NATO STANDARD

ATP-3.3.4.6

AIR-TO-AIR (AERIAL) REFUELING EQUIPMENT: PROBE–DROGUE INTERFACE CHARACTERISTICS

Edition A Version 1

JUNE 2016

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED TECHNICAL PUBLICATION

Published by the
NATO STANDARDIZATION OFFICE (NSO)

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION OFFICE (NSO)

NATO LETTER OF PROMULGATION

28 June 2016

1. The enclosed Allied Technical Publication ATP-3.3.4.6, Edition A, Version 1, AIR-TO-AIR (AERIAL) REFUELING EQUIPMENT: PROBE – DROGUE INTERFACE CHARACTERISTICS, 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 3447.

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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 Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
DEU	The requirement to ensure a maximum pressure of 55PSI during every possible rate of flow according to chapter 2.5 isn't possible for DEU A310 MRTT.
FR	This STANAG will be implemented for new equipment. France will not apply paragraphs 2.6 and 2.7.
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 Document Database for the complete list of existing reservations.	

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CHAPTER 1 INTRODUCTION

1.1. RELATED DOCUMENTS

1. STANAG 3971 - Air-to-Air Refuelling – ATP-3.3.4.2

2. STANAG 7191 - Air-to-Air (Aerial) Refuelling Equipment: Boom-Receptacle System and Interface Requirements – ATP-3.3.4.5

3. Military Specifications Mil-H-4495 - Hose Assembly, Rubber, Aerial Refueling

4. Military Specifications Mil-A-008865 - Airplane Strength and Rigidity Miscellaneous Loads

5. Military Specifications Mil-A-19736 – Air Refueling Systems, General Specification for

6. Military Specifications Mil-N-25161 - Nozzle, Aerial Pressure Refueling, Type MA-2

7. Military Specifications Mil-PRF-81975 - Coupling, Regulated, Aerial Pressure Refueling Type MA-2, Type MA-3, and Type MA-4

8. Military Standards MS24354 - Drogue Cone, Nozzle and Reception Coupling Type MA-2 Flight Pressure Refuelling System, Assembly of

9. Military Standards MS24355 - Coupling Reception – Type MA-2, Flight-Pressure Refueling, Assembly of

10. Military Standards MS24356 - Nozzle – Type MA-2, Flight Pressure Refueling

11. Military Standards MS24357 - Flange, Drogue Cone – Type MA-2 Reception Coupling, Flight Pressure Refueling, Outline Dimensions For

12. Military Standards MS24358 - Fitting, Hose End – Type MA-2, Flight Pressure Refueling, Reception Coupling, Outline Dimensions For

13. Military Standards MS24359 - Nose, Probe Mast – Type MA-2, Flight Pressure Refueling Nozzle, Outline Dimensions For

14. Military Standards MS24360 - Ring, Lock Flight Pressure Refueling Nozzle

15. Military Standards MS24361 - Ring, Split – Type MA-2, Flight Pressure Refueling, Reception Coupling

16. Military Standards MS24362 - Sleeve – Type MA-2, Flight Pressure Refueling, Reception Coupling

17. JSSG-2001 Department of Defense Joint Service Specification Guide: Air Vehicles Subsystems (22 Oct 2002 or later revision)

18. Aerial Refueling Systems Advisory Group (ARSAG) 03-00-03R - Aerial Refueling Pressures: Definitions and Terms, Design and Verification Guidance, dated 21 Sept. 2010 or later revision

19. Aerial Refueling Systems Advisory Group (ARSAG) 17-81-03R - Standardized Technical Data Survey for Aerial Refueling, dated Apr 2011 or later revision

1.2. AIM

The aim of this NATO STANDARD is to provide the air-to-air refueling (AAR) systems requirements and to standardize the interfaces required to engage in probe-drogue refueling operations to facilitate AAR between aircraft of NATO forces.

1.3. AGREEMENT

Participating nations agree to use the probe-drogue system and interface requirements established in this NATO STANDARD and its ANNEXES.

1.4. IMPLEMENTATION OF THE NATO STANDARD

This NATO STANDARD and its covering STANAG is implemented when a nation has issued instructions that all future equipment developed or services contracted will be in accordance with the specifications detailed in this document. Any nation procuring tanker/receiver aircraft or services, which existed prior to promulgation of this NATO STANDARD, shall identify any and all exceptions to the specifications detailed herein for said aircraft. Any nation which modifies an aircraft, or procures services of a modified aircraft, with AAR equipment which existed prior to the promulgation of this document, shall identify any and all exceptions to the specifications detailed herein for said aircraft.

CHAPTER 2 SPECIFICATIONS

2.1. MATING DIMENSIONS

The mating dimensions of the reception coupling and of the probe nozzle shall conform to Annexes A and B, respectively.

2.2. CLEARANCE ENVELOPE

A clearance envelope shall be provided around the probe nozzle/probe mast installation in accordance with Annex C.

1. The receiver AAR probe installation shall be such that all receiver aircraft structure (including probe mast, door, etc.) is outside of the hatched area.

2. The tanker drogue shall be designed such that all parts (including ribs, canopy, etc.) are within the hatched area.

2.3. ENGAGEMENT FORCE

The force required to engage the nozzle in the coupling shall not exceed 155 lbf at a head pressure of 10 psig.

2.4. LATCH OPERATION

Functional operation of the latches shall be verified by the test gauge of Annex D. With the sleeve closed, the gauge shall be passed along the longitudinal axis of the nozzle/probe mast over the latches in both directions. A maximum force of 20 lbf (89 Newtons) in the engaging direction and 50 lbf (223 Newtons) in the disengaging direction shall be allowed.

2.5. PRESSURE REGULATION

Where tankers are capable of delivering fuel pressures greater than 55 psig (379 kPa), the tanker shall regulate the steady state fuel delivery pressure to not exceed 55 psig (379 kPa) downstream of the nozzle outlet at all flow rates down to zero flow.

2.6. TANKER PRESSURE SURGES

Pressure surges generated by the tanker aircraft shall not exceed receiver fuel system proof pressure downstream of the coupling.

2.7. RECEIVER PRESSURE SURGES

Pressure surges generated by the receiver shall be controlled by the receiver so as to not exceed the design proof pressure limit of the receiver and tanker.

2.8. NOTES FOR NEW RECEIVER DESIGN CONSIDERING LEGACY TANKERS

1. Some tanker drogue systems, which provide only hose end fuel pressure regulation (e.g., using MA-3/MA-4 couplings), require up to 30 cc/min flow in order to regulate their delivery pressure so that it does not exceed 55 psig. When refueling with these types of tanker drogue systems, receiver aircraft AR systems, which provide less than 30 cc/min flow at receiver top-off (e.g., employ "no-leak" fuel shut-off valves) may experience steady state delivery pressures that exceed 55 psig (i.e., possibly up to the tanker's AR pump deadhead pressure).

2. Under no flow/low flow (less than 30 cc/min) conditions, some systems allow for maximum pressure of 65 psig.

2.9. NOTES FOR NEW TANKER DESIGN CONSIDERING LEGACY RECEIVERS

1. Some legacy receivers (for example helicopters) may require an interface pressure lower than 55 psig.

2. Some legacy receiver probes are not ATP 3.3.4.6 (STANAG 3447) compliant. (See Annex B.)

3. Some legacy receivers have a fuel system proof pressure of 120 psig (828 kPa).

ANNEX A RECEPTION COUPLING - MATING DIMENSIONS

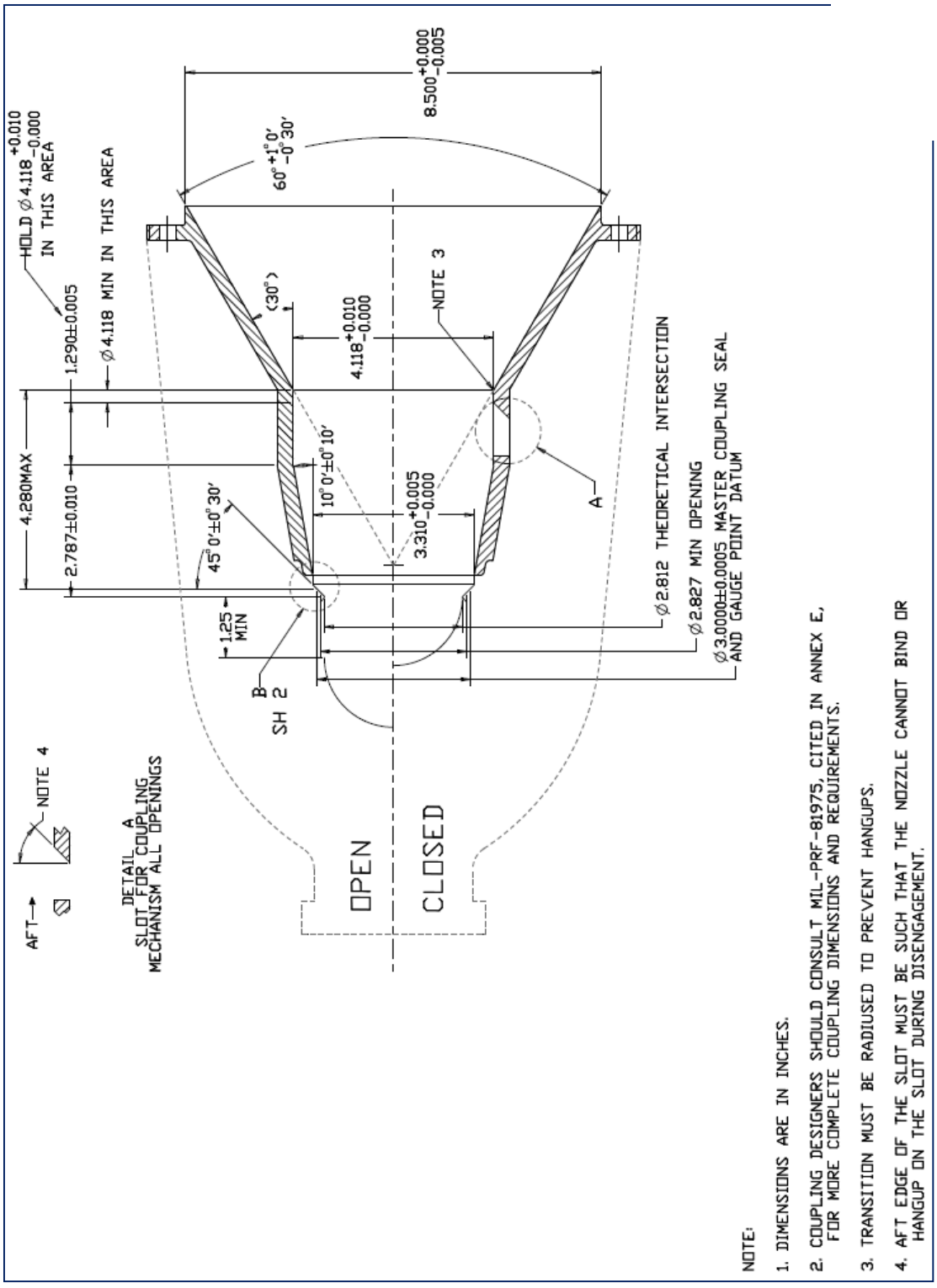


Figure 1: Reception Coupling - Mating Dimensions

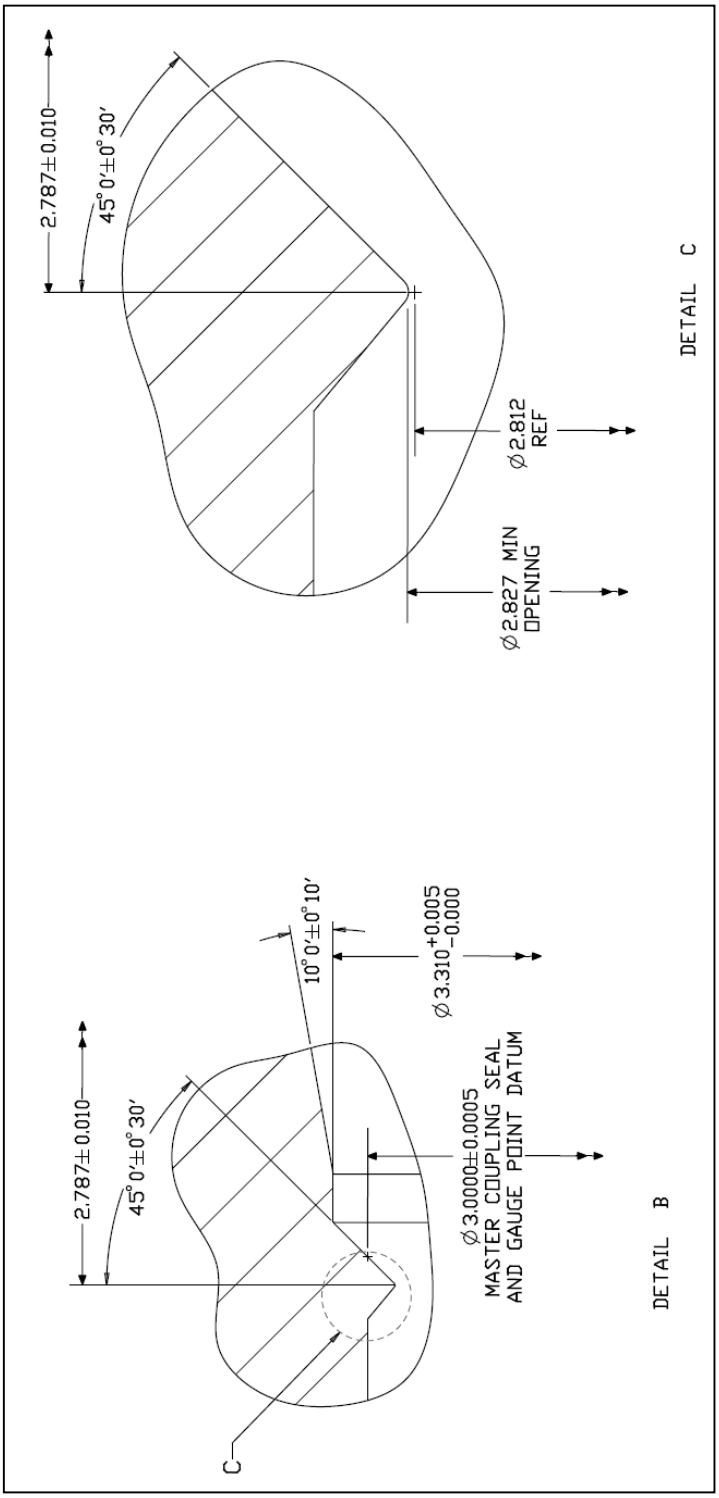


Figure 2: Reception Coupling - Mating Dimensions

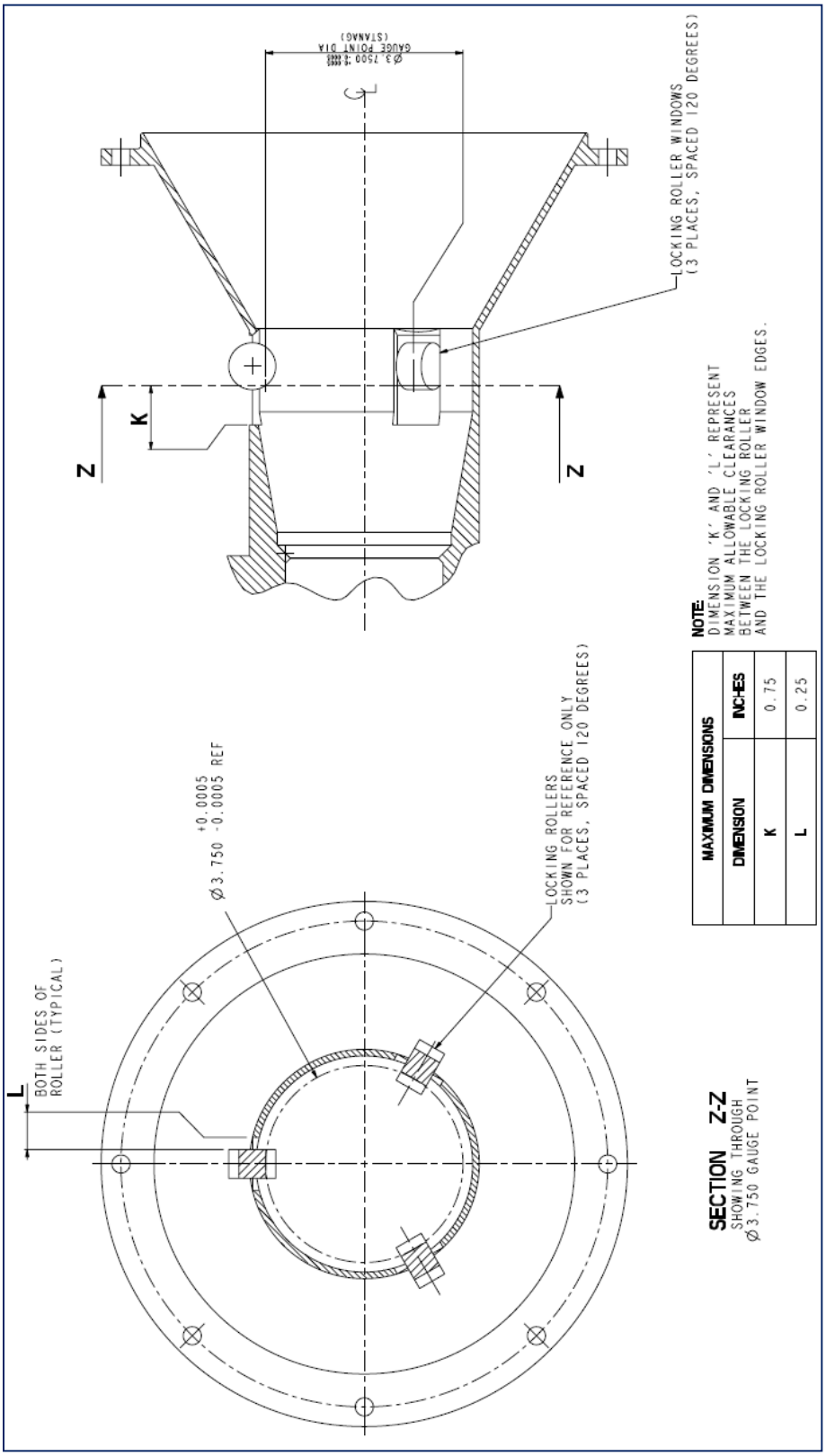


Figure 3: Reception Coupling - Mating Dimensions

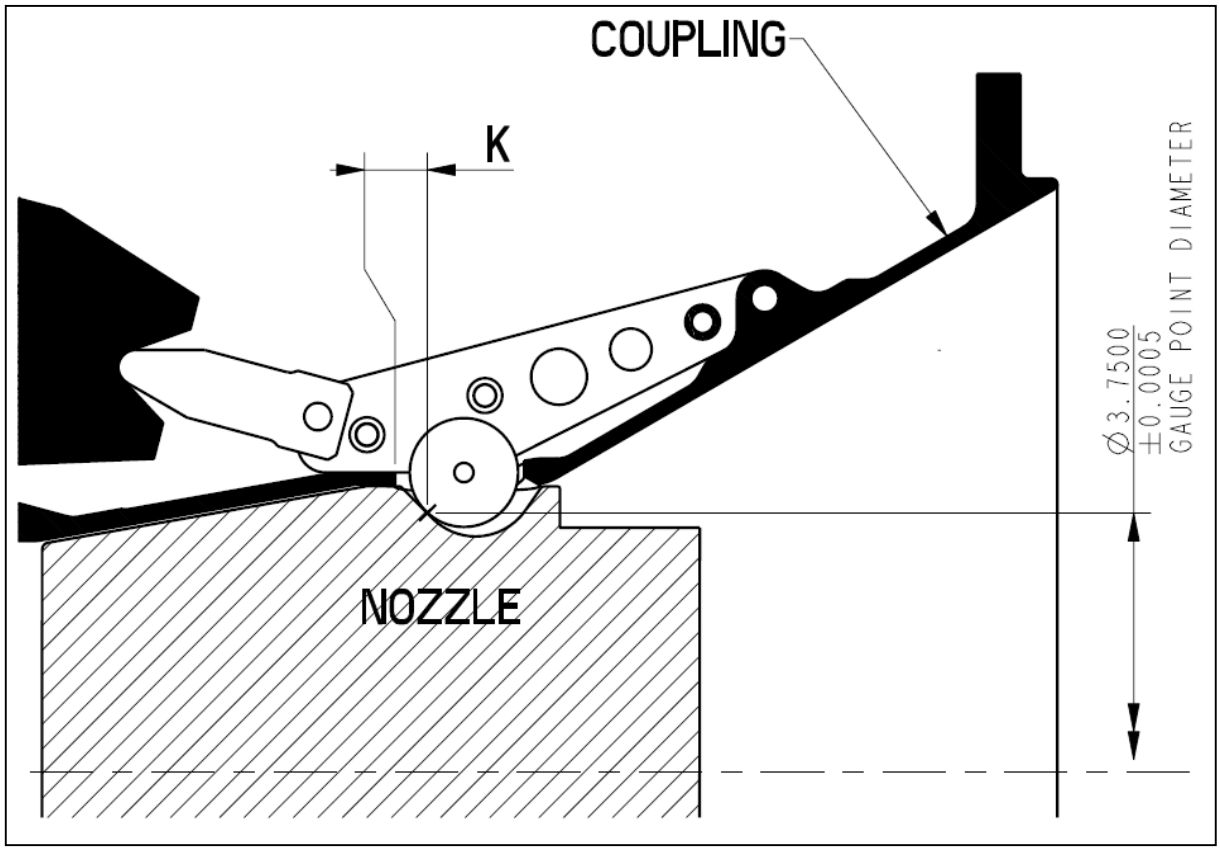


Figure 4: Reception Coupling - Mating Dimensions

NOTE:
To determine the coupling roller max diameter and location, the AAR probe nozzle mating dimension must be reviewed.

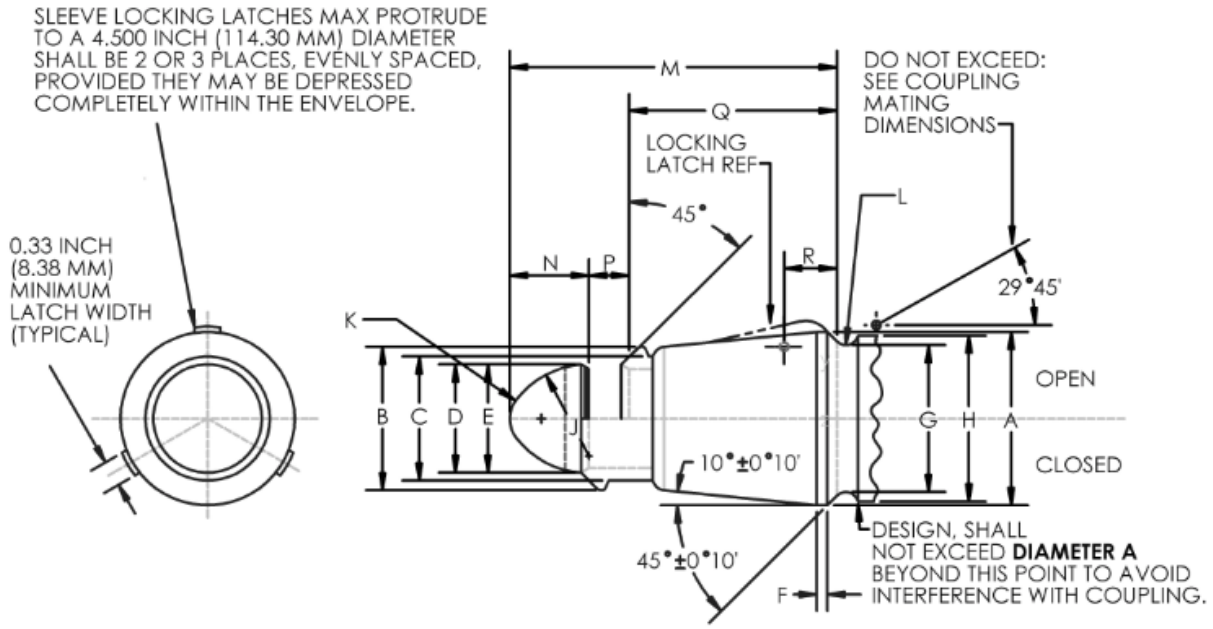
ANNEX B NOZZLE MATING DIMENSIONS

DIM	MINIMUM		MAXIMUM	
	INCH	MM	INCH	MM
A	4.090	103.89	4.095	104.01
B	3.300	83.82	3.305	83.95
C	2.9995	76.19	3.0005	76.21
D	------	-----	2.791	70.89
E	2.812	71.42	2.812	71.42
F	0.240	6.10	0.260	6.60
G	3.365	85.47	3.385	85.98
H	3.7495	95.24	3.7505	95.26

C - MASTER COUPLING SEAL & GAUGE POINT DATA
D - NOZZLE TIP DIAMETER
E - THEORETICAL NOZZLE TIP SEAL/SLEEVE INTERSECTION
H - GAUGE POINT

DIM	MINIMUM		MAXIUM	
	INCH	MM	INCH	MM
J*	2.490	63.246	2.510	63.754
K*@	0.990	25.15	1.010	25.65
L*	0.427	10.85	0.447	11.35
M	6.280	159.51	6.300	160.02
N	1.886	47.90	1.906	48.41
P%	1.250	31.75	-----	------
Q	3.136	79.65	3.142	79.81
R	0.950	24.13	-----	------

@ - SPHERICAL
% - REFERENCE
* - RADIUS
P - MOVEMENT REFERENCE
Q - SLEEVE BOTTOMED OUT
R - LATCH PIVOT OFFSET



NOTE: NOZZLE SHALL BE INSTALLED WITH CRES MATERIAL LOCKING RING P/N MS24360-2. ALUMINUM LOCKING RING PROHIBITED.

Figure 5: Nozzle Mating Dimensions

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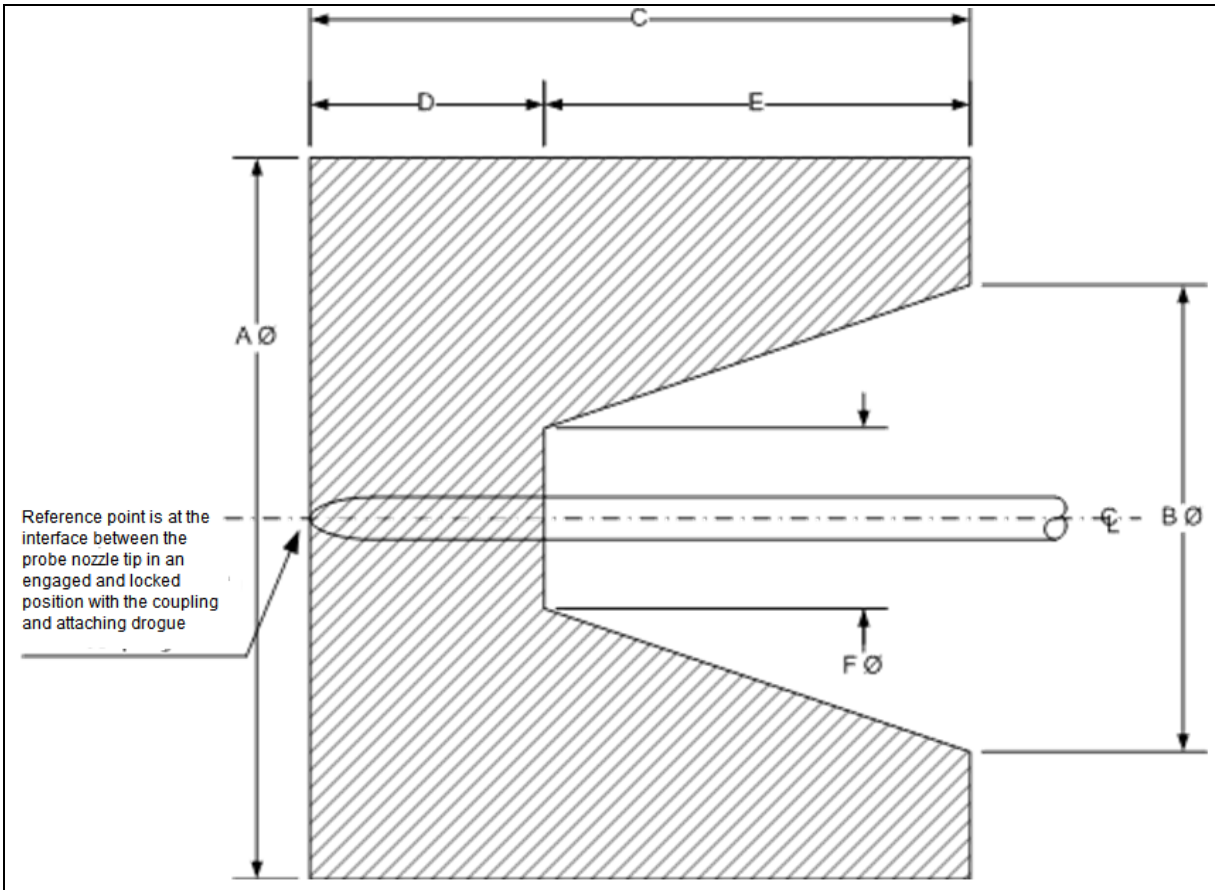
ANNEX C AAR PROBE CLEARANCE ENVELOPE



	INCH	MM
A	34.00	863.60
B	22.00	558.80
C	31.00	787.40
D	11.00	279.40
E	20.00	508.00
F	8.50	215.90

Figure 6: AAR Probe Clearance Envelope

NOTES for Figure 6:

1. This figure defines the minimum envelope area to be provided around the AAR probe to permit proper engagement with the reception coupling. Designers should give careful consideration to increasing the envelope space due to the following reasons:

a. The figure does not account for relative movement between the drogue and the receiver aircraft during contact, disconnect, and particularly during mis-engagements. To permit successful contacts/disconnects of the probe and drogue, and to avoid drogue and receiver damage due to mis-engagements, designers should avoid having any protrusions located on the probe mast or aircraft outer mold-line structure such as probe light(s), clamps, or other projections that could damage the drogue.

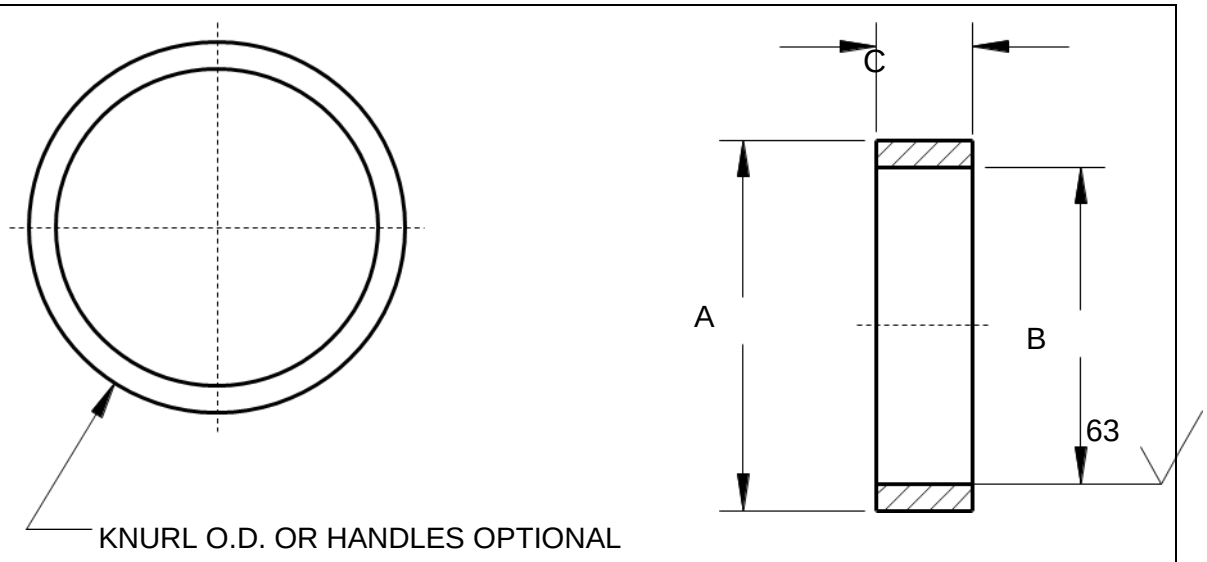
b. If the drogue travels within the influence of the receiver's flow field (for example, bow wave) a portion of the drogue (canopy type drogues) may not be fully inflated just prior to the coupling engagement. As a result, the tanker's drogue struts may contact the receiver aircraft probe mast, actuators, doors, lights, airframe, etc. and prevent engagement. Therefore, the probe mast should be of sufficient length to preclude the collapsed drogue struts from striking the probe mast and associated clamps, lighting, etc.

2. A minimum of 12 inches (305 mm) should be provided between the outer edge of the drogue and the aircraft canopy once engaged with the nozzle or including during engagement/disengagement process.

3. Receiver aircraft designers should consider that the drogue can contact the fuselage of the receiver e.g. when the probe (nozzle/mast) engagement is missed or is off-center to the drogue, thus allowing the drogue to contact and damage the aircraft skin and/or critical air data equipment like pitot-static probes, angle of attack vanes, etc. that are installed near the AAR probe.

4. This figure is intended for design of fixed wing aircraft. Dimensions A, C and E may not apply to rotary wing aircraft design.

ANNEX D AAR PROBE NOZZLE LATCH TEST GAUGE



NOTES:
1. SURFACE TEXTURE IN ACCORDANCE WITH ANSI B46.1.
2. BREAK SHARP EDGES 0.010 IN. MAX (0.254mm).
3. MATERIAL: CORROSION-RESISTANT STEEL.

DIMENSION	MAX		MIN	
	INCH	MM	INCH	MM
"A" O.D.	4.812	122.22	4.688	119.08
"B" I.D.	4.110	104.39	4.105	104.27
"C" THICKNESS	1.250	31.75	1.188	30.16

Figure 7: AAR Probe Nozzle Latch Test Gauge

ATP-3.3.4.6(A)(1)