information to the receiver crew. The lights shall therefore flash at a rate according to their colour as follows:

(1) FLASHING RED: Flashing is to be from OFF to ON to OFF. A fast flash rate is to be used; however the rate should be such that the same rate is usable for the equivalent flashing signal during NVG operations as described in Chapter 3 below.

[6] Diagonal means any arrangement of the Reference Set of signal lights that is neither vertical nor horizontal.

[7] Subject to flight test verification and further amplification as to flash rates may be included in future editions of this NATO STANDARD.

(2) FLASHING AMBER: Flashing is to be from OFF to ON to OFF. AMBER lights are to flash at the same fast rate as described in paragraph 2.1. – 5.b.(1).

(3) FLASHING GREEN: Flashing is to be from OFF to ON to OFF at a rate that is less than that of the FLASHING RED and FLASHING AMBER light. However, the rate must not be so slow as to be misinterpreted by the receiver crew as a pod failure resulting in all lights being OFF.

c. OFF. No emission of light from the position of the light source is to be apparent to the receiver crew.

6. Unwanted Reflected Light. Signal lights are to be designed so as to avoid any signal light that is OFF appearing to be ON (see paragraph 2.1. – 5. above) when light from either ambient light or other aircraft lights is cast on such signal light.

7. Dimming[8]. All coloured lights are to be capable of being dimmed simultaneously by a member of the tanker crew.

a. RED Signals.

(1) For signals involving the use of FLASHING RED lights, the lights are to ignore the dimmed setting and use full brilliance.

(2) For signals involving the use of RED ON lights, the lights are to respect the dimmed setting.

b. AMBER and GREEN Signals. For signals involving the use of AMBER or GREEN, whether FLASHING or ON, the lights are to respect the dimmed setting.

8. Breakaway. To reduce tanker crew workload, after the FLASHING RED signal has been displayed for 10-15 seconds, the signal is to revert to the RED ON signal, respecting any previous dimming setting, until the tanker crew resumes normal operations.

[8] Subject to flight test verification and further definition of “Dimming” capability may be contained in subsequent editions of this NATO STANDARD.

9. Disconnect. After receiver disconnection, if the system is not ready for further refuelling, a RED ON signal is to be automatically provided, without undue delay, to avoid the receiver attempting to make a subsequent contact before the equipment is ready.

2.2. SIGNAL INDICATIONS AND MEANINGS

1. Single Colour Usage. Each message signalled to a receiver aircraft is to use only one colour of light. No two different colours of light should be lit, at any one time. It shall not be permissible for a single message to be indicated by alternating between any two coloured lights.

2. Priority of Signals:

   a. FLASHING RED. The display of the FLASHING RED signal is to cancel all other signals.

   b. RED. The selection of, or automatic display of, the RED ON signals is to cancel any AMBER or GREEN signals.

   c. AMBER. The automatic display of any AMBER signals is to cancel any GREEN signals.

3. Receiver Actions. The desired receiver action to a given signal may vary according to such receiver's current position as either in or out of contact with the hose. Full details of receiver desired actions for each signal are at Annex B.

   a. FLASHING Signals:

      (1) RED or AMBER. A receiver crew is to move aft in response to either a FLASHING RED or a FLASHING AMBER signal.

      (2) GREEN. A receiver crew may remain in the refuelling range appropriate to the circumstances in response to a FLASHING GREEN signal.

   b. Mandatory Instructions. FLASHING RED, RED ON and FLASHING AMBER signals indicate mandatory instructions to the receiver crew.

4. Fuel Transfer Associated with Signals. When any RED or AMBER signals are displayed, then fuel flow is either stopped or is stopping.

CHAPTER 3 SIGNALLING PRESENTED TO RECEIVER AIRCRAFT BEING OPERATED WITH THE USE OF NVG

3.1. APPLICABILITY

In cases where it is not possible to differentiate between coloured lights with NVG, the requirements of this Part 2 shall apply as follows:

a. For systems where it is not possible for the receiver to clearly identify the relative position of individual signal lights, the provisions of Section I shall apply.

b. For systems where it is possible for the receiver to clearly identify the relative position of individual signal lights, the provisions of Section II shall apply.

SECTION I – NUMERICAL BASED SYSTEM

3.2. TYPE, NUMBER AND DISPOSITION OF LIGHTS

1. Coloured Lights vs. Night Vision Lights. The system of coloured lights shall be off and NVG lights shall be available instead.

2. Number vs. Colour. The signal lights used for the drogue air-to-air refuelling system shall utilise the following lighting scheme:

a. RED: 3-Lights illuminated.

b. AMBER: 2-Lights illuminated.

c. GREEN: 1-Light illuminated.

The greater number of lights is used for the RED signal to indicate a greater sense of alert and warning.

3. Number. Two sets of signal lights are to be fitted each containing 3 lights[9]. A signal is to comprise 2 sets of lights of the appropriate number illuminated simultaneously in order to:

a. Provide system redundancy in case of the failure of a single light;

b. Reduce the risk of disorientation;

[9] A “light” may comprise one or more energy emitters which when viewed by the receiver crew through NVG appear as a single light source.

c. Increase the probability of the receiver crew being able to see at least one full set of lights when required to deviate from the centreline.

In the event of a signal indicating a different number of lights in each set of lights, then the receiver crew is to respond to the set of lights with the greater number of lights lit.

4. Positioning. The two sets of lights are to be positioned symmetrically such that there is one set either side of the refuelling hose, each set mirroring the other about the vertical axis as follows.

5. Distance between Lights. The individual lights have to be clearly discernable by the receiver crew even with the limited visual acuity of NVGs.

a. Minimum Separation. The minimum distance between any 2 individual lights within a set of 3 signal lights, and between the 2 sets of lights depends on the viewer's visual acuity and the viewing distance (with or without the use of NVG). Furthermore, the visual acuity will vary according to NVG types[10]. Therefore, a minimum of 20/30 visual acuity is to be used in calculating the minimum separation between any 2 signal lights. These minimum distances must allow clear identification of individual lights during refuelling operations.

b. Maximum Separation. When the receiver crew is observing the tanker from either the astern position or while in contact, all 3 lights within a set of signal lights are to be visible to the receiver crew, such that the NVG's field of view does not obstruct any part of the set of 3 signal lights.

c. Non-signal Lights. Signal lights are to be positioned such that no confusion may arise as to which lights form part of a set of signal lights and which lights are being used for other purposes; any foreign, close light may change the meaning of signal lights. Ideally, no other direct light source should be visible to the receiver crew while observing the tanker from either the astern position or while in contact during refuelling.

[10] See STANAG 3224 NVG-NVIS types (Annex E)

6. Light Status. Each light(s) is to have one of 3 states as appropriate to the signalling requirements as follows:

a. ON. The light(s) is to be of constant intensity appropriate to its dimmed or undimmed setting.

b. Flashing. Two rates of flashing are to be used for the light signals as described in this paragraph. The 3-Light signals are to flash to gain the immediate attention of the receiver crew; 2-Light signals are to flash to provide cautionary information to the receiver crew; the 1-Light signals are to flash to provide advisory information to the receiver crew. When multiple lights are FLASHING (3-Lights or 2-Lights cases) it shall be simultaneously. The lights shall therefore flash at a rate according to their number as follows:

(1) FLASHING 3-Light: Flashing is to be from OFF to ON to OFF. A fast flash rate should be used; however the rate should be such that the rate is usable during NVG operations.

(2) FLASHING 2-Light: Flashing is to be from OFF to ON to OFF. 2-Light signals are to flash at the same fast rate as described in paragraph 0302-6-b(1).

(3) FLASHING 1-Light: Flashing is to be from OFF to ON to OFF at a rate that is less than that of the FLASHING 3-Light signal and FLASHING 2-Light signal. However, the rate must not be so slow as to be misinterpreted by the receiver crew as a pod failure resulting in all lights being OFF.

c. OFF. No emission of light from the position of the light source is to be apparent to the receiver crew.

7. Unwanted Reflected Light. Signal lights are to be designed so as avoid any signal light that is OFF appearing to be ON (see paragraph 0302-6 above) when light from either ambient light or other aircraft lights is cast on such signal light.

8. Dimming. All lights are to be capable of being dimmed simultaneously by a member of the tanker crew.

a. 3-Lights Signals:

(1) For signals involving the use of FLASHING 3-Lights, the signal is to ignore any dimmed setting and use full brilliance.

(2) For signals involving the use of 3-Lights ON, the lights are to respect the dimmed setting.

b. 2-Lights and 1-Light Signals. For signals involving the use of either 2-Lights or 1-Light, whether FLASHING or ON, the lights are to respect the dimmed setting.

9. Breakaway. To reduce tanker crew workload, after the FLASHING 3-Lights signal has been displayed for 10-15 seconds, the signal is to revert to 3-Lights ON, respecting any previous dimming setting, until the tanker crew resumes normal operations.

10. Disconnect. After receiver disconnection, if the system is not instantly ready for further refuelling a 3-Light ON signal is to be automatically provided, without undue delay, to avoid the receiver attempting to make a subsequent contact before the equipment is ready.

3.3. SIGNAL INDICATIONS AND MEANINGS

1. Single Number Usage. Each message signalled to a receiver aircraft is to use only one number of light(s). For example, it shall not be permissible for a single message to be indicated by alternating between two different signals, such as by alternating between having 1 and then 2 lights illuminated.

2. Priority of Signals:

a. FLASHING 3-Lights. The display of the FLASHING 3-Lights signal is to cancel all other signals;

b. 3-Lights ON. The selection of, or automatic display of, 3-Lights ON signal is to cancel any 2-Lights or 1-Light signals;

c. 2-Lights. The automatic display of any 2-Lights signals is to cancel any 1-Light signals.

3. Receiver Actions. The desired receiver action to a given signal may vary according to such receiver's current position as either in or out of contact with the hose. Full details of receiver actions for each signal are at Annex C.

a. FLASHING Signals.

(1) A receiver crew is to move aft in response to either a FLASHING 3-Lights signal or FLASHING 2-Lights signal.

(2) A receiver crew may remain in the refuelling range appropriate to the circumstances in response to a FLASHING 1-Light signal.

b. Mandatory Signals. FLASHING 3-Lights, 3-Lights ON and FLASHING 2-Lights signals indicate mandatory instructions to the receiver crew.

4. Fuel Transfer Associated with Signals. When any 3-Lights or 2-Lights signals are displayed, then fuel flow is either stopped or is stopping.

SECTION II – POSITION-BASED SYSTEM

3.4. TYPE, NUMBER AND DISPOSITION OF LIGHTS

1. Recognition of Signals. For operations involving the use of NVG by receiver crews, the coloured lights, if used, referred to in Chapter 2 shall be NVG-friendly such that when ON, they appear as a single large, monochrome signal light without impairing the use of the NVG. A suitable, low intensity IR source, a "**Marker Light**", shall always be lit either immediately adjacent to, or collocated with, the position of each of the coloured lights as a reference, thus allowing the receiver crew to ascertain the relative position of the ON light source in the set of 3 positions. For systems fitted with coloured lights which are not NVG-friendly, then the implementation for the NVG operations shall be in accordance with Chapter 3 Section I of this NATO STANDARD.

2. Position vs. Colour. Each signal light is to be located in a uniquely recognisable position within a set of 3 possible positions:

a. RED: UPPER/OUTER-Light illuminated.

b. AMBER: MIDDLE-Light illuminated.

c. GREEN: LOWER/INNER-Light illuminated.

3. Number. Two sets of lights are to be fitted each containing 3 lights. A signal is to comprise 2 lights at the appropriate positions, as described in paragraph 0304-4 below, being illuminated simultaneously in order to:

a. Provide system redundancy in case of the failure of a single light;

b. Reduce the risk of disorientation;

c. Increase the probability of the receiver crew being able to see at least one light when required to deviate from the centreline.

4. Positioning. The two sets of lights are to be positioned symmetrically such that there is one set of lights either side of the refuelling hose, each set of lights mirroring the other about the vertical axis as follows:

a. Vertical Light Design:

(1) RED/UPPER-Light: Upper position illuminated.
(2) AMBER/MIDDLE-Light: Middle position illuminated.
(3) GREEN/LOWER-Light: Lower position illuminated.

b. Horizontal Light Design:[11]

(1) RED/OUTER-Light: Outboard position illuminated.
(2) AMBER/MIDDLE-Light: Middle position illuminated.
(3) GREEN/INNER-Light: Inboard position illuminated.

c. Diagonal[12] Light Design[13]. For design purposes, in this NATO STANDARD the term "**Reference Set**" is defined as the left-hand set of signal lights as viewed by the receiver crew. For lights positioned diagonally on the refuelling equipment or aircraft structure, the Reference Set may be rotated anticlockwise from the vertical axis, starting in the position described in paragraph 0304-4-a above to the horizontal position, or may be rotated clockwise from the vertical up to a maximum of 60 degrees. (See Figure A-1).

(1) Anticlockwise. The GREEN/INNER light is to remain in the lower position for rotation of the set from 0 to 90 degrees.

[11] Reference Set oriented clockwise with more than 60 degrees shall not be implemented. Orientation shall be in accordance with Signal Lights Display in Figure A-1
[12] Diagonal means any arrangement of the Reference Set of signal lights that is neither vertical nor horizontal.
[13] Reference Set oriented clockwise with > 60 degrees shall not be implemented. Orientation shall be in accordance with Signal Lights Display in Figure A-1

(2) Clockwise. The GREEN light is to remain in the lower position until the imaginary line drawn between the GREEN and RED lights reaches a maximum 60 degrees from the vertical as described in paragraph 0304-4-a above. In this instance the GREEN light will be the outer-most light, and the RED light will be inner-most light.

The remaining paragraphs below in this section shall, for clarity, describe the anticlockwise rotation of lights. For clockwise rotations of lights, the term RED/UPPER/OUTER shall be replaced by RED/UPPER/INNER, and the term GREEN/LOWER/INNER shall be replaced by GREEN/LOWER/OUTER.

5. Distance Between Lights. The individual lights have to be clearly discernable by the receiver crew even with the limited visual acuity of NVGs.

a. Minimum Separation. The minimum distance between any 2 individual lights within a set of 3 signal lights, or between the 2 sets of lights depends on the viewer's visual acuity and the viewing distance (with or without the use of NVG). Furthermore, the visual acuity will vary according to NVG types[14]. Therefore, a minimum of 20/30 visual acuity is to be used in calculating the minimum separation between any 2 signal lights. These minimum distances must allow clear identification of individual lights and reference lights during refuelling operations;

b. Maximum Separation. The maximum distance between any 2 individual lights within a set of signal lights should be limited. When the receiver crew is observing the tanker from either the astern position or while in contact, all 3 individual reference positions within a set of signal lights are to be visible to the receiver crew, such that the NVG's field of view does not obstruct a change in lights being misinterpreted as all lights being OFF;

c. Non-signal Lights. Signal lights are to be positioned such that no confusion may arise as to which lights form part of a set of signal lights and which lights are being used for other purposes; any foreign, close light may change the meaning of signal lights. Ideally, no other direct light source should be visible to the receiver crew while observing the tanker from either the astern position or while in contact during refuelling.

[14] See STANAG 3224 NVG-NVIS types (Annex E)

6. Light Status. Each light(s) is to have one of 3 states as appropriate to the signalling requirements as follows:

a. ON. The light(s) is to be of constant intensity appropriate to its dimmed or undimmed setting;

b. FLASHING. Two rates of flashing are to be used for the light signals as described in this paragraph. The RED/UPPER/OUTER lights are to flash to gain the immediate attention of the receiver crew; AMBER/MIDDLE lights are to flash to provide cautionary information to the receiver crew; GREEN/LOWER/INNER lights are to flash to provide advisory information to the receiver crew. The lights shall therefore flash at a rate according to their position as follows:

(1) FLASHING RED/UPPER/OUTER: Flashing is to be from OFF to ON to OFF. A fast flash rate should be used; however the rate should be such that the rate is usable during NVG operations;

(2) FLASHING AMBER/MIDDLE: Flashing is to be from OFF to ON to OFF. AMBER/MIDDLE signals are to flash at the same fast rate as described in paragraph 0304-6-b(1);

(3) FLASHING GREEN/LOWER/INNER: Flashing is to be from OFF to ON to OFF at a rate that is less than that of the FLASHING RED/UPPER/OUTER signal and the FLASHING AMBER/MIDDLE signal. However, the rate must not be so slow as to be misinterpreted by the receiver crew as a pod failure resulting in all lights being OFF.

c. OFF. No emission of light from the position of the light source is to be apparent to the receiver crew.

The Marker Light associated with the position of the FLASHING coloured light is to follow the same status as the coloured light, such that both the coloured light and the Marker Light are either both ON or are both OFF simultaneously during the FLASHING sequence.

7. Unwanted Reflected Light. Signal lights are to be designed so as avoid any signal light that is OFF appearing to be ON (see paragraph 0304-6 above) when light from either ambient light or other aircraft lights is cast on such signal light.

8. Dimming. All lights are to be capable of being dimmed simultaneously by a member of the tanker crew.

a. RED/UPPER/OUTER-Lights Signals:

(1) For signals involving the use of the FLASHING RED/UPPER/OUTER - Lights, the signal is to ignore any dimmed setting and use full brilliance;

(2) For signals involving the use of RED/UPPER/OUTER-Lights ON, the lights are to respect the dimmed setting.

b. AMBER/MIDDLE-Lights and GREEN/LOWER/INNER-Light Signals. For signals involving the use of any AMBER/MIDDLE - Lights or GREEN/LOWER/INNER - Lights, the lights are to respect the dimmed setting.

9. Breakaway. To reduce tanker crew workload, after the FLASHING RED/UPPER/OUTER-Lights signal has been displayed for 10-15 seconds, the signal is to revert to RED/UPPER/OUTER-Lights ON until the tanker crew resumes normal operations.

10. Disconnect. After receiver disconnection, if the system is not instantly ready for further refuelling a RED/UPPER/OUTER-Light ON signal is to be automatically provided, without undue delay, to avoid the receiver attempting to make a subsequent contact before the equipment is ready.

3.5. SIGNAL INDICATIONS AND MEANINGS

1. Single Number Usage. Each message signalled to a receiver aircraft is to use only one pair of lights. For example, it shall not be permissible for a single message to be indicated by illuminating both the RED/UPPER/OUTER-Lights and the AMBER/MIDDLE-Lights. It shall not be permissible for a single message to be indicated by alternating between any two positions of lights.

2. Priority of Signals:

a. FLASHING RED/UPPER/OUTER-Lights. The display of the FLASHING RED/UPPER/OUTER-Lights signal is to cancel all other signals;

b. RED/UPPER/OUTER-Lights ON. The selection of, or automatic display of, UPPER/OUTER-Lights ON signal is to cancel any AMBER/MIDDLE-Lights or GREEN/LOWER/INNER-Lights signals;

c. AMBER/MIDDLE-Lights. The automatic display of any AMBER/MIDDLE-Lights signal is to cancel any GREEN/LOWER/INNER-Lights signal.

3. Receiver Actions. The desired receiver action to a given signal may vary according to such receiver's current position as either in or out of contact with the hose. Full details of receiver actions for each signal are at Annex D.

a. FLASHING Signals:

(1) A receiver crew is to move aft in response to either a FLASHING RED/UPPER/OUTER-Light signal or FLASHING AMBER/MIDDLE-Light signal;

(2) A receiver crew may remain in the refuelling range appropriate to the circumstances in response to a FLASHING GREEN/LOWER/INNER-Light signal.

b. Mandatory Signals. FLASHING RED/UPPER/OUTER-Light, RED/UPPER/OUTER ON and FLASHING AMBER/MIDDLE-Light signals indicate mandatory instructions to the receiver crew.

3. Fuel Transfer Associated with Signals. When any RED/UPPER/OUTER-Light or AMBER/MIDDLE-Light signals are displayed, then fuel flow is either stopped or is stopping.

ANNEX A SIGNAL LIGHTS DISPLAY

Set out below are examples of different layouts of signal light sets that may be implemented. For the avoidance of doubt, system designers are not required to use any particular angle of orientation. The diagrams are given only to aid understanding of the descriptions given in the text of the main body of this NATO STANDARD.

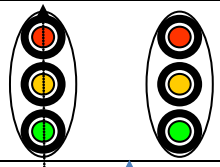
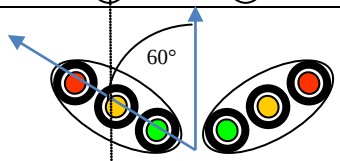
Angle of Orientation (Degrees)	Layout of Coloured Lights	
	Reference Set Orientated Anticlockwise	Reference Set Orientated Clockwise[15]
0° Vertical		
< or = 60°		
>60°		Not used
90° Horizontal		
	Reference Set	Reference Set

Figure A-1. Layouts of signal light sets

[15] In Position Based System ,Reference Set oriented clockwise with > 60 degrees shall not be implemented

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ANNEX B SIGNALS AND MEANINGS – NON NVG

RECEIVER POSITION		NON - NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED**	**AMBER**	**GREEN**
Breakaway Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP 56) for Breakaway After the FLASHING RED signal has been displayed for 10-15 seconds, the signal should revert to RED ON until the tanker crew resumes normal operations.	**Breakaway** Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP 56) for Breakaway After the FLASHING RED signal has been displayed for 10-15 seconds, the signal should revert to RED ON until the tanker crew resumes normal operations. Fuel flow is either stopped or is stopping.	FLASH	OFF	OFF
Maintain Astern Tanker not yet ready to refuel receiver. Receiver should remain in Astern	**Disconnect** Mandatory instruction: Non-emergency Disconnect Receiver is to carry out a normal Disconnect and either: Radio Procedures. Remain in Astern position Radio Silent. Move to Reform position. Fuel flow is either stopped or is stopping.	ON	OFF	OFF

RECEIVER POSITION		NON - NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED**	**AMBER**	**GREEN**
Not Applicable	**Too Close – Move Aft** Mandatory instruction: Move aft. Receiver is forward of the refuelling range and is too close to the tanker. Fuel flow stops.	OFF	FLASH	OFF
Clear Contact Tanker ready for receiver to make Contact. Receiver should make Contact with hose.	**Move forward into refuelling range** Hose is aft of refuelling range. Receiver should continue to push hose in to enter refuelling range. Fuel flow stops.	OFF	ON	OFF

RECEIVER POSITION		NON - NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED**	**AMBER**	**GREEN**
Not Applicable	**Clear to disconnect as required** Receiver is in refuel range but fuel flow is less than 50[16] US gal per min Radio Procedures. Await instruction from tanker crew. Radio Silent. Maintain position or disconnect when ready. Receiver crew should determine reason for low fuel flow as either: a. Tanks are full. b. Fuel offload complete. c. Receiver switch selections incorrect. d. Soft Contact. e. Dry Contact.	OFF	OFF	FLASH
Not Applicable	Receiver is in refuel range and fuel flow is more than 50[17] US gal per min. Receiver should: Radio Procedures. Await instruction to Disconnect. Radio Silent. Maintain position or Disconnect.	OFF	OFF	ON

[16] Fuel flow rates can be set differently, especially for helicopters. The aircraft with very low fuel on load rates of less than 50 gal per min may observe a Flashing Green Light through the whole refuelling period
[17] Fuel flow rates can be set differently, especially for helicopters. The aircraft with very low fuel on load rates of less than 50 gal per min may observe a Flashing Green Light through the whole refuelling period

RECEIVER POSITION		NON - NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED**	**AMBER**	**GREEN**
Breakaway Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP-56) for Breakaway	**Breakaway** Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP-56) for Breakaway	OFF	OFF	OFF

ANNEX C SIGNALS AND MEANINGS – NUMERICAL BASED SYSTEM

RECEIVER POSITION		NUMERICAL BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**3-Lights**	**2-Lights**	**1-Light**
Breakaway Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP 56) for Breakaway After the FLASHING 3-Light signal has been displayed for 10-15 seconds, the signal should revert to 3-Lights ON until the tanker crew resumes normal operations.	**Breakaway** Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP 56) for Breakaway After the FLASHING 3-Light signal has been displayed for 10-15 seconds, the signal should revert to 3-Lights ON until the tanker crew resumes normal operations. Fuel flow is either stopped or is stopping.	FLASH	FLASH	FLASH

RECEIVER POSITION		NUMERICAL BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**3-Lights**	**2-Lights**	**1-Light**
Maintain Astern Tanker not yet ready to refuel receiver. Receiver should remain in Astern	**Disconnect** Mandatory instruction: Non-emergency Disconnect Receiver is to carry out a normal Disconnect and either: Radio Procedures. Remain in Astern position Radio Silent. Move to Reform position. Fuel flow is either stopped or is stopping.	ON	ON	ON
Not Applicable	**Too Close – Move Aft** Mandatory instruction: Move aft. Receiver is forward of the refuelling range and is too close to the tanker. Fuel flow stops.	OFF	FLASH	FLASH
Clear Contact Tanker ready for receiver to make Contact. Receiver should make Contact with hose.	**Move forward into refuelling range** Hose is aft of refuelling range. Receiver should continue to push hose in to enter refuelling range. Fuel flow stops.	OFF	ON	ON

RECEIVER POSITION		NUMERICAL BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**3-Lights**	**2-Lights**	**1-Light**
Not Applicable	**Clear to disconnect as required** Receiver is in refuel range but fuel flow is less than 50[18] US gal per min Radio Procedures. Await instruction from tanker crew. Radio Silent. Maintain position or disconnect when ready. Receiver crew should determine reason for low fuel flow as either: a. Tanks are full. b. Fuel offload complete. c. Receiver switch selections incorrect. d. Soft Contact. e. Dry Contact.	OFF	OFF	FLASH
Not Applicable	Receiver is in refuel range and fuel flow is more than 50[19] US gal per min. Receiver should: Radio Procedures. Await instruction to Disconnect. Radio Silent. Maintain position or Disconnect.	OFF	OFF	ON

[18] Fuel flow rates can be set differently, especially for helicopters. The aircraft with very low fuel on load rates of less than 50 gal per min may observe a Flashing Green Light through the whole refuelling period
[19] Fuel flow rates can be set differently, especially for helicopters. The aircraft with very low fuel on load rates of less than 50 gal per min may observe a Flashing Green Light through the whole refuelling period

RECEIVER POSITION		NUMERICAL BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**3-Lights**	**2-Lights**	**1-Light**
Breakaway Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP-56) for Breakaway	**Breakaway** Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP-56) for Breakaway	OFF	OFF	OFF

ANNEX D SIGNALS AND MEANINGS – POSITION BASED SYSTEM

RECEIVER POSITION		POSITION BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED/ UPPER/ OUTER**	**AMBER/ MIDDLE**	**GREEN/ LOWER/ INNER**
Breakaway Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP 56) for Breakaway After the FLASHING RED/UPPER/OUTER-Light signal has been displayed for 10-15 seconds, the signal should revert to RED/UPPER/OUTER-Light ON until the tanker crew resumes normal operations.	**Breakaway** Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP 56) for Breakaway After the FLASHING RED/UPPER/OUTER-Light signal has been displayed for 10-15 seconds, the signal should revert to RED/UPPER/OUTER-Light ON until the tanker crew resumes normal operations. Fuel flow is either stopped or is stopping.	FLASH	OFF	OFF

RECEIVER POSITION		POSITION BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED/ UPPER/ OUTER**	**AMBER/ MIDDLE**	**GREEN/ LOWER/ INNER**
Maintain Astern Tanker not yet ready to refuel receiver. Receiver should remain in Astern or Pre-contact Position	**Disconnect** Mandatory instruction: Non-emergency Disconnect. Receiver is to carry out a normal Disconnect and either: Radio Procedures. Remain in Astern position Radio Silent. Move to Reform position. Fuel flow is either stopped or is stopping	ON	OFF	OFF
Not Applicable	**Too Close – Move Aft** Mandatory instruction: Move aft immediately. Receiver is forward of the refuelling range and is too close to the tanker. Fuel flow stops.	OFF	FLASH	OFF
Clear Contact Tanker ready for receiver to make Contact. Receiver should make Contact with hose.	**Move forward into refuelling range** Hose is aft of refuelling range. Receiver should continue to push hose in to enter refuelling range. Fuel flow stops.	OFF	ON	OFF

RECEIVER POSITION		POSITION BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED/ UPPER/ OUTER**	**AMBER/ MIDDLE**	**GREEN/ LOWER/ INNER**
Not Applicable	**Clear to disconnect as required** Receiver is in refuel range but fuel flow is less than 50[20] US gal per min Radio Procedures. Await instruction from tanker crew. Radio Silent. Maintain position or disconnect when ready. Receiver crew should determine reason for low fuel flow as either: a. Tanks are full. b. Fuel offload complete. c. Receiver switch selections incorrect. d. Soft Contact. e. Dry Contact.	OFF	OFF	FLASH

[20] Fuel flow rates can be set differently, especially for helicopters. The aircraft with very low fuel on load rates of less than 50 gal per min may observe a Flashing Green Light through the whole refuelling period

RECEIVER POSITION		POSITION BASED NVG OPS		
NOT IN CONTACT	**IN CONTACT**	**RED/ UPPER/ OUTER**	**AMBER/ MIDDLE**	**GREEN/ LOWER/ INNER**
Not Applicable	Receiver is in refuel range and fuel flow is more than 50[21] US gal per min. Receiver should: Radio Procedures. Await instruction to Disconnect. Radio Silent. Maintain position or Disconnect.	OFF	OFF	ON
Breakaway Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP-56) for Breakaway	**Breakaway** Mandatory instruction: Carry out procedure described in STANAG 3971 (ATP-56) for Breakaway	OFF	OFF	OFF

[21] Fuel flow rates can be set differently, especially for helicopters. The aircraft with very low fuel on load rates of less than 50 gal per min may observe a Flashing Green Light through the whole refuelling period

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