TECHNICAL MANUAL

OPERATOR'S MANUAL

UH-60A AND EH-60A HELICOPTER

THIS MANUAL SUPERSEDES
TM55-1520-237-10/ TO 1H-60(U)A-1,
21 MAY 1979, INCLUDING ALL CHANGES.

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This copy is a reprint which includes current pages from Changes 1 through 15.

HEADQUARTERS, DEPARTMENT OF THE ARMY

8 JANUARY 1988

CHANGE
NO. 15

HEADQUARTE
DEPARTMENT OF THE A
WASHINGTON, D.C., 29 NOVEMBER

Operator's Manual

UH-60A, EH-60A and UH-60L HELICOPTERS

TM 55-1520-237-10, 8 January 1988, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text ma is indicated by a vertical bar in the margin. An illustration change is ind by a miniature pointing hand.

Remove pages	Insert pages
1-1 and 1-2	1-1 and 1-2
2-3 and 2-4	2-3 and 2-4
2-7 and 2-8	2-7 and 2-8
2-17 and 2-18	2-17 and 2-18
2-18.1/2-18.2	2-18.1/2-18.1
2-19 and 2-20	2-19 and 2-20
2-21 and 2-22	2-21 and 2-22
2-28.1 through 2-28.4	2-28.1 through 2-28.4
2-29 through 2-32	2-29 through 2-32
2-37 through 2-40	2-37 through 2-40
2-43 through 2-46	2-43 through 2-46
2-49 through 2-58	2-49 through 2-58
2-61 and 2-62	2-61 and 2-62
2-73 and 2-74	2-73 and 2-74
2-79 through 2-84	2-79 through 2-84
2-87 and 2-88	2-87 and 2-88
2-91 and 2-92	2-91 and 2-92
2-97 through 2-102	2-97 through 2-102
3-1 and 3-2	3-1 and 3-2
3-21 and 3-22	3-21 and 3-22
3-53 and 3-54	3-53 and 3-54
3-59 and 3-60	3-59 and 3-60
4-7 and 4-8	4-7 and 4-8
4-28.1/4-28.2	4-28.1/4-28.2
4-31 and 4-32	4-31 and 4-32
4-38.1/4-38.2	4-38.1/4-38.2
- - - -	4-41/4-42
5-1 and 5-2	5-1 and 5-2
5-5 through 5-8	5-5 through 5-8
- - - -	5-8.1/5-8.2
5-9 through 5-14	5-9 through 5-14
5-17/5-18	5-17/5-18
6-3 through 6-6	6-3 through 6-6
6-6.1 and 6-6.2	6-6.1 and 6-6.2
6-7 through 6-12	6-7 through 6-12
6-15 and 6-16	6-15 and 6-16
6-19 and 6-20	6-19 and 6-20

Remove pages	Insert pages
7-1 and 7-2	7-1 and 7-2
7-2.1/7-2.2	- - - -
7-3 through 7-86	7-3 through 7-86
- - - -	7-87 through 7-142
- - - -	7-142.1/7-142.2
- - - -	7-143 through 7-164
7.1-2.1/7.1-2.2	7.1-2.1 and 7.1-2.2
7.1-3 through 7.1-12	7.1-3 through 7.1-12
7.1-12.1 and 7.1-12.2	7.1-12.1/7.1-12.2
7.1-13 and 7.1-14	7.1-13 and 7.1-14
- - - -	7.1-14.1 through 7.1-14.6
7.1-15 and 7.1-16	7.1-15 and 7.1-16
7.1-16.1 and 7.1-16.2	7.1-16.1 and 7.1-16.2
7.1-19 through 7.1-22	7.1-19 through 7.1-22
7.1-56.1 through 7.1-56.4	7.1-56.1 through 7.1-56.4
7.1-79 and 7.1-80	7.1-79 and 7.1-80
7.1-82.1/7.1-82.2	7.1-82.1/7.1-82.2
7.1-93 and 7.1-94	7.1-93 and 7.1-94
8-9 through 8-12	8-9 through 8-12
8-15 and 8-16	8-15 and 8-16
8-19 and 8-20	8-19 and 8-20
- - - -	8-20.1/8-20.2
8-23/8-24	8-23/8-24
9-5 and 9-6	9-5 and 9-6
9-6.1/9-6.2	9-6.1/9-6.2
9-7 and 9-8	9-7 and 9-8
9-9 and 9-10	9-9 and 9-10
- - - -	9-10.1/9-10.2
9-11 and 9-12	9-11 and 9-12
9-13 through 9-16	9-13 through 9-16
B-1 and B-2	B-1 and B-2
Index-1 through Index-10	Index-1 through Index-10
Index-10.1/Index-10.2	- - - -
Index-11 through Index-20	Index-11 through Index-22

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Official:

Milton H. Hamilton

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
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TM 55-1520-237-10
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CHANGE }
NO. 14 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 11 October 1991

Operator's Manual

UH-60A, EH-60A and UH-60L Helicopters

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Remove pages	Insert pages
2-33 and 2-34	2-33 and 2-34
5-7 and 5-8	5-7 and 5-8
8-9 and 8-10	8-9 and 8-10

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WASHINGTON, D.C., 30 August 1991

Operator's Manual

UH-60A, EH-60A and UH-60L HELICOPTERS

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Remove pages	Insert pages
Warning	Warning
1-1 and 1-2	1-1 and 1-2
2-7 and 2-8	2-7 and 2-8
2-8.1/2-8.2	2-8.1 and 2-8.2
2-21 and 2-22	2-21 and 2-22
- - - -	2-22.1/2-22.2
2-23 and 2-24	2-23 and 2-24
2-27 and 2-28	2-27 and 2-28
2-28.1 through 2-28.3/2-28.4	2-28.1 through 2-28.4
2-33 and 2-34	2-33 and 2-34
2-37 and 2-38	2-37 and 2-38
2-48.1/2-48.2	2-48.1/2-48.2
2-55 and 2-56	2-55 and 2-56
2-59 and 2-60	2-59 and 2-60
2-63 and 2-64	2-63
2-65 and 2-66	Blank/2-66
2-67 through 2-72	2-67 through 2-70
2-73 through 2-76	2-73 through 2-76
2-79 and 2-80	2-79 and 2-80
2-89 and 2-90	2-89 and 2-90
2-93 through 2-96	2-93 through 2-96
2-101 and 2-102	2-101 and 2-102
3-53 through 3-56	3-53 through 3-56
4-19 and 4-20	4-19 and 4-20
4-28.1/4-28.2	4-28.1/4-28.2
4-38.1/4-38.2	4-38.1/4-38.2
5-1 through 5-8	5-1 through 5-8
5-11 and 5-12	5-11 and 5-12
5-15 through 5-17/5-18	5-15 through 5-17/5-18
6-3 through 6-6	6-3 through 6-6
- - - -	6-6.1 through 6-6.3/6-6.4
7-11 through 7-14	7-11 through 7-14
7-85 and 7-86	7-85 and 7-86
7.1-1 and 7.1-2	7.1-1 and 7.1-2
- - - -	7.1-2.1/7.1-2.2
7.1-3 and 7.1-4	7.1-3 and 7.1-4
7.1-9 through 7.1-12	7.1-9 through 7.1-12

Remove pages	Insert pages
- - - -	7.1-12.1 and 7.1-12.2
7.1-13 and 7.1-14	7.1-13 and 7.1-14
- - - -	7.1-16.1 through 7.1-16.3/ 7.1-16.4
7.1-19 and 7.1-20	7.1-19 and 7.1-20
- - - -	7.1-26.1 through 7.1-26.6
7.1-27 and 7.1-28	7.1-27 and 7.1-28
- - - -	7.1-32.1 through 7.1-32.6
7.1-33 and 7.1-34	7.1-33 and 7.1-34
- - - -	7.1-38.1 through 7.1-38.6
7.1-39 and 7.1-40	7.1-39 and 7.1-40
- - - -	7.1-44.1 through 7.1-44.6
7.1-45 and 7.1-46	7.1-45 and 7.1-46
- - - -	7.1-50.1 through 7.1-50.6
7.1-51 and 7.1-52	7.1-51 and 7.1-52
- - - -	7.1-56.1 through 7.1-56.5/ 7.1-56.6
- - - -	7.1-60.1 through 7.1-60.5/ 7.1-60.6
7.1-61 and 7.1-62	7.1-61 and 7.1-62
- - - -	7.1-66.1 through 7.1-66.5/ 7.1-66.6
- - - -	7.1-70.1 through 7.1-70.4
- - - -	7.1-74.1 through 7.1-74.4
- - - -	7.1-78.1 through 7.1-78.4
7.1-79 and 7.1-80	7.1-79 and 7.1-80
- - - -	7.1-80.1/7.1-80.2
7.1-81 and 7.1-82	7.1-81 and 7.1-82
- - - -	7.1-82.1/7.1-82.2
7.1-83 and 7.1-84	7.1-83 and 7.1-84
- - - -	7.1-84.1/7.1-84.2
7.1-85 and 7.1-86	7.1-85 and 7.1-86
- - - -	7.1-86.1/7.1-86.2
7.1-89 and 7.1-90	7.1-89 and 7.1-90
- - - -	7.1-91 through 7.1-98
8-5 through 8-16	8-5 through 8-16
8-21 and 8-22	8-21 and 8-22
9-5 and 9-6	9-5 and 9-6
- - - -	9-6.1/9-6.2
9-7 and 9-8	9-7 and 9-8
9-8.1/9-8.2	9-8.1 and 9-8.2
9-9 and 9-10	9-9 and 9-10
9-12.1/9-12.2	9-12.1/9-12.2
9-13 through 9-18	9-13 through 9-18
A-1/A-2	A-1/A-2
Index - 1 and Index - 2	Index - 1 and Index - 2
Index - 7 through Index - 10	Index - 7 through Index - 10
- - - -	Index - 10.1/Index - 10.2
Index - 13 and Index - 14	Index-13 and Index - 14

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Chief of Staff

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Colonel, United States Army
The Adjutant General

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CHANGE }
NO. 12 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 13 February 1991

Operator's Manual

UH-60A, EH-60A and UH-60L HELICOPTERS

TM 55-1520-237-10, 8 January 1988, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-1 and 2-2	2-1 and 2-2
2-9 and 2-10	2-9 and 2-10
2-25 through 2-28	2-25 through 2-28
2-28.1 and 2-28.2	2-28.1 and 2-28.2
2-47 and 2-48	2-47 and 2-48
- - - - - -	2-48.1/2-48.2
2-49 and 2-50	2-49 and 2-50
2-61 and 2-62	2-61 and 2-62
2-75 and 2-76	2-75 and 2-76
2-89 and 2-90	2-89 and 2-90
2-99 and 2-100	2-99 and 2-100
3-67 and 3-68	3-67 and 3-68
4-23 and 4-24	4-23 and 4-24
4-27 and 4-28	4-27 and 4-28
4-28.1/4-28.2	4-28.1/4-28.2
4-31 through 4-34	4-31 through 4-34
- - - - - -	4-34.1/4-34.2
4-35 through 4-38	4-35 through 4-38
- - - - - -	4-38.1/4-38.2
5-1 through 5-4	5-1 through 5-4
5-4.1/5-4.2	- - - - - -
5-5 and 5-6	5-5 and 5-6
5-6.1/5-6.2	- - - - - -
5-7 through 5-12	5-7 through 5-12
5-13 and 5-14	5-13 through 5-17/5-18
6-1 and 6-2	6-1 and 6-2
6-5 and 6-6	6-5 and 6-6
7-1 and 7-2	7-1 and 7-2
7-3 through 7-6	7-3 through 7-6
7-11 and 7-12	7-11 and 7-12
7-69 and 7-70	7-69 and 7-70
7.1-1 through 7.1-11/7.1-12	7.1-1 through 7.1-90
8-1 and 8-2	8-1 and 8-2
8-5 through 8-8	8-5 through 8-8
8-8.1/8-8.2	- - - - - -
8-9 through 8-12	8-9 through 8-12
8-12.1/8-12.2	- - - - - -

Remove pages	Insert pages
8-13 through 8-20	8-13 through 8-20
8-20.1/8-20.2	- - - - -
8-21 and 8-22	8-21 and 8-22
9-1 and 9-2	9-1 and 9-2
9-7 and 9-8	9-7 and 9-8
9-13 and 9-14	9-13 and 9-14
A-1/A-2	A-1/A-2
Index-1 through Index-18	Index-1 through Index-20

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General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

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CHANGE NO. 11

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 24 August 1990

Operator's Manual

UH-60A, EH-60A AND UH-60L HELICOPTERS

TM 55-1520-237-10, 8 January 1988, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-79 and 2-80	2-79 and 2-80

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The Adjutant General

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CHANGE NO. 10

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 24 July 1990

Operator's Manual

UH-60A, EH-60A AND UH-60L HELICOPTERS

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1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
4-31 and 4-32	4-31 and 4-32
4-35 and 4-36	4-35 and 4-36

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CHANGE
NO. 9

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 2 July 1990

Operator's Manual

UH-60A, EH-60A AND UH-60L HELICOPTERS

TM 55-1520-237-10, 8 January 1988, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-7 and 2-8	2-7 and 2-8
2-65 through 2-68	2-65 through 2-68
2-71 and 2-72	2-71 and 2-72
4-23 and 4-24	4-23 and 4-24
4-24.1/4-24.2	4-24.1 and 4-24.2
8-11 and 8-12	8-11 and 8-12
8-13 and 8-14	8-13 and 8-14
8-14.1/8-14.2	- - - -
8-15 and 8-16	8-15 and 8-16
Index-1 and Index-2	Index-1 and Index-2

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CHANGE }
NO. 8 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 13 June 1990

Operator's Manual

UH-60A, EH-60A and UH-60L HELICOPTERS

TM 55-1520-237-10, 8 January 1988, is changed as follows:

1. Title has been changed to read as stated above.

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Remove pages	Insert pages
i and ii	i through iii/iv
2-25 and 2-26	2-25 and 2-26
2-43 and 2-44	2-43 and 2-44
2-53 and 2-54	2-53 and 2-54
3-3 and 3-4	3-3 and 3-4
----	3-18.1/3-18.2
3-19	3-19 and 3-20
4-15 and 4-16	4-15 and 4-16
4-24.1/4-24.2	4-21.1/4-24.2
4-25 through 4-28	4-25 through 4-28
4-39 and 4-40	4-39 and 4-40
5-1 and 5-2	5-1 and 5-2
5-4.1/5-4.2	5-4.1/5-4.2
5-5 and 5-6	5-5 and 5-6
5-6.1/5-6.2	5-6.1/5-6.2
5-7 and 5-8	5-7 and 5-8
5-13 and 5-14	5-13 and 5-14
6-5 and 6-6	6-5 and 6-6
8-3 through 8-6	8-3 through 8-6
8-6.1/8-6.2	----
8-7 and 8-8	8-7 and 8-8
8-8.1/8-8.2	8-8.1/8-8.2
8-12.1/8-12.2	8-12.1/8-12.2
8-13 and 8-14	8-13 and 8-14
8-14.1/8-14.2	----
8-15 through 8-18	8-15 through 8-18
9-1 and 9-2	9-1 and 9-2
9-5 through 9-8	9-5 through 9-8
9-8.1/9-8.2	9-8.1/9-8.2
9-9 and 9-10	9-9 and 9-10
9-15 and 9-16	9-15 and 9-16
9-19 and 9-20	9-19 and 9-20
Index 17 and Index 18	Index 17 and Index 18

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CHANGE NO. 7

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 28 February 1990

Operator's Manual

UH-60A, EH-60A AND UH-60L HELICOPTERS

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1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
4-31 and 4-32	4-31 and 4-32
5-7 and 5-8	5-7 and 5-8

2. Retain this sheet in front of manual for reference purposes.

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

Official:

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The Adjutant General

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CHANGE NO. 6

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 22 November 1989

OPERATOR'S MANUAL

UH-60A, EH-60A AND UH-60L HELICOPTERS

TM 55-1520-237-10, 8 January 1988, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
1-1 and 1-2	1-1 and 1-2
2-1 through 2-8	2-1 through 2-8
2-9 and 2-10	2-9 and 2-10
- - - -	2-10.1/2-10.2
2-13 and 2-14	2-13 and 2-14
2-15 through 2-18	2-15 through 2-18
- - - -	2-18.1/2-18.2
2-21 through 2-28	2-21 through 2-28
- - - -	2-28.1 and 2-28.2
- - - -	2-28.3/2-28.4
2-29 through 2-34	2-29 through 2-34
2-47 and 2-48	2-47 and 2-48
2-55 and 2-56	2-55 and 2-56
2-59 and 2-60	2-59 and 2-60
2-73 and 2-74	2-73 and 2-74
2-79 and 2-80	2-79 and 2-80
2-89 and 2-90	2-89 and 2-90
3-1 through 3-4	3-1 through 3-4
3-9 and 3-10	3-9 and 3-10
3-15 and 3-16	3-15 and 3-16
- - - -	3-16.1/3-16.2
3-17 and 3-18	3-17 and 3-18
3-19 and 3-20	3-19/3-20
3-20.1 and 3-20.2	3-20.1 and 3-20.2
3-25 and 3-26	3-25 and 3-26
3-59 and 3-60	3-59 and 3-60
3-63 and 3-64	3-63 and 3-64
4-3 and 4-4	4-3 and 4-4
4-7 and 4-8	4-7 and 4-8
4-10.1 and 4-10.2	4-10.1 and 4-10.2
4-10.3/4-10.4	4-10.3/4-10.4
4-15 and 4-16	4-15 and 4-16
4-23 and 4-24	4-23 and 4-24
- - - -	4-24.1/4-24.2
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Index-11/Index-12	Index-11 through Index-18

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Index 9 through Index 11/Index 12	Index 9 through Index 11/Index 12

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9-17 and 9-18	9-17 and 9-18
9-19/9-20	-----------
-----------	9-19 and 9-20

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WARNING

Personnel performing operations, procedures, and practices which are included or implied in this technical manual shall observe the following warnings. Disregard of these warnings and precautionary information can cause serious injury or loss of life.

BATTERY ELECTROLYTE
Battery electrolyte is harmful to the skin and clothing. If potassium hydroxide is spilled on clothing or other material, wash immediately with clean water. If spilled on personnel, immediately flush the affected area with clean water. Continue washing until medical assistance arrives. Neutralize any spilled electrolyte by thoroughly flushing contacted area with water.

CARBON MONOXIDE
When smoke, suspected carbon monoxide fumes, or symptoms of anoxia exist, the crew should immediately ventilate the cockpit.

ELECTROMAGNETIC INTERFERENCE (EMI)
No electrical/electronic devices of any sort, other than those described in this manual or appropriate airworthiness release and approved by USAAVSCOM AMSAV-ECU, are to be operated by crewmembers or passengers during operation of this helicopter.

FIRE EXTINGUISHER
Exposure to high concentrations of extinguishing agent or decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burns.

HANDLING FUEL AND OIL
Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary.

HIGH VOLTAGE
All ground handling personnel shall be informed of high voltage hazards when making external cargo hookups.

NOISE
Sound pressure levels in this helicopter during some operating conditions exceed the Surgeon General's hearing conservation criteria, as defined in TB MED 501. Hearing protection devices, such as the aviator helmet or ear plugs are required to be worn by all personnel in and around the helicopter during its operation.

WEAPONS AND AMMUNITION
Observe all standard safety precautions governing the handling of weapons and live ammunition. When not in use, point all weapons in a direction offering the least exposure to personnel and property in case of accidental firing. Do not walk in front of weapons. SAFE the machinegun before servicing. To avoid potentially dangerous situations, follow all procedural warnings in text.

ELECTROMAGNETIC RADIATION EH
Do not stand within six feet of Aircraft Survivability Equipment (ASE), ALQ-156 and ALQ-162, transmit antennas when the ASE equipment is on. High frequency electromagnetic radiation can cause internal burns without causing any sensation of heat.

TABLE OF CONTENTS

REPORTING OF ERRORS

Every effort is made to keep this publication current and error free. Review conferences with using personnel, and a constant review of accident and flight test reports assure inclusion of the latest data in this publication. However, we cannot correct an error unless we know of its existence. In this regard it is essential that you do your part. Errors, omissions and recommendations for improving this publication by you are encouraged. Your letter or DA Form 2028, Recommended Changes to Publications, should be mailed to Commander, U.S. Army Aviation Systems Command, Attn: AMSAV-MC, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

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TABLE OF CONTENTS (Cont)

CHAPTER 1
INTRODUCTION

1-1. General.

These instructions are for use by the operator. They apply to UH-60A, UH-60L, and EH-60A helicopters.

1-2. Warnings, Cautions, and Notes.

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which it is essential to highlight.

1-3. Description.

a. This manual contains the best operating instructions and procedures for the UH-60A, UH-60L, and EH-60A helicopters. The primary mission of this helicopter is that of tactical transport of troops, medical evacuation, cargo, and reconnaissance within the capabilities of the helicopter. The observance of limitations, performance and weight and balance data provided is mandatory. The observance of procedures is mandatory except when modification is required because of multiple emergencies, adverse weather, terrain, etc. Your flying experience is recognized and therefore, basic flight principles are not included. IT IS REQUIRED THAT THIS MANUAL BE CARRIED IN THE HELICOPTER AT ALL TIMES.

1-4. Appendix A, References.

Appendix A is a listing of official publications cited within the manual applicable to and available for flight crews, and fault isolation/trouble references.

1-5. Appendix B, Abbreviations and Terms.

Abbreviations listed are to be used to clarify the text in this manual only. Do not use them as standard abbreviations.

1-6. Index.

The index lists, in alphabetical order, every titled paragraph, figure, and table contained in this manual. Chapter 7 performance data has an additional index within the chapter.

1-7. Army Aviation Safety Program.

Reports necessary to comply with the safety program are prescribed in AR 385-40.

1-8. Destruction of Army Materiel to Prevent Enemy Use.

For information concerning destruction of Army materiel to prevent enemy use, refer to TM 750-244-1-5.

1-9. Forms and Records.

Army aviators flight record and aircraft inspection and maintenance records which are to be used by crewmembers are prescribed in DA PAM 738-751 and TM 55-1500-342-23.

1-10. Explanation of Change Symbols.

Changes, except as noted below, to the text and tables, including new material on added pages, are indicated by a vertical line in the outer margin extending close to the entire area of the material affected: exception; pages with emergency markings, which consist of black diagonal lines around three edges, may have the vertical line or change symbol placed along the inner margin. Symbols show current changes only. A miniature pointing hand symbol is used to denote a change to an illustration. However, a vertical line in the outer margin, rather than miniature pointing hands, is utilized when there have been extensive changes made to an illustration. Changes to diagrams and schematics have shading or screening to highlight the area containing the change. Change symbols are not used to indicate changes in the following:

a. Introductory material.

b. Indexes and tabular data where the change cannot be identified.

c. Blank space resulting from the deletion of text, an illustration, or a table.

d. Correction of minor inaccuracies, such as spelling, punctuation, relocation of material, etc., unless such correction changes the meaning of instructive information and procedures.

1-11. Series and Effectivity Codes.

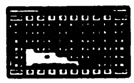
Designator symbols listed below, are used to show limited effectivity of airframe information material in conjunction with text content, paragraphs titles, and illustrations. Designators may be used to indicate proper effectivity, unless the material applies to all models and configuration within the manual. Designator symbols proceed procedural steps in Chapters 8 and 9. If the material applies to all series and configurations, no designator symbol will be used.

DESIGNATOR SYMBOL	APPLICATION
UH	UH-60A, UH-60L information.
UH 60A	UH-60A peculiar information.
UH 60L	UH-60L peculiar information.
EH	EH-60A peculiar information.
NV	Aircraft with NVG compatible lighting.
ES	Aircraft with ESSS provisions.
700	UH-60A, EH-60A aircraft equipped with T700-GE-700 engines.
701C	UH-60L aircraft equipped with T700-GE-701C engine.

1-11.1 High Drag Symbol.

This symbol  will be used throughout this manual to designate information applicable to the high drag configuration described in Chapters 7 and 7.1.

1-11.2. Placarded Aircraft Symbol.

This symbol  will be used throughout this manual to designate applicability to helicopters which have torque placard limitations.

1-12. Use of Words Shall, Should, and May.

Within this technical manual the word *shall* is used to indicate a mandatory requirement. The word *should* is used to indicate a nonmandatory but preferred method of accomplishment. The word *may* is used to indicate an acceptable method of accomplishment.

CHAPTER 2
AIRCRAFT AND SYSTEMS DESCRIPTION AND OPERATION

Section I AIRCRAFT

2-1. General

This chapter describes the UH-60A, UH-60L, and EH-60A helicopter's systems and flight controls. The functioning of electrical and mechanical components is simplified where more detailed knowledge is not necessary.

2-2. UH-60A. UH-60A

The UH-60A (BLACK HAWK) (Figure 2-1) is a twin turbine engine, single rotor, semimonocoque fuselage, rotary wing helicopter. With a crew of three, it carries eleven combat-equipped troops with optional seating of 14 arranged in various configurations, and internal and external cargo. Primary mission capability of the helicopter is tactical transport of troops, supplies and equipment. Secondary missions include training, mobilization, development of new and improved concepts, and support of disaster relief. The main rotor system has four blades made of titanium/fiberglass. The drive train consists of a main transmission, intermediate gear box and tail rotor gear box with interconnecting shafts. The propulsion system has two T700-GE-700 engines operating in parallel. The nonretractable landing gear consists of the main landing gear and a tailwheel. The armament consists of two 7.62 mm machineguns, one on each side of the helicopter in the forward cabin. Detailed descriptions of these systems are given in these chapters. For additional weight information, refer to Chapters 5, 6, and 7. Kit installations for the helicopter consist of range extension tanks, rescue hoist, medical evacuation, infrared suppression, blade anti-icing/deicing, blackout devices, winterization and static/rappelling kit. Refer to this chapter and Chapter 4 for kit descriptions.

2-2.1. UH-60L. UH-60L

The UH-60L helicopter is the same as the UH-60A helicopter except engines T700-GE-701C replace T700-GE-700. The main transmission is replaced by an improved durability gearbox (IDGB).

2-3. EH-60A. EH

The EH-60A helicopter is a modified UH-60A (Figure 2-1) with a crew of four. The Mission equipment consists of electronic systems with modifications that will ensure that the mission requirements are met. The EH-60A system includes air conditioning, helicopter survivability equipment, and avionics equipment. An electronics compartment within the transition section is used for avionics equipment. The compartment can be entered from the right side of the helicopter. The mission systems employ two operators: The DF (ESM) operator controlling the electronics surveillance functions, and the electronics countermeasure (ECM) operator controlling the active countermeasure functions. The EH-60A can operate independently or in conjunction with up to two additional, similarly equipped, aircraft. When operating in the multisystem mode, secured air-to-air communications are provided for automatic tasking between aircraft. Secured air-to-ground communications are also provided for voice reporting purposes.

2-4. Dimensions.

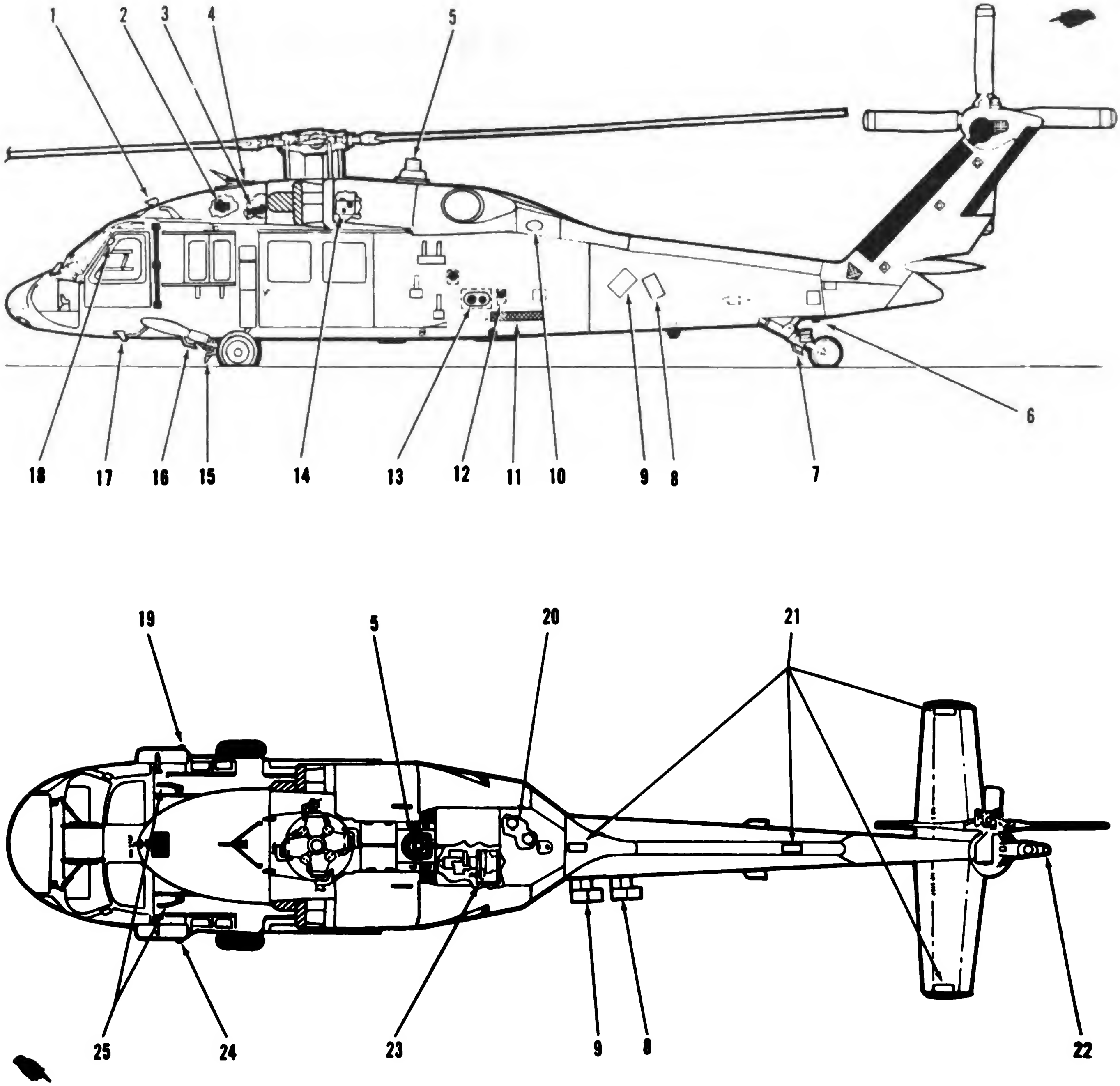
Principal dimensions of the helicopter are based on the cyclic stick and tail rotor pedals being centered and the collective stick being in its lowest position. All dimensions are approximate and they are as shown on Figure 2-2.

2-5. Turning Radius and Ground Clearance.

For information on turning radius and ground clearance, see Figure 2-3.

2-6. Compartment Diagram. UH

The fuselage is divided into two main compartments, the cockpit and cabin. The cockpit (Figure 2-4) is at the front of the helicopter with the pilots sitting in parallel, each with its own flight controls and instruments. Operation of electrical controls are shared by both. The cabin compartment (Figure 2-5) contains space for crew chief seating, troop seating, litter installation and cargo. Restraint of cargo is by tiedown rings installed in the floor. Two stowage compartments, at

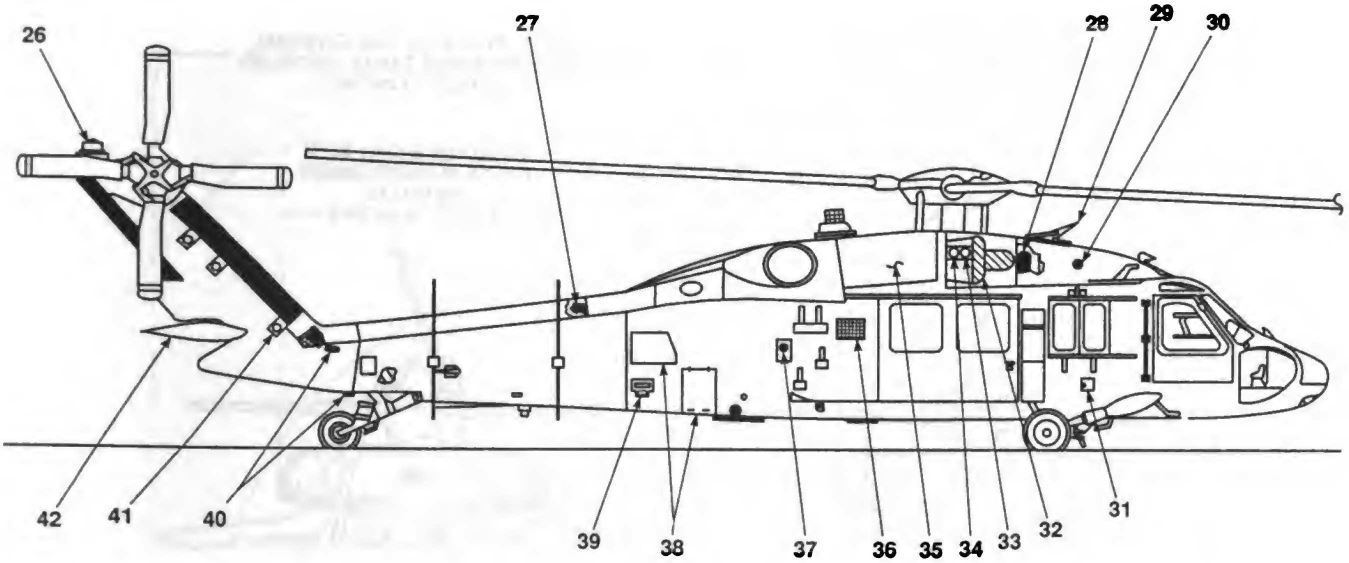


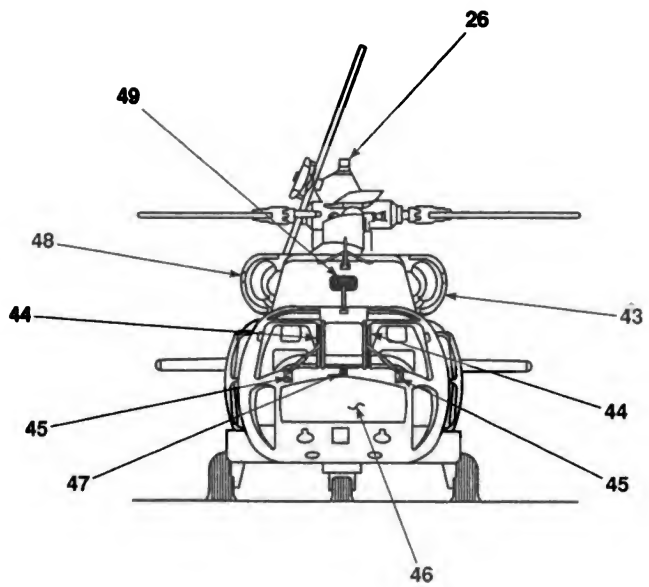
* 1 PITOT CUTTER
2 BACKUP HYDRAULIC PUMP
3 NO. 1 HYDRAULIC PUMP AND NO. 1 GENERATOR
* 4 UPPER (ROTOR PYLON) CUTTER
5 INFRARED COUNTERMEASURE TRANSMITTER
6 AFT MAINTENANCE LIGHT RECEPTACLE
* 7 TAIL LANDING GEAR DEFLECTOR
8 FLARE DISPENSER
9 CHAFF DISPENSER
10 APU EXHAUST PORT
11 COOLING AIR INLET PORT
12 PNEUMATIC PORT
13 PRESSURE AND CLOSED CIRCUIT REFUELING PORTS
14 NO. 1 ENGINE
*15 MAIN LANDING GEAR DEFLECTOR/CUTTER
*16 LANDING GEAR JOINT DEFLECTOR
*17 STEP AND EXTENSION DEFLECTOR
*18 DOOR HINGE DEFLECTOR
19 RIGHT POSITION LIGHT (GREEN)
20 FIRE EXTINGUISHER BOTTLES
21 FORMATION LIGHTS
22 TAIL POSITION LIGHT (WHITE)
23 APU
24 LEFT POSITION LIGHT (RED)
25 PITOT TUBES

*ON HELICOPTERS EQUIPPED WITH WIRE STRIKE PROTECTION SYSTEM

UH60A/EH60A-44778.1 (C6)

Figure 2-1. General Arrangement (Sheet 1 of 2)





26 UPPER ANTICOLLISION LIGHT
27 TAIL DRIVE SHAFT
28 NO. 2 HYDRAULIC PUMP AND NO. 2 GENERATOR
• 29 PYLON CUTTER
30 HEATER AIR INTAKE PORT
31 EXTERNAL ELECTRICAL POWER RECEPTACLE
32 NO. 2 ENGINE
33 ICE DETECTOR
34 AMBIENT SENSE PORT
35 ENGINE FAIRING / WORK PLATFORM (SAME BOTH SIDES)
EH 36 CONDENSER EXHAUST / STEP
37 GRAVITY REFUELING PORT (SAME BOTH SIDES)
EH 38 AFT AVIONICS COMPARTMENT DOORS
EH 39 IINS BLOWER INLET FILTER
40 TAIL PYLON FOLD HINGES
41 TAIL PYLON SERVICE LADDER (SAME BOTH SIDES)
42 STABILATOR
43 ENGINE BAY AREA COOLING AIR INTAKE (SAME BOTH SIDES)
• 44 WINDSHIELD POST DEFLECTOR
• 45 WINDSHIELD WIPER DEFLECTOR
46 AVIONICS COMPARTMENT
47 OAT SENSOR
48 ICE DETECTOR
49 PYLON COOLING AIR INTAKE

• ON HELICOPTERS EQUPPED WITH WIRE STRIKE PROTECTION SYSTEM

AA0403_2A

Figure 2-1. General Arrangement (Sheet 2 of 2)

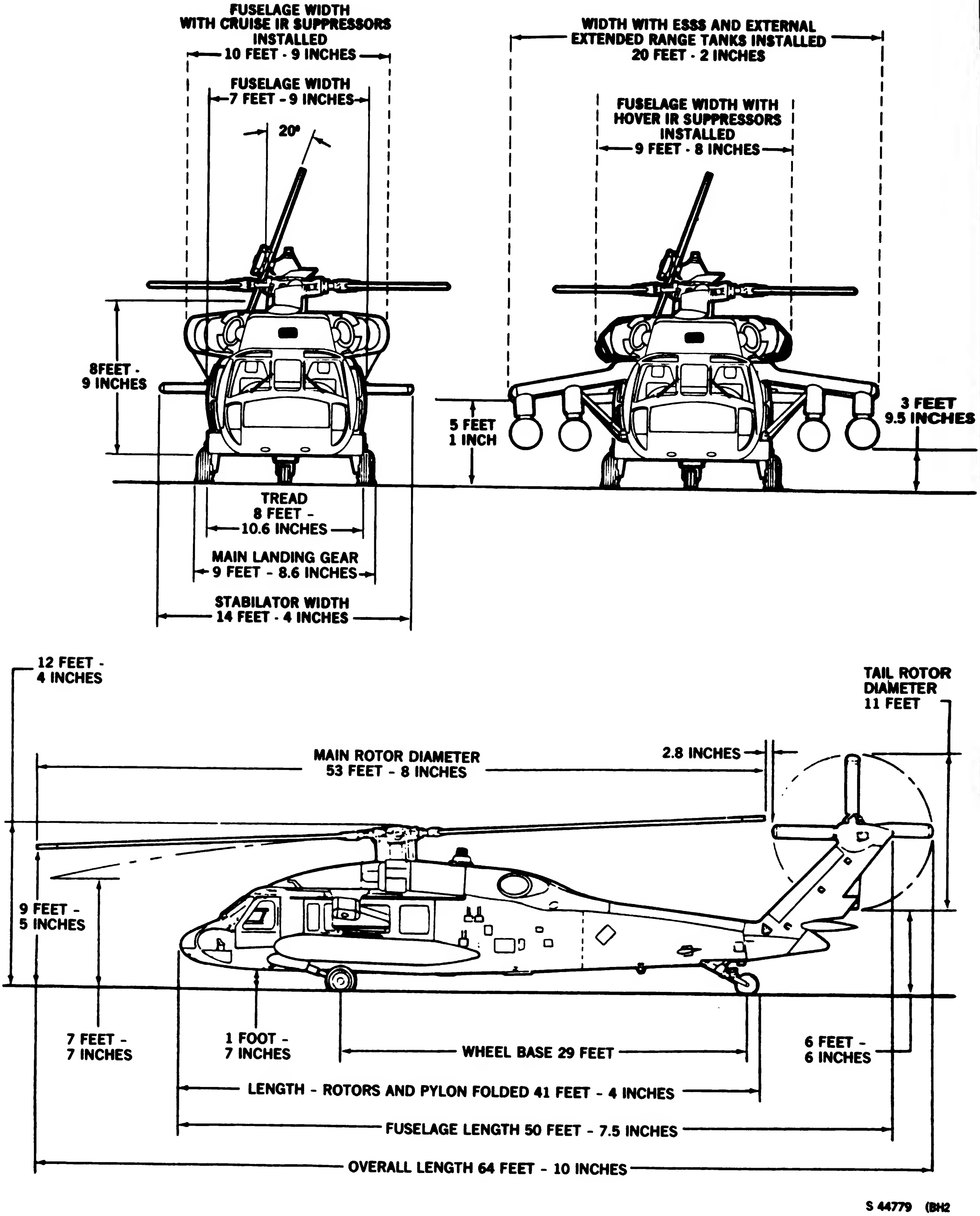


Figure 2-2. Principal Dimensions

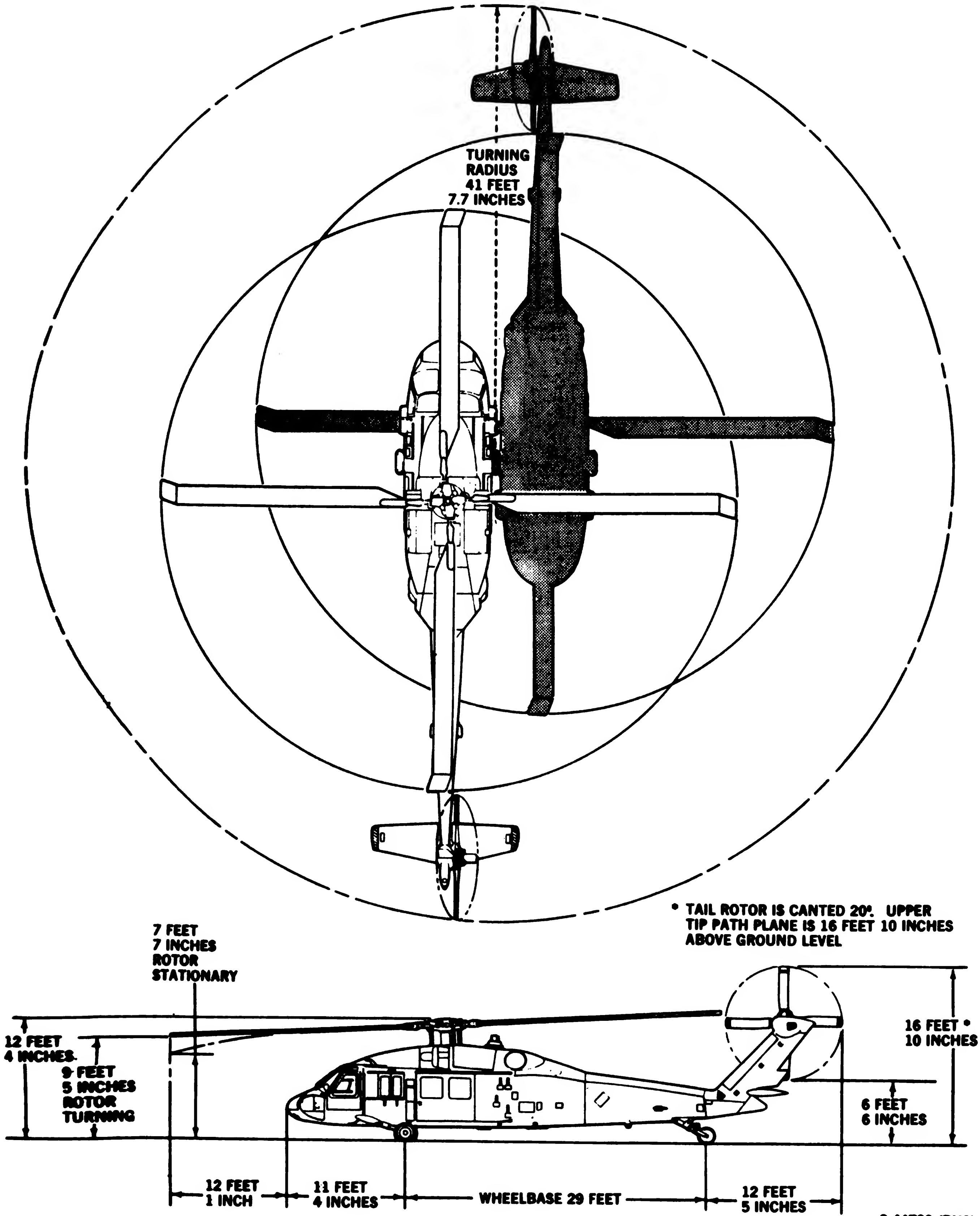
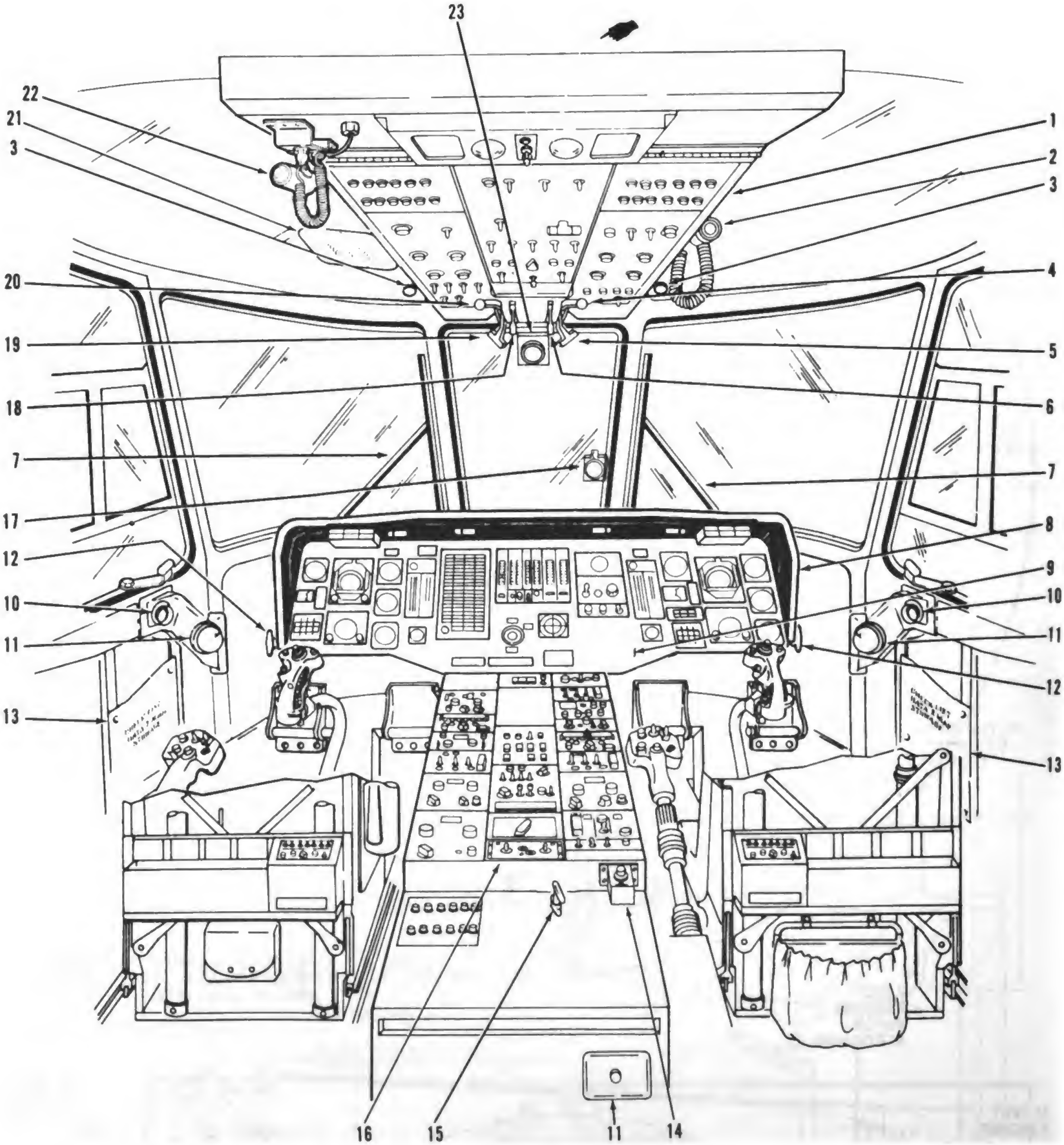


Figure 2-3. Turning Radius and Clearance



1	UPPER CONSOLE	9	INSTRUMENT PANEL	18	NO. 1 ENGINE POWER CONTROL LEVER
2	PILOT'S COCKPIT UTILITY LIGHT	10	VENT/DEFOGGER	19	NO. 1 ENGINE OFF/FIRE T-HANDLE
3	FREE-AIR TEMPERATURE GAGE (ON HELICOPTERS WITH HEATED CENTER WINDSHIELD)	11	ASHTRAY	20	NO. 1 ENGINE FUEL SELECTOR LEVER
4	NO. 2 ENGINE FUEL SELECTOR LEVER	12	PEDAL ADJUST LEVER	21	AC ESNTL BUS CIRCUIT BREAKER PANEL
5	NO. 2 ENGINE OFF/FIRE T-HANDLE	13	MAP/DATA CASE	22	COPILOT'S COCKPIT UTILITY LIGHT
6	NO. 2 ENGINE POWER CONTROL LEVER	14	CHAFF RELEASE SWITCH	23	FREE-AIR TEMPERATURE GAGE (ON HELICOPTERS WITHOUT HEATED CENTER WINDSHIELD)
7	WINDSHIELD WIPER	15	PARKING BRAKE LEVER		
8	INSTRUMENT PANEL GLARE SHIELD	16	FUEL BOOST PUMP PANEL		
		17	STANDBY (MAGNETIC COMPASS)		

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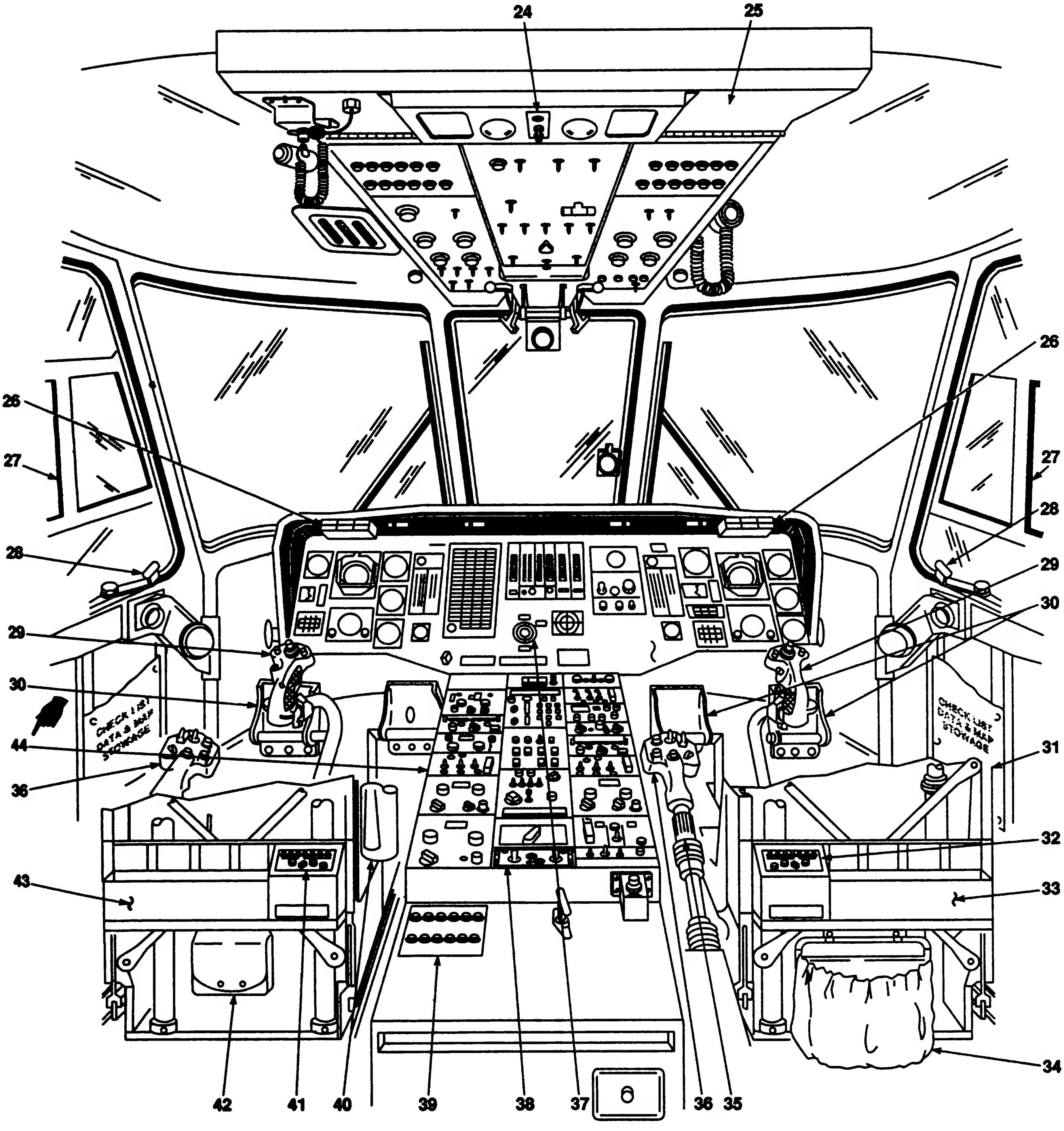
Figure 2-4. Cockpit Diagram (Sheet 1 of 2)



24 COCKPIT FLOODLIGHT CONTROL
25 UPPER CONSOLE
26 MASTER WARNING PANEL
27 SLIDING WINDOW
28 COCKPIT DOOR EMERGENCY RELEASE
29 CYCLIC STICK
30 DIRECTIONAL CONTROL PEDALS
31 PILOT'S SEAT
32 CREW CHIEF / GUNNER ICS CONTROL PANEL
33 CREW CHIEF AMMUNITION / GRENADE STOWAGE COMPARTMENT
34 STOWAGE BAG
35 COLLECTIVE STICK FRICTION CONTROL
36 COLLECTIVE STICK GRIP
37 ENGINE IGNITION KEYLOCK
38 LOWER CONSOLE
39 BATTERY / BATTERY UTILITY BUS CIRCUIT BREAKER PANEL
40 FIRE EXTINGUISHER
41 GUNNER'S ICS CONTROL PANEL
42 FIRST AID KIT
43 GUNNER'S AMMUNITION / GRENADE
44 COPILOT'S SIDE LOWER CONSOLE

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Figure 2-4. Cockpit Diagram (Sheet 2 of 2)

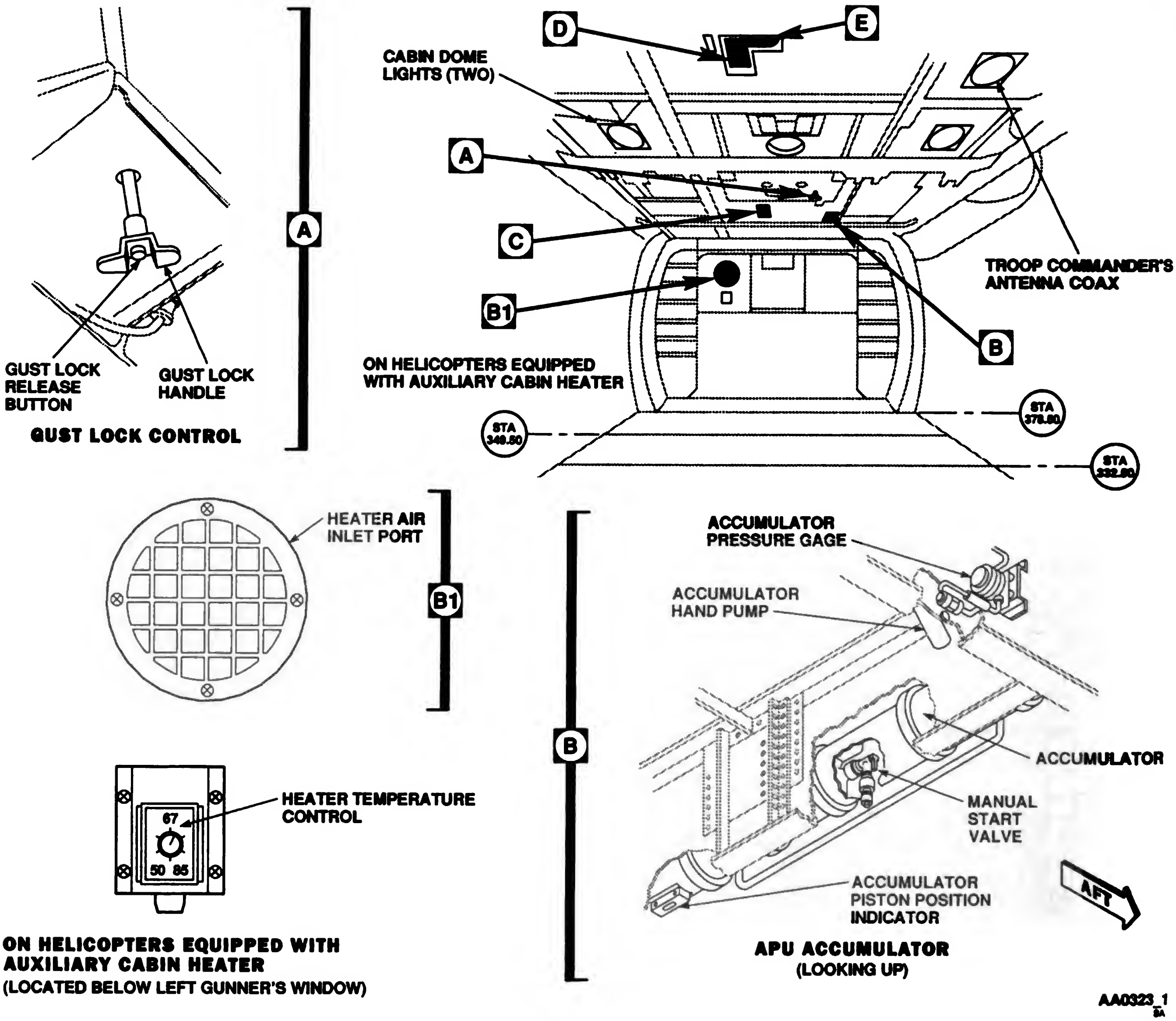


Figure 2-5. Cabin Interior (Sheet 1 of 2)

FAULT INDICATION — FAULTS

	T-62T-40-1 BITE # 1	2	3	4	DECODED BITE INFORMATION
START SEQUENCE	●	●	●	●	RESET
	○	●	●	●	START FUEL VALVE & EXCITER SIGNAL OUT (5%)
	○	○	●	●	MAIN FUEL VALVE SIGNAL OUT (14%)
	○	○	○	●	START FUEL VALVE & EXCITER SIGNAL OFF (70%)
	○	○	○	○	90% RPM SWITCH ON
OPERATION	●	●	●	●	READY FOR SERVICE (90% + 1.5 SEC)
	○	●	●	●	PROCESSOR BOARD FAILURE
	●	○	●	●	SENSOR/DATA BOARD FAILURE
	○	○	●	●	OVERTEMPERATURE
	●	●	○	●	OVERSPEED
	○	●	○	●	UNDERSPEED
	●	○	○	●	FAIL TO START
	○	○	○	●	LOW OIL PRESSURE
	●	●	●	○	HIGH OIL TEMPERATURE (WARNING)
	○	○	○	○	FAIL TO LIGHT (NO DATA)
	●	○	●	○	SHORTED THERMOCOUPLE PROBE (WARNING)
	●	●	○	○	OPEN THERMOCOUPLE
	●	○	○	○	PROCESSOR SEQUENCE FAIL
	○	○	○	○	NO DATA

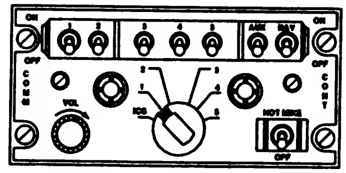
APU ELECTRONIC SEQUENCE UNIT FAULT INDICATION
(ON HELICOPTERS EQUIPPED WITH T-62T-40-1 APU)

C

FAULT INDICATION — FAULTS

	GTC-P36-150 BITE # 1	2	3	4	DECODED BITE INFORMATION
START SEQUENCE	●	●	●	●	RESET (START INITIATED)
	○	●	●	●	FUEL VALVE AND IGNITION SIGNAL ON (5%)
	○	○	●	●	START VALVE SIGNAL OFF (70%)
	○	○	○	●	IGNITION SIGNAL OFF (95%)
OPERATION	●	●	●	●	READY FOR SERVICE (LOSS OF DC POWER)
	○	●	●	●	ESU FAILURE
	●	○	●	●	A/C START SYSTEM FAILURE
	○	○	●	●	OVERTEMPERATURE
	●	●	○	●	OVERSPEED
	○	●	○	●	UNDERSPEED
	●	○	○	●	FAIL TO START
	○	○	○	●	LOW OIL PRESSURE
	●	●	●	○	OIL PRESSURE SWITCH FAILED
	○	●	●	○	THERMOCOUPLE FAILED
	●	○	●	○	MONOPOLE FAILED
	●	●	○	○	FUEL SOLENOID FAILED
	●	○	○	○	FUEL TORQUE MOTOR FAILED
	○	○	●	○	IGNITION UNIT FAILED
	○	●	○	○	HOT SENSOR FAILED
	○	○	○	○	NO DATA

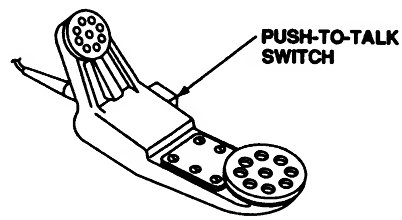
APU ELECTRONIC SEQUENCE UNIT FAULT INDICATION
(ON HELICOPTERS EQUIPPED WITH GTC-P36-150 APU)



TROOP COMMANDER'S ICS CONTROL

D

E



TROOP COMMANDER'S HANDSET

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SA

Figure 2-5. Cabin Interior (Sheet 2 of 2)

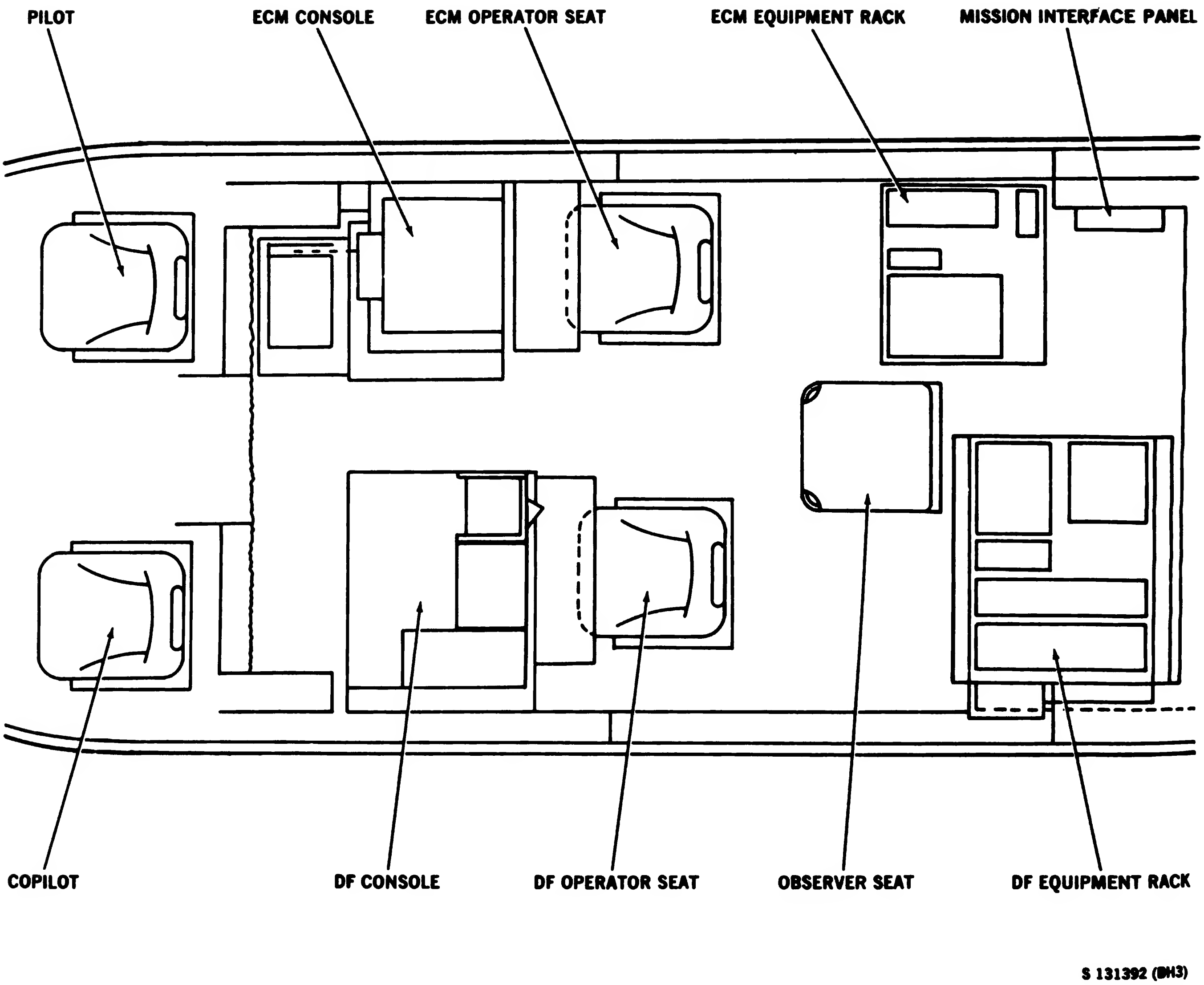


Figure 2-5.1. Cabin Mission Equipment Arrangement EH

the rear of the cabin over the main fuel tanks, each about 20x20x40 inches, are for flyaway equipment (Figure 6-12). The equipment storage compartments are reached from inside the cabin. A gust lock control, APU accumulator handpump and pressure gage, and APU ESU are also installed.

2-7. Compartment Diagram. EH

A fixed observer seat is installed to allow observation of either operator position. Floor attachments are provided for securing rack mounts and seats. Blackout curtains may be used to eliminate any light intrusion into the cockpit during night operations, or any glare on the operator's console during day operations. Blackout curtains may be used between cockpit and cabin during NVG operations.

2-8. Upper and Lower Consoles.

All cockpit electrical controls are on the upper and lower consoles and instrument panel. The upper console, overhead between pilot and copilot, contains engine controls, fire emergency controls, heater and windshield wiper controls, internal and external light controls, electrical systems and miscellaneous helicopter system controls (Figure 2-6). The rear portion of the upper panel contains the dc essential bus circuit breaker panels. The lower console next to the base of the instrument panel (Figure 2-7) and extending through the cockpit between the pilot and copilot, is easily reached by either pilot. The console is arranged with communication panels, navigational panels and flight attitude/stability controls. The rear part of the console houses the BATT BUS/BATT UTIL BUS circuit breaker panel, and parking brake handle.

2-9. Landing Gear System.

The helicopter has a nonretractable landing gear consisting of two main gear assemblies and a tailwheel assembly. The landing gear permits helicopter takeoffs and landings on slopes in any direction. The system incorporates a jack and kneel feature that permits manual raising or lowering of the fuselage for air transportability. A landing weight-on-wheels (WOW) switch is installed on the left landing gear to control operation of selected systems as shown below. The switch is deactivated when the weight of the helicopter is on the landing gear. On helicopters equipped with ESSS fixed provisions, a WOW switch is also installed on the right landing gear drag beam to provide ac underfrequency cutout and external stores jettison. The left weight-on-wheels switch provides all other WOW functions as without ESSS provisions and the EMER JETT ALL capabilities. See Figure 2-5.2 for reference.

2-10. Main Landing Gear.

The main landing gear is mounted on each side of the helicopter forward of center of gravity (Figure 2-1). Each individual landing gear has a single wheel, a drag beam, and a two-stage oleo shock strut. The lower

WOW SWITCH FUNCTION FOR:	ON GROUND	IN FLIGHT
Back-up Pump Thermal Switch	Enable	Disabled
Back-up Pump Automatic Operation	Disabled (Except when APU accumulator is low)	Enable
Hydraulic Leak Test System	Enable	Disabled
Low % RPM R Audio Warning	Disabled	Enable
SAS/FPS Computer	Disabled	Enable
Generator Underfrequency Protection	Enable	Disabled
IFF Mode 4 Operation	Disabled	Enable
External Stores Jettison	Disabled	Enable
XM-130 Control EH	Disabled	Enable

Figure 2-5.2. Weight-on-Wheels Functions

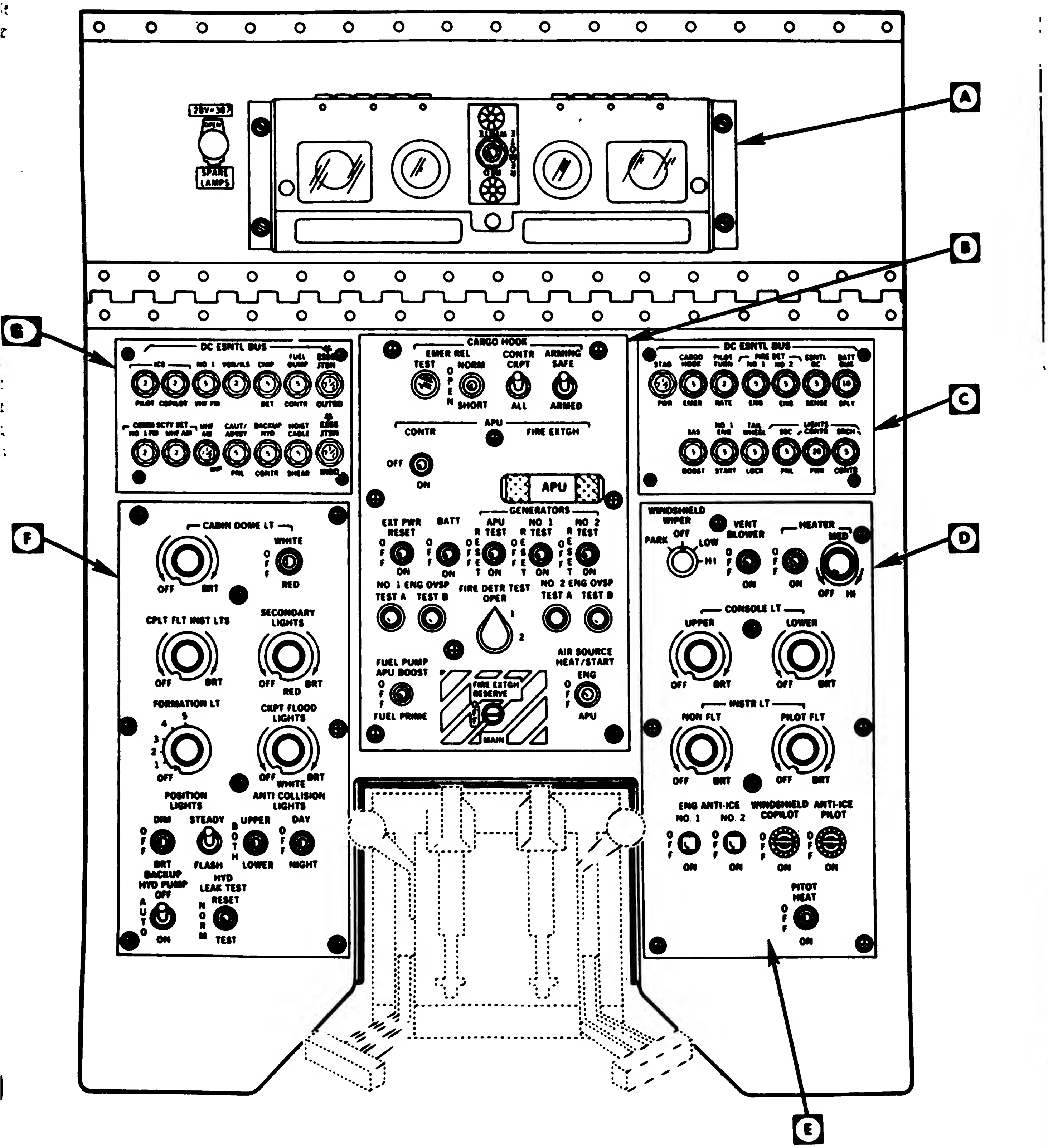
stage will absorb energy from landings up to 10 feet-per-second (fps). Above 10 fps the upper stage and lower stage combine to absorb loads up to 39 fps (about 11.25 Gs).

2-11. Wheel Brake System.

Main landing gear wheels have disc hydraulic brakes. The self-contained self-adjusting system is operated by the pilot's and copilot's tail rotor pedals. The brakes have a visual brake puck wear indicator. Each wheel brake consists of two steel rotating discs, brake pucks and a housing that contains the hydraulic pistons. The parking brake handle, marked PARKING BRAKE, is on the right side of the lower console (Figure 2-7). A hand-operated parking brake handle allows brakes to be locked by either pilot or copilot after brake pressure is applied. The parking brakes are applied by pressing the toe brake pedals, pulling the parking brake handle to its fully extended position, and then releasing the toe brakes while holding the handle out. An advisory light will go on, indicating PARKING BRAKES ON. Pressing either pilot or copilot left brake pedal will release the parking brakes, the handle will return to the off position and the advisory light will go off. Power for the advisory light comes from the No. 1 dc primary bus through a circuit breaker marked LIGHTS ADVSY.

2-12. Tail Landing Gear.

The tail landing gear (Figure 2-1) is below the rear section of the tail cone. It has a two-stage oleo shock strut, tailwheel lock system fork assembly, yoke assembly, and a wheel and tire. The fork assembly is the attachment point for the tailwheel and allows the wheel to swivel 360°. The tailwheel can be locked in a trail position by a TAILWHEEL switch in the cockpit indicating LOCK or UNLK (Figure 2-7). The fork is locked by an electrical actuator through a bellcrank and locking pin. When the pin is extended, the switch will indicate LOCK. When the pin is retracted, the switch



UPPER CONSOLE

S 44703.1 (BH2)

Figure 2-6. Upper Console (Sheet 1 of 2)

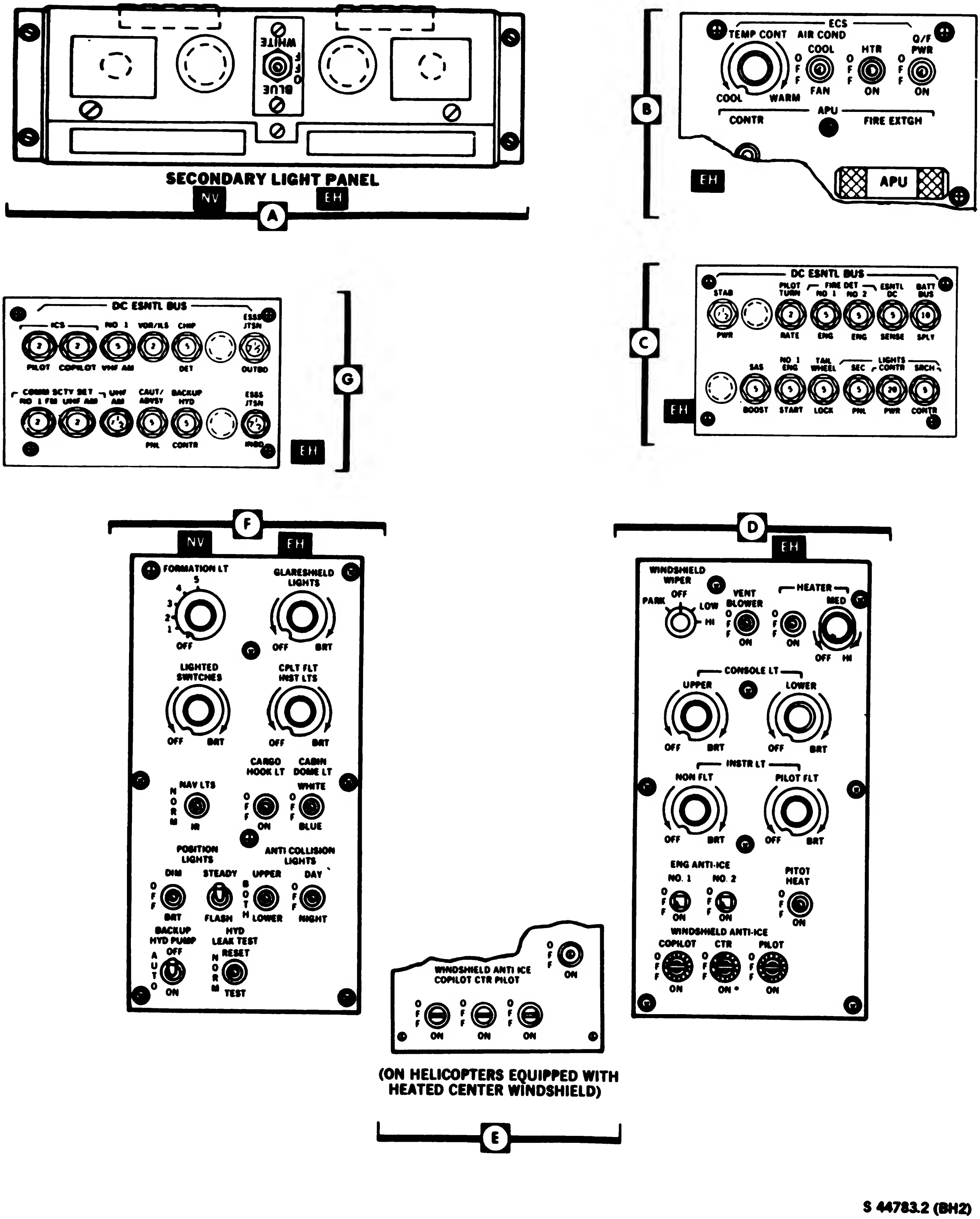
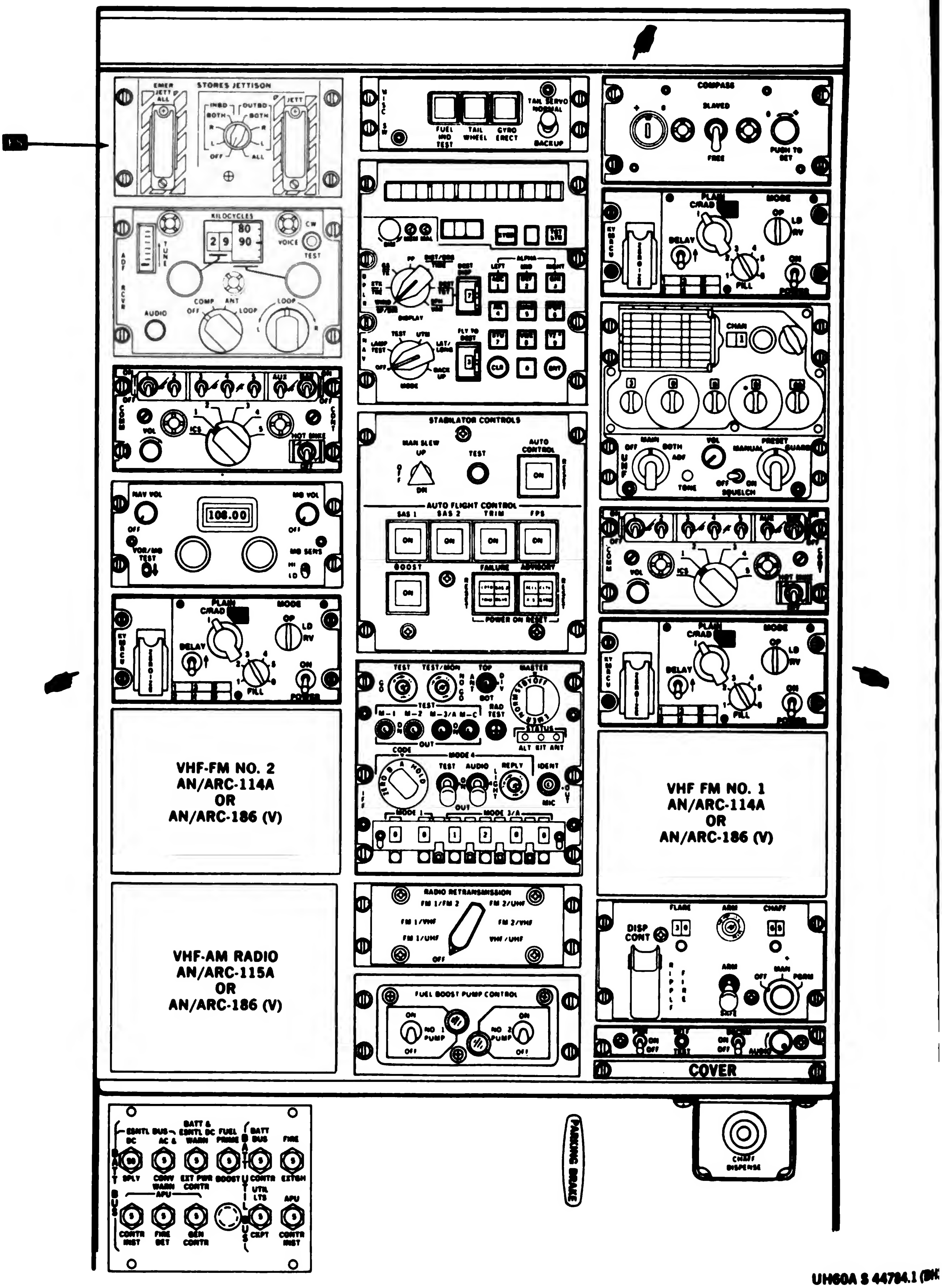
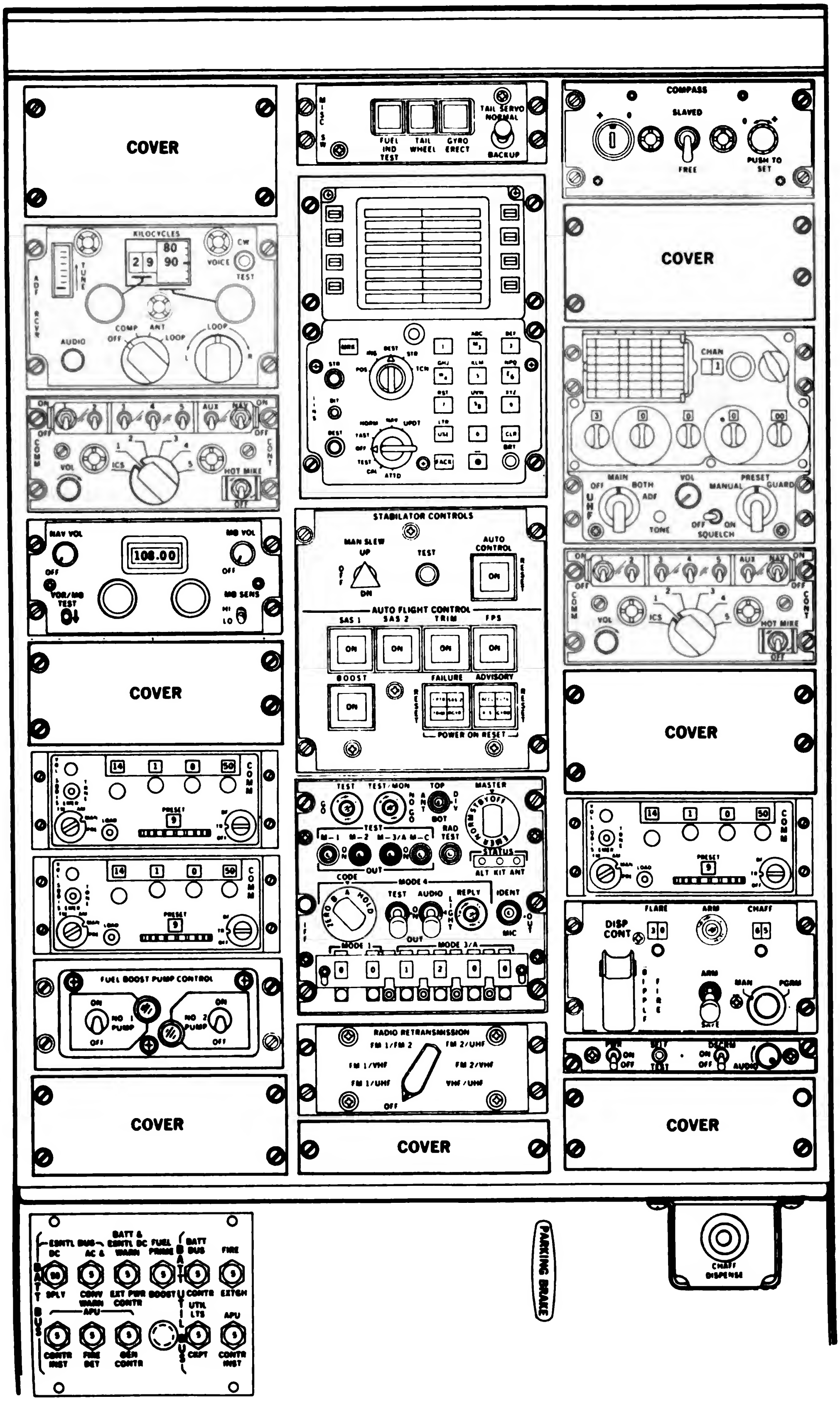


Figure 2-6. Upper Console (Sheet 2 of 2)



UH60A S 44784.1 (SH

Figure 2-7. Lower Console (Sheet 1 of 2) UH



S 44784.2 (BH2)

Figure 2-7. Lower Console (Sheet 2 of 2) EH will indicate UNLK. Power to operate the locking system is by the dc essential bus through a circuit breaker marked TAILWHEEL LOCK.

2-13. Instrument Panel. UH

Engine and dual flight instruments are on the one-piece instrument panel (Figure 2-8). The panel is tilted back 30°. The master warning panels are mounted on the upper instrument panel below the glare shield, to inform the pilot of conditions that require immediate action.

2-14. Instrument Panel. EH

The instrument panel of the EH-60A is as shown on Figure 2-8. Refer to Chapter 3 for description and operation of systems switch panels and Chapter 4 for BDHI, CREW CALL switch, FLARE switch and ECM ANTENNA switch and countermeasure set ALQ-156.

2-15. Vertical Instrument Display System (VIDS).

The VIDS (Figure 2-8) consists of a vertical strip central display unit (CDU), two vertical strip pilot display units (PDU), and two signal data converters (SDC). Those readings are shown by ascending and descending columns of multicolored lights (red, yellow, and green) measured against vertical scales which operate in this manner: the segments will light in normal progression and remain on as the received signal level increases. Those scales will go off in normal progression as the received signal level decreases. Scales with red-coded and/or amber-coded segments below green-coded segments operate in this manner: When the received signal level is zero or bottom scale, the segments will light in normal progression and will remain on. When the first segment above the red or amber range goes on, all red-coded or amber-coded segments will go off. These segments will remain off until the received signal level indicates a reading at or within the red or amber range. At that time all red-coded or amber-coded segments will go on and the scale display will either go on or go off in normal progression, depending upon the received signal level. For an increasing indication, a scale with side arrows: when the first segment for which there is an associated side arrow lighting lights, the corresponding side arrow also lights. As the segments go on, the corresponding side arrows will also go on, one at a time. Only the side arrow associated with the highest percent indication of the corresponding scale will be on. For a decreasing indication, scales with side arrows will operate in the manner described above, and only the side arrow associated with the highest percent indication of the corresponding scale will be on. The CDU and PDUs contain photocells that automatically adjust lighting of the indicators with respect to ambient light. If either photocell should fail, the lights on the vertical scales of the PDUs and the CDU will go off. The DIM knob on the CDU contains an override capability which allows the pilot to manually set the display light level. The SDCs receive parameter data from the No. 1 and No. 2 engines, transmission, and fuel system; provides processing and transmits the resulting signal data to the instrument display. The No. 1 engine instruments on the CDU and copilot's PDU, receive signal data from the No. 1 SDC (CHAN 1). The No. 2 engine and main transmission instruments on the CDU and pilot's PDU, receives signal data from the No. 2 SDC (CHAN 2). If either SDC fails, the corresponding CHAN 1 or 2 warning light will go on, the pilot's or copilot's PDU and the corresponding instruments will fail. Failure of a lamp power supply within an SDC will cause every second display light on the CDU to go off. Both SDCs receive % RPM 1 and 2, % RPM R and % TRQ information from both engines. Therefore if one SDC fails, only one PDU will provide % RPM 1 and 2 and % TRQ for both engines. On helicopters equipped with NVG compatible lighting, operation of the display units are same as helicopters without NVG compatible lighting. In each display unit a NVG compatible information panel is installed.

2-16. Central Display Unit (CDU).

The CDU (Figure 2-8) contains instruments that display fuel quantity, transmission oil temperature and pressure, engine oil temperature and pressure, turbine gas temperature (TGT), and gas generator speed (N_g) readings. Those readings are shown by ascending and descending columns of multicolored lights (red, yellow, and green) measured against vertical scales. If the instrument contains low range turnoff (red or yellow lights below green lights) they will go off when the system is operating within the normal range (green). If the instrument contains yellow or red lights above the green range, the green as well as the yellow or red will stay on when operating above the green range. The operating ranges for the different instruments are shown in Figure 5-1. Digital readouts are also installed on the FUEL quantity, TGT, and N_g gages.

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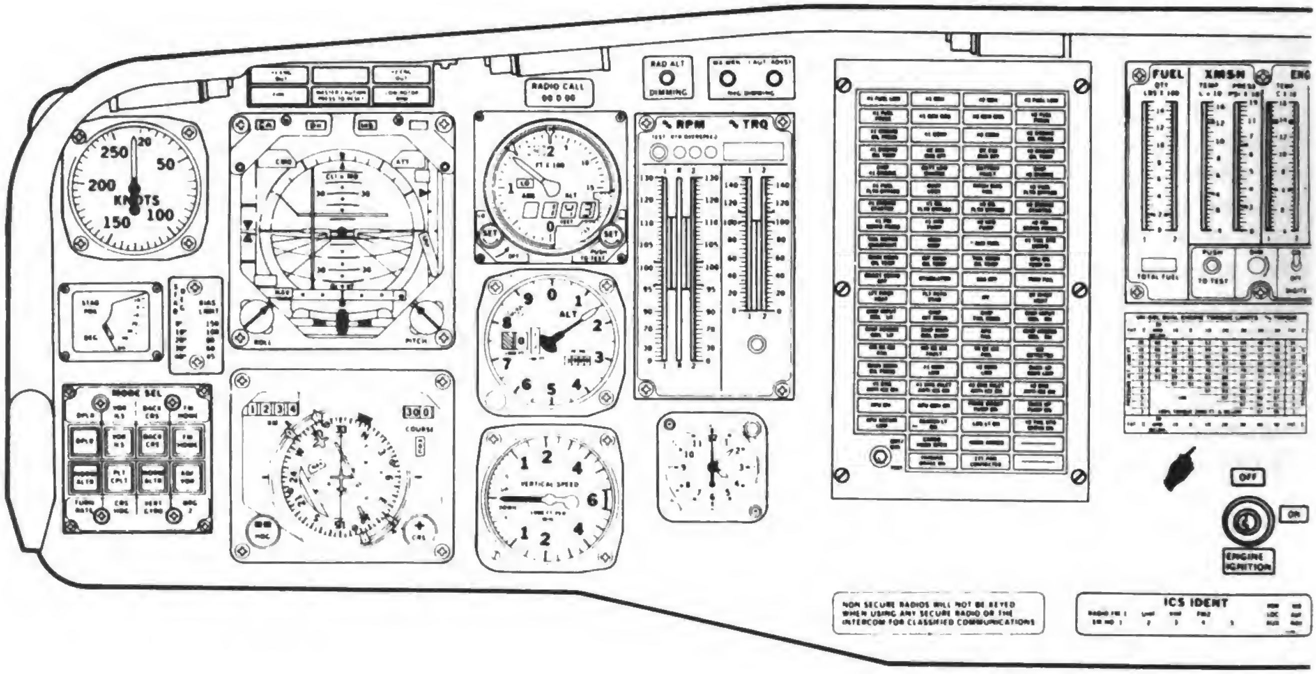

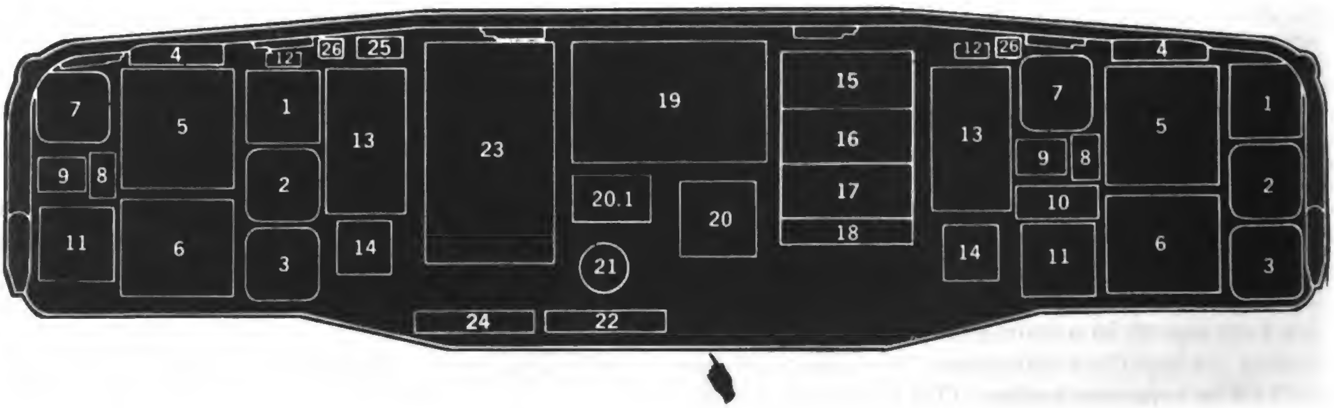

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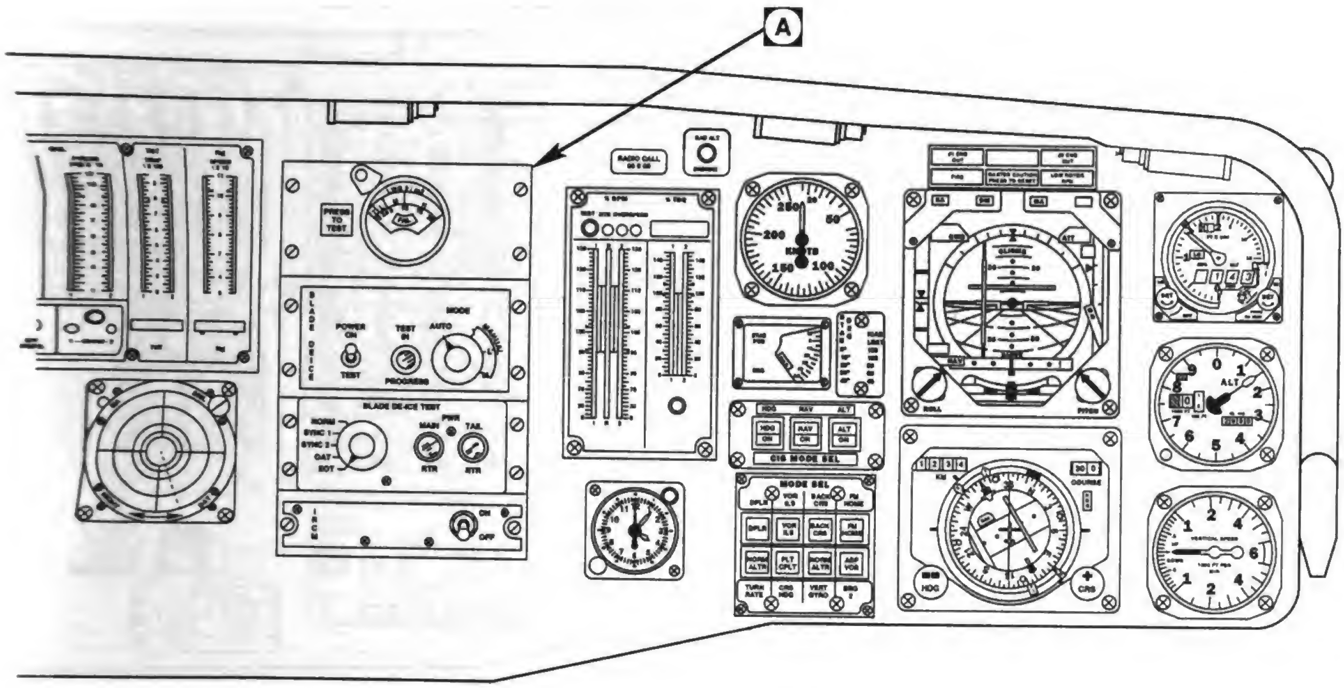
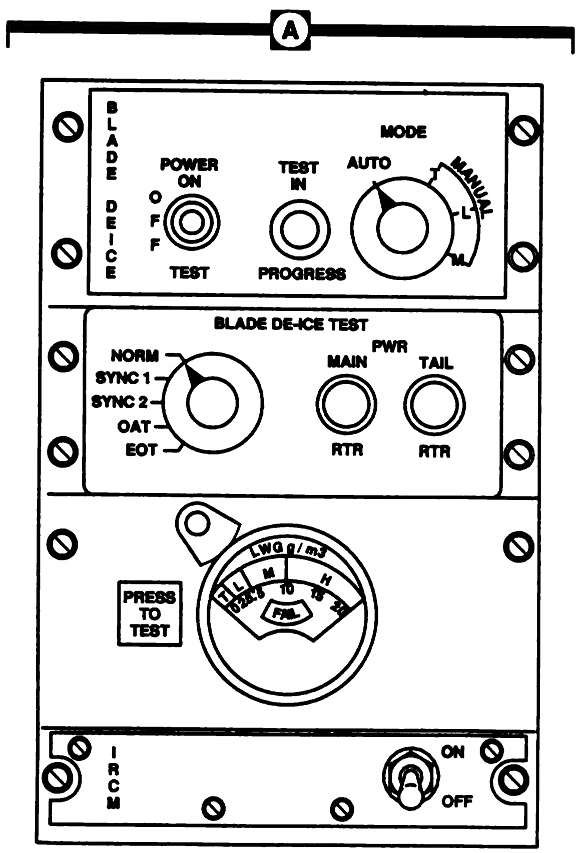
Figure 2-8. Instrument Panel (Sheet 1 of 4) UH





(ON HELICOPTERS WITH REARRANGED BLADE DEICE PANELS)

1. RADAR ALTIMETER
2. BAROMETRIC ALTIMETER
3. VERTICAL SPEED INDICATOR
4. MASTER WARNING PANEL
5. VERTICAL SITUATION INDICATOR
6. HORIZONTAL SITUATION INDICATOR
7. AIRSPEED INDICATOR
8. STABILATOR POSITION PLACARD
9. STABILATOR INDICATOR
10. CIS MODE SELECTOR
11. VSI / HSI MODE SELECTOR
12. RADIO CALL PLACARD
13. PILOT'S DISPLAY UNIT
14. CLOCK
15. ICE RATE METER
16. BLADE DE-ICE CONTROL PANEL
17. BLADE DE-ICE TEST PANEL
18. INFRARED COUNTERMEASURE CONTROL PANEL
19. CENTRAL DISPLAY UNIT
20. RADAR WARNING INDICATOR
20.1. DUAL ENGINE TORQUE LIMITS PLACARD UH60L
21. ENGINE IGNITION SWITCH
22. RADIO SELECT PLACARD
23. CAUTION / ADVISORY PANEL
24. SECURE WARNING PLACARD
25. NVG DIMMING CONTROL PANEL
26. RAD ALT DIMMING

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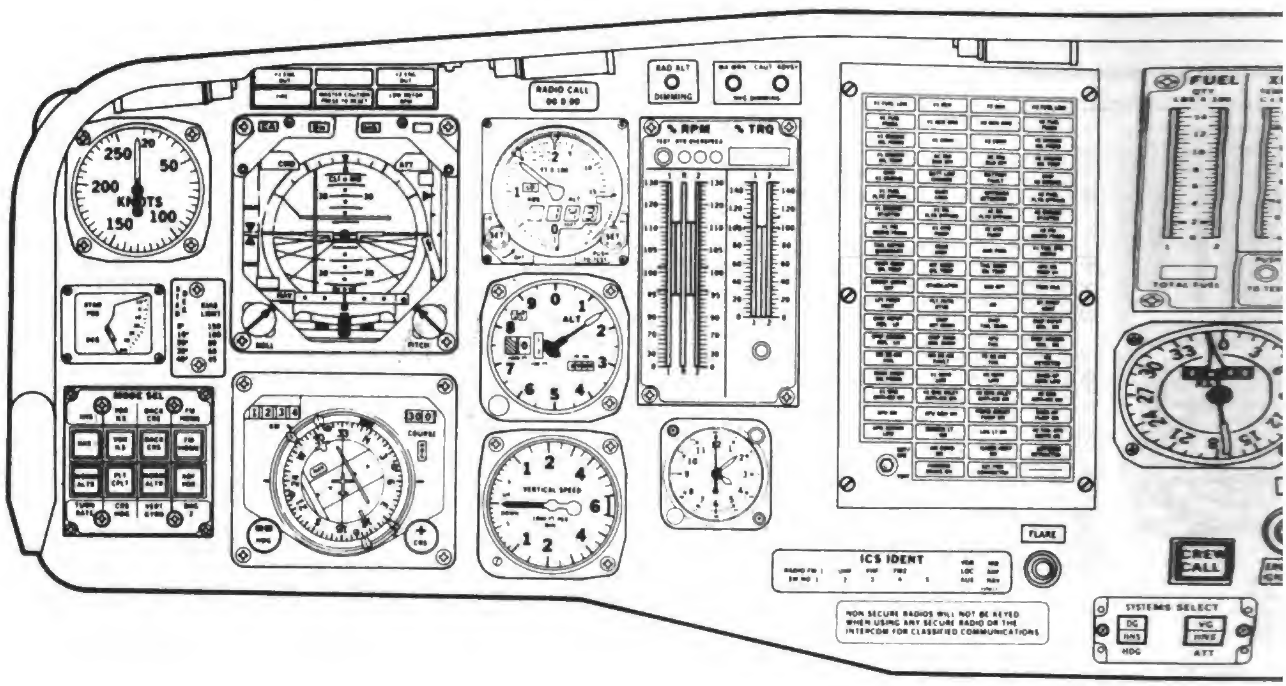
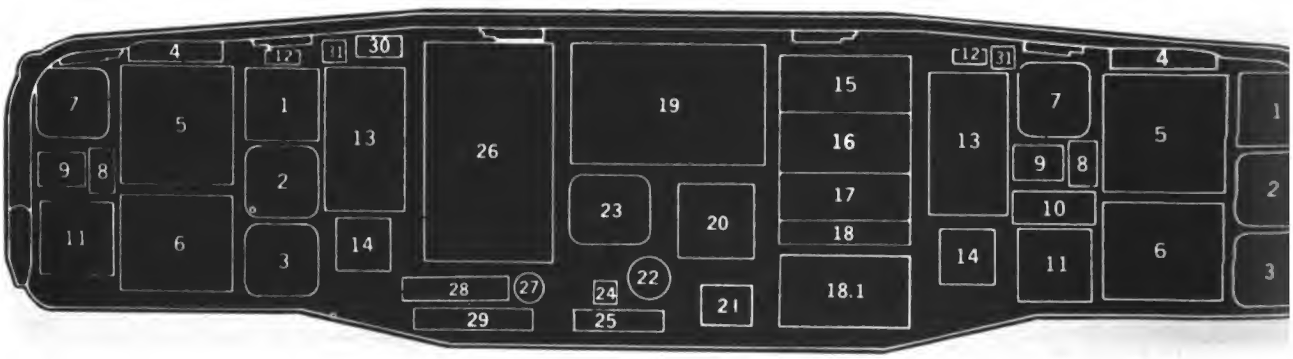
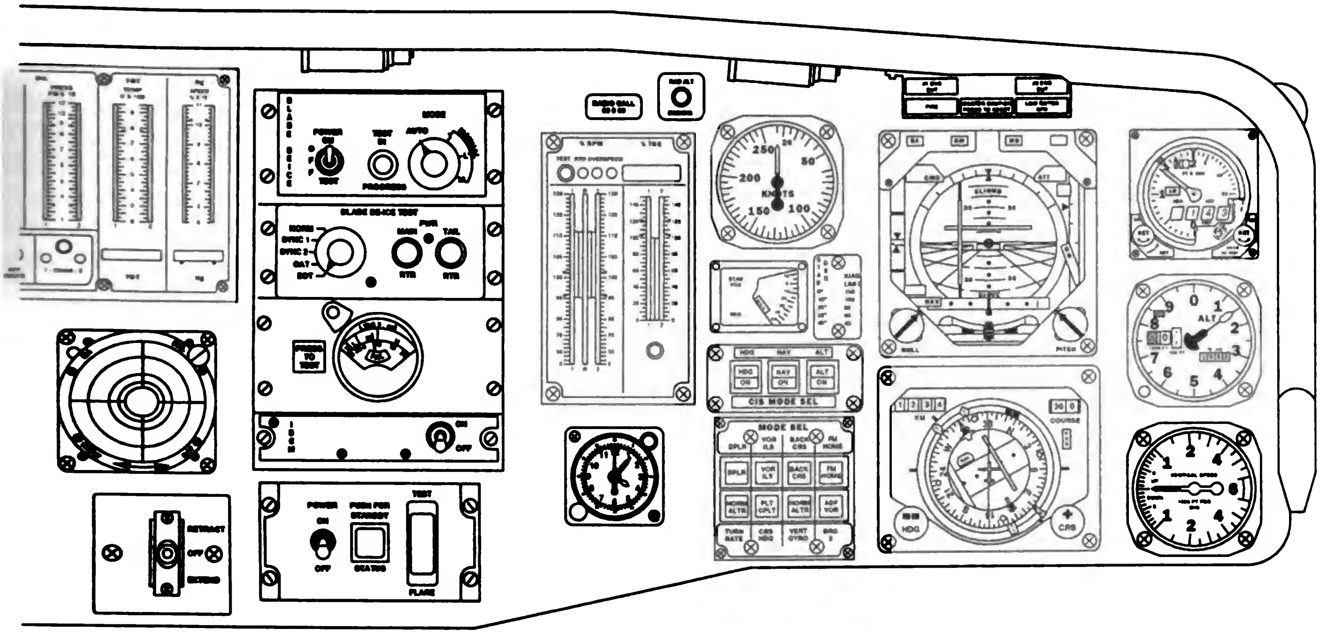
Figure 2-8. Instrument Panel (Sheet 2 of 4) UH





S 44787.3 (EH)

Figure 2-8. Instrument Panel (Sheet 3 of 4) EH



1. RADAR ALTIMETER
2. BAROMETRIC ALTIMETER
3. VERTICAL SPEED INDICATOR
4. MASTER WARNING PANEL
5. VERTICAL SITUATION INDICATOR
6. HORIZONTAL SITUATION INDICATOR
7. AIRSPEED INDICATOR
8. STABILATOR POSITION PLACARD
9. STABILATOR POSITION INDICATOR
10. CIS MODE SELECTOR
11. VSI / HSI MODE SELECTOR
12. RADIO CALL PLACARD
13. PILOT'S DISPLAY UNIT
14. CLOCK
15. BLADE DE-ICE CONTROL PANEL
16. BLADE DE-ICE TEST PANEL
17. ICE RATE METER
18. INFRARED COUNTERMEASURE CONTROL PANEL
18.1. ALQ-144 COUNTERMEASURE PANEL
19. CENTRAL DISPLAY UNIT
20. RADAR WARNING INDICATOR
21. ECM ANTENNA SWITCH
22. ENGINE IGNITION SWITCH
23. BEARING DISTANCE HEADING INDICATOR
24. CREW CALL SWITCH / INDICATOR
25. SYSTEM SELECT PANEL
26. CAUTION / ADVISORY PANEL
27. FLARE DISPENSE SWITCH
28. RADIO SELECT PLACARD
29. SECURE RADIO WARNING PLACARD
30. NVG DIMMING CONTROL PANEL
31. RADAR ALTIMETER DIMMING

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Figure 2-8. Instrument Panel (Sheet 4 of 4) EH

2-17. Lamp Test System.

The lamp test provides a means of electrically checking all CDU scale lamps, digital readouts, and % RPM RTR OVERSPEED lights on the PDUs. When the PUSH TO TEST switch on the CDU is pressed, all CDU scale lamps should light, digital readouts should display 888, and three RTR OVERSPEED lights on the PDUs should be on.

2-18. Dim Control.

The DIM control allows the pilot to set a desired display light level of the CDU and PDUs in accordance with the ambient light, or override the auto-dim sensors. A fully counterclockwise position switch gives the pilot the capability of regaining the display if an ambient light sensor should fail. After turning the control to the switch position the control may be turned clockwise to increase display light level.

2-19. CDU and PDU Digital Control.

An ON, OFF DIGITS control switch is on the CDU (Figure 2-8) to turn on or off the digital readout displays on the CDU and PDUs. If a digital processor fails, all digital displays will go off.

2-20. Pilot's Display Unit (PDU).

The PDU (Figure 2-8) displays to the pilot engine power turbines speed (% RPM 1 and 2), rotor speed (% RPM R), and torque (% TRQ). Readings are shown by ascending and descending columns of multicolored lights (red, yellow, and green) measured against vertical scales. The % RPM indicators contains low range turnoff below the normal operating range. Three over-speed lights at the top will go on from left to right when a corresponding rotor speed of 127%, 137%, and 142% is exceeded. Once a light is turned on, a latch prevents it from going off until reset by maintenance. Power for the PDUs is from No. 1 and No. 2 ac and dc primary buses through circuit breakers marked NO. 1 AC and NO. 1 DC INST respectively. See Figure 5-1 for instrument markings.

2-21. Doors and Windows.

2-22. Cockpit Doors.

The crew compartment is reached through two doors, one on each side of the cockpit. The doors swing outward and are hinged on the forward side (Figure 2-1). Each door has a sliding window for ventilation. Installed on the back of each door is a latch handle to allow unlatching the door from either inside or outside the cockpit. Emergency release handles are on the inside frame of each door (Figure 2-4). They allow the cockpit doors to be jettisoned in case of an emergency.

2-23. Troop/Cargo (Cabin) Doors.

Aft sliding doors are on each side of the troop/cargo compartment (Figure 2-1). Single-action door latches allow the doors to be latched in the fully open or fully closed positions. Each of the two doors incorporate two jettisonable windows, for emergency exit (Figure 9-1).

2-24. Crew Chief/Gunner Windows.

The Crew Chief/Gunner Stations have forward sliding hatch windows, split vertically into two panels (Figure 2-1). A spring-loaded security latch is installed on each gunner's aft window, to prevent the window opening from the outside. The dead bolt lock requires activation of the security latch lever from inside the helicopter. Another window latch bar is actuated to allow the forward window to be moved to a stowed position. The windows may be opened to move a machinegun into position for firing.

2-25. Crew Seats.

2-26. Pilots Primary Seats.

WARNING

Do not store any items below seats. Seats stroke downward during a crash and any obstruction will increase the probability and severity of injury.

The pilots seats provide ballistic protection and can be adjusted for the pilot's leg length and height. The pilot's seat is on the right side, and the copilot's is on the left. Each seat has a one-piece ceramic composite bucket attached to two energy absorption tubes. Each seat is positioned on a track with the bucket directly above a recess in the cockpit floor. Crash loads are reduced by allowing the seat and occupant to move vertically as a single unit. Occupant restraint is provided by a shoulder harness, lap belts, and a crotch belt.

a. Seat Height Adjustment. Vertical seat adjustment is controlled by a lever on the right front of the seat bucket. When the lever is pulled up, the seat can move vertically through 5 inches and be locked at any 1/2 inch interval. Springs are installed to counterbalance the weight of the seat. The lever returns to the locked position when released.

b. Forward and Rear Adjustment. The seat is adjusted for leg length by a locking lever on the left front of the seat bucket. Moving the lever forward allows the seat to be moved 4.37 inches. The seat can be locked at any 1/2-inch interval along its travel. The lever is spring-loaded and returns to the locked position when released.

c. Emergency Tilt Levers. The emergency tilt release levers are on each side of the seat support frame. The seat may be tilted back into the cabin for removal or treatment of a wounded pilot. Seat tilting can be done from the cabin, only with the seat in the fulldown and aft position by pushing in on the tilt handles, and pulling the seat top rearward.

d. Emergency Vertical Release Lever. The emergency vertical release permits the seat to drop to the lowest adjustment point for tilting. The release lever is on the upper center back of the seat, and is actuated by pulling right on the lever.

e. Seat Belts. The pilot's and copilot's seats each contain a shoulder harness, seat belt, and a crotch strap connected to a common buckle assembly. All belts and straps have adjustment fittings. The common attachment buckle has a single-point release marked TURN. When turned, it simultaneously releases all belts and straps.

2-27. Pilots Alternate Seating.

WARNING

Do not store any items below seats. During a crash any obstruction will increase the probability and severity of injury.

The pilots alternate seats are the same as primary seats except as in the following paragraphs: Each seat has a one-piece steel/Kevlar armored bucket attached to six energy absorption elements. Crash loads are reduced by allowing the seat and occupant to move in the direction of the crash as a single unit.

2-28. Protective Armor.

Armor protection is provided for the body of the pilot and copilot against 7.62 mm from the side and from the back and below. Armored wings, attached to the cockpit interior, consist of a sliding panel at the outboard side of each seat. A release lever at the front of each panel permits sliding the panel aft to allow rapid entrance and exit, as well as freedom of movement for the seat occupant.

2-29. Crew Chief/Gunner Seats.

WARNING

Do not store any items below seats. During a crash any obstruction will increase the probability and severity of injury.

Two outward facing seats (Figure 2-16), one on each side of the helicopter at the front of the cabin, are for the crew chief/gunners. Each seat faces a window. Each seat is a cable-supported steel tube assembly with a fire-resistant, high strength fabric seat and backrest. Each seat contains two lower energy attenuators designed and oriented to reduce personal injury in a crash. Each seat has a complete lap belt and dual torso-restraint shoulder harness attached to a dual action rotary release buckle. The shoulder harness is connected to inertia reels on the seat back and bottom. This gives the wearer freedom to move about his station. On helicopters equipped with improved crewchief/gunner's restraint system, the restraint system is equipped with a single action rotary release buckle with a guard. A release plate must be pressed to allow rotation of release, preventing inadvertent handle rotation from contact with equipment etc. The inertia reel lock control is replaced by a shorter push/pull manual locking control. Push in and the inertia reel is manually locked in place. When the control is pulled out, the reel will lock on sudden pull.

2-30. Troop Provisions. UH

WARNING

Do not store any items below seats. During a crash any obstruction will increase the probability and severity of injury.

Troop seats may be installed for 14 persons. Each troop seat has a belt and shoulder harness for body restraint. The backs and seat pans are attached through cables to the cabin ceiling and through cables and rods to seat fittings installed in the floor. The seats may be installed in any quantity from 1 to 14. Each seat contains two lower energy attenuators designed and oriented to reduce personnel injury. In Row 1, where a forward facing troop seat can be installed, attenuators small end is up and toward right of aircraft. When seats are removed from the cabin and stowed in the storage compartment, adjustments must be made for weight and balance using data in Figures 6-4 and 6-12.

2-31. Troop Seat Belt Operation.

a. Extend shoulder strap and attach shoulder strap fittings to buckle.

b. Extend lap belt and place across body.

c. Place lap belt fitting into buckle and make certain of positive lock.

d. Adjust lap belt tension adjustments and shoulder strap adjustments for a comfortable fit.

2-31.1. DF and ECM Operator's Seats. EH

The seats are similar to the pilot's and copilot's alternate seats except that armored wing protection is not provided.

2-31.2. Observer's Seat. EH

The observer's seat is identical to a troop seat (Figure 2-16). It is installed behind, and to the right, of the DF operator's seat.

Section II EMERGENCY EQUIPMENT

2-32. Fire Protection Systems.

Fire detection and fire extinguishing systems are installed so that a fire may be detected and put out at either engine or the APU installation, without affecting the remaining two. The engines and APU are monitored by infrared radiation type sensing units, and protected by a main and reserve high-rate discharge type fire extinguishing installation.

2-33. Fire Detection System.

A detection system provides fire warning to the cockpit in case of fire in either main engine compartment or in the APU compartment. The system consists of five radiation-sensing flame detectors, control amplifiers, and a test panel. Two detectors are installed in each main engine compartment and one detector is in the APU compartment (Figure 2-1). The flame detectors are solid-state photo-conductive cells providing continuous volume optical surveillance of the monitored areas. In case of fire, the detectors react to the infrared radiation and send a signal to one of the three control amplifiers which in turn signals the fire warning assembly lighting the proper T-handle (Figures 2-6 and 2-10). Also, the master FIRE warning lights will go on if a fire is detected (Figure 2-8). The detector system automatically resets itself, with warning lights off, when the infrared radiation source ceases to emit.

2-34. Fire Detector Test Panel.

A test switch on the fire DET TEST panel on the upper console (Figure 2-6), when moved to positions 1 and 2, sends a test signal through the system to put on the fire warning lights and verify proper system operation to, but not including, the photo cells. The No. 1 TEST position lights No. 1 and No. 2 ENG EMER OFF T-handles and APU T-handle and checks all firewall mounted detectors. The No. 2 TEST lights No. 1 and No. 2 ENG EMER OFF T-handle only, and checks all deck mounted detectors. The engines and APU are completely enclosed within their own firewall compartment, thus reducing the possibility of a false fire warning from outside sources. Electrical power to operate the No. 1 and No. 2 detector system is by the dc essential bus through circuit breakers marked FIRE DET, NO. 1 ENG and NO. 2 ENG, respectively. Power to operate the APU detector system is by the battery bus through a circuit breaker marked APU FIRE DET.

2-35. Fire Extinguishing Systems.

A high-rate discharge extinguishing system provides a two-shot, main and reserve capability to either main engine compartment or APU compartment. Two containers are each filled with 2.5 pounds of liquid and charged with gaseous nitrogen to a pressure of 600 +25 −0 psi. The containers are mounted above the upper deck, behind the right engine compartment (Figure 2-1). Both containers have dual outlets, each with its own firing mechanism. Each extinguishing agent container has a pressure gage, easily viewed for preflight inspection. The system also has a thermal discharge safety port that will cause a visual indicator on the right side of the fuselage to rupture, indicating that one or both containers are empty. Electrical power to operate the No. 1 main and No. 2 reserve outlet valves is by the No. 2 dc primary bus through a circuit breaker, marked FIRE EXTGH on the pilot's circuit breaker panel. Power to operate the No. 2 main and No. 1 reserve fire bottles outlet port valves and the directional control valve is by the battery utility bus through a circuit breaker on the lower console marked FIRE EXTGH.

2-36. Fire Extinguisher Arming Levers (T-Handles).

Three T-shaped handles: one APU T-handle is on the upper console (Figure 2-6) marked APU, and two engine fire extinguisher T-handles are on the engine control quadrant, marked #1 ENG EMER OFF, #2 ENG EMER OFF (Figures 2-4 and 2-10). The handle marked #1 ENG EMER OFF is for the No. 1 engine compartment, the handle marked #2 ENG EMER OFF is for the No. 2 engine compartment, and APU is for the auxiliary power unit compartment. When a handle is pulled, dc power actuates the fire extinguisher logic module to select the compartment to which the fire extinguisher agent is to be directed, and also energizes the circuit to the fire extinguisher switch. The ends of the handles house fire detector warning lights.

2-37. Fire Extinguisher Control Panel.

WARNING

In case of fire when ac electrical power is not applied to the helicopter, the reserve fire extinguisher must be discharged. Fire extinguisher agent cannot be discharged into No. 2 engine compartment if ac electrical power is not applied to helicopter.

The switch, marked FIRE EXTGH, on the upper console (Figure 2-6), has marked positions RESERVE-OFF-MAIN. The switch is operative only after one of the ENG EMER OFF or APU lever (T-handle) has been pulled. When the switch is placed to MAIN, after an ENG EMER OFF lever has been pulled, the contents of the fire extinguisher bottle is discharged into the corresponding compartment. When the FIRE EXTGH switch is placed to RESERVE after an ENG EMER OFF lever has been pulled, the contents of the opposite fire extinguisher bottle is discharged into the selected compartment. The contents of the fire extinguisher bottle discharges into the compartment of the last lever pulled.

2-38. Crash-Actuated System.

A crash-actuated system is part of the fire extinguisher system. An omnidirectional inertia switch is hard-mounted to the airframe to sense crash forces. Upon impact of a crash of 10 Gs or more, the switch will automatically fire both fire extinguishing containers into both engine compartments. Electrical power is supplied from the battery utility bus through a circuit breaker on the lower console, marked FIRE EXTGH.

2-39. Hand-Operated Fire Extinguishers.

WARNING

Exposure to high concentrations of extinguishing agent or decomposition products should be avoided. The liquid should not be allowed to contact the skin; it could cause frostbite or low temperature burns.

One hand-operated fire extinguisher (Figure 9-1) is mounted on the cabin wall left of the gunner's seat. A second fire extinguisher is on the copilot's seat. The extinguishers are held in place by a quick-release spring.

2-40. Crash Axe.

UH One axe (Figure 9-1) is installed between the pilot's seats in the cabin. EH Four hand operated portable fire extinguishers are installed. One is mounted on the right gunner window, one on the left pilot seat, one on the DF operator seat, and one on the ECM operator seat.

2-41. First Aid Kits.

UH Three first aid kits (Figure 9-1) are installed, two on the back of the copilot's seat and one on the back of the pilot's seat. EH Five first aid kits are installed. One on the back of the right pilot seat, two on the back of the left pilot seat, one on the back of the DF operator seat, and one on the back of the ECM operator seat.

Section III ENGINES AND RELATED SYSTEMS

2-42. Engine.

The T700 engine (Figure 2-9), is a front drive, turboshaft engine of modular construction. One is mounted on the airframe at either side of the main transmission. The T700 is divided into four modules: cold section, hot section, power turbine section, and accessory section.

2-43. Cold Section Module.

The cold section module (Figure 2-9), includes the inlet particle separator, the compressor, the output shaft assembly, and line replaceable units (LRU's). The inlet particle separator (Figure 2-9) removes sand, dust, and other foreign material from the engine inlet air. Engine inlet air passes through the swirl vanes, spinning the air and throwing dirt out by inertial action into the collector scroll, after which it is sucked through by the engine-driven blower and discharged overboard around the engine exhaust duct. The compressor has five axial stages and one centrifugal stage. There are variable inlet guide vanes and variable stage 1 and stage 2 stator vanes. LRU's mounted on the cold section module are the electrical control unit (ECU) -700, or digital electronic control (DEC) -701C, anti-icing and start bleed valve, history recorder -700, or history counter -701C, ignition system, and electrical cables.

2-44. Hot Section Module.

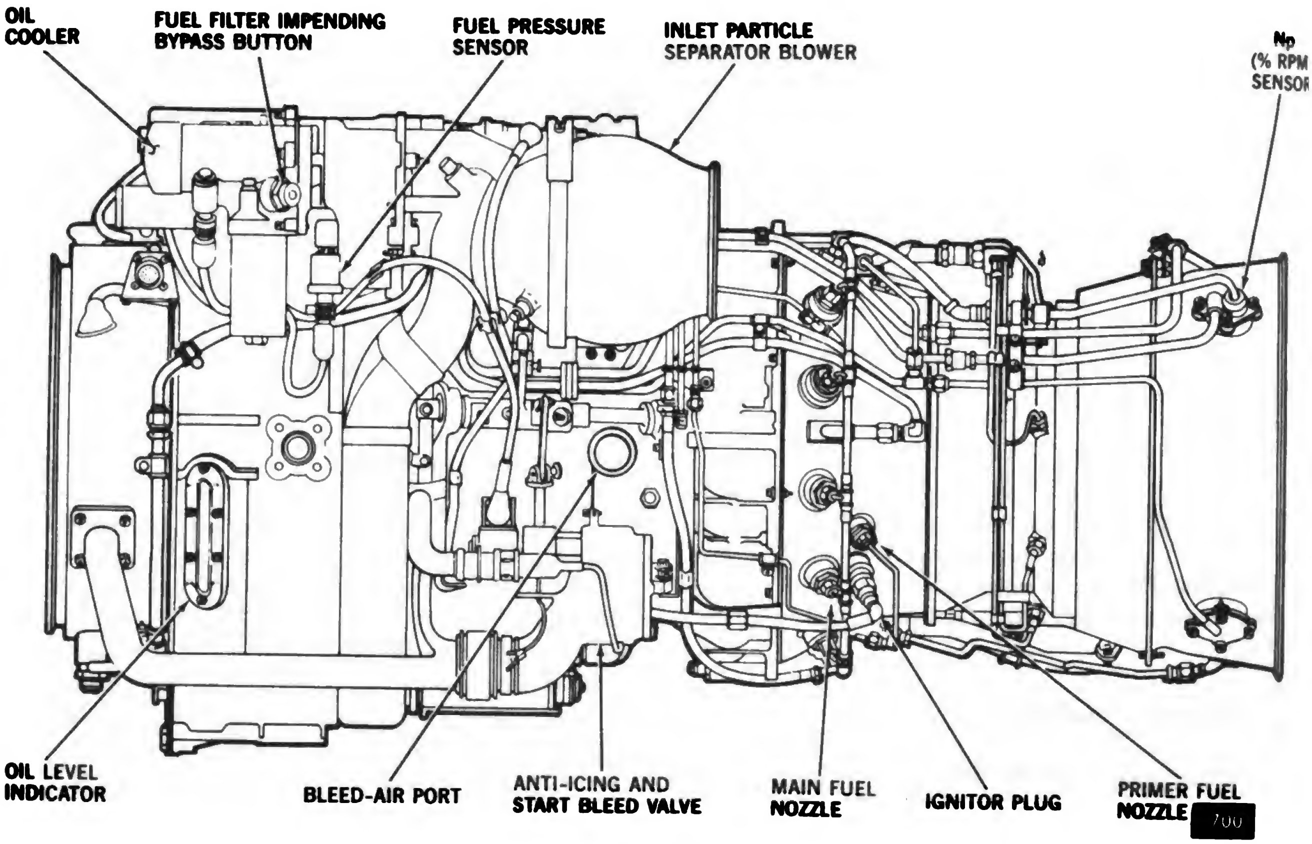
The hot section module (Figure 2-9) consists of three subassemblies; the gas generator turbine, stage 1 nozzle assembly, and combustion liner. LRU's on the hot section module are primer nozzles 700 and ignitors. The gas generator turbine consists of a gas generator stator assembly and a two-stage air cooled turbine rotor assembly which drives the compressor and the accessory gear box. Stage 1 nozzle assembly contains air cooled nozzle segments. The nozzle assemblies direct gas flow to the gas generator turbine. The combustion liner is a ring type combustor cooled by air flow from the diffuser case.

2-45. Power Turbine Section Module.

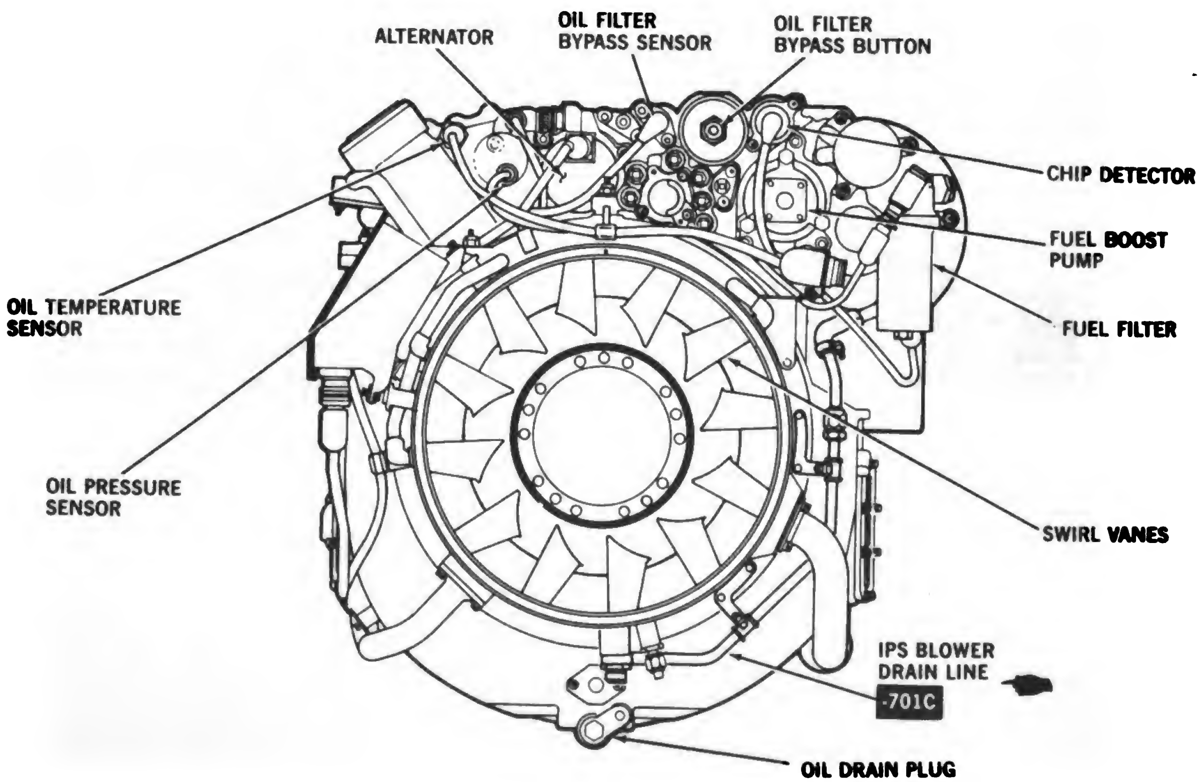
The power turbine module (Figure 2-9), includes a two stage power turbine, exhaust frame, and the shaft and C-sump assembly. The LRU's mounted on the power turbine section module are the thermocouple harness, torque and overspeed sensor, and Np (% RPM 1 or 2) sensor.

2-46. Accessory Section Module.

The accessory section module (Figure 2-9) includes the top mounted accessory gear box and a



LEFT SIDE



FRONT VIEW

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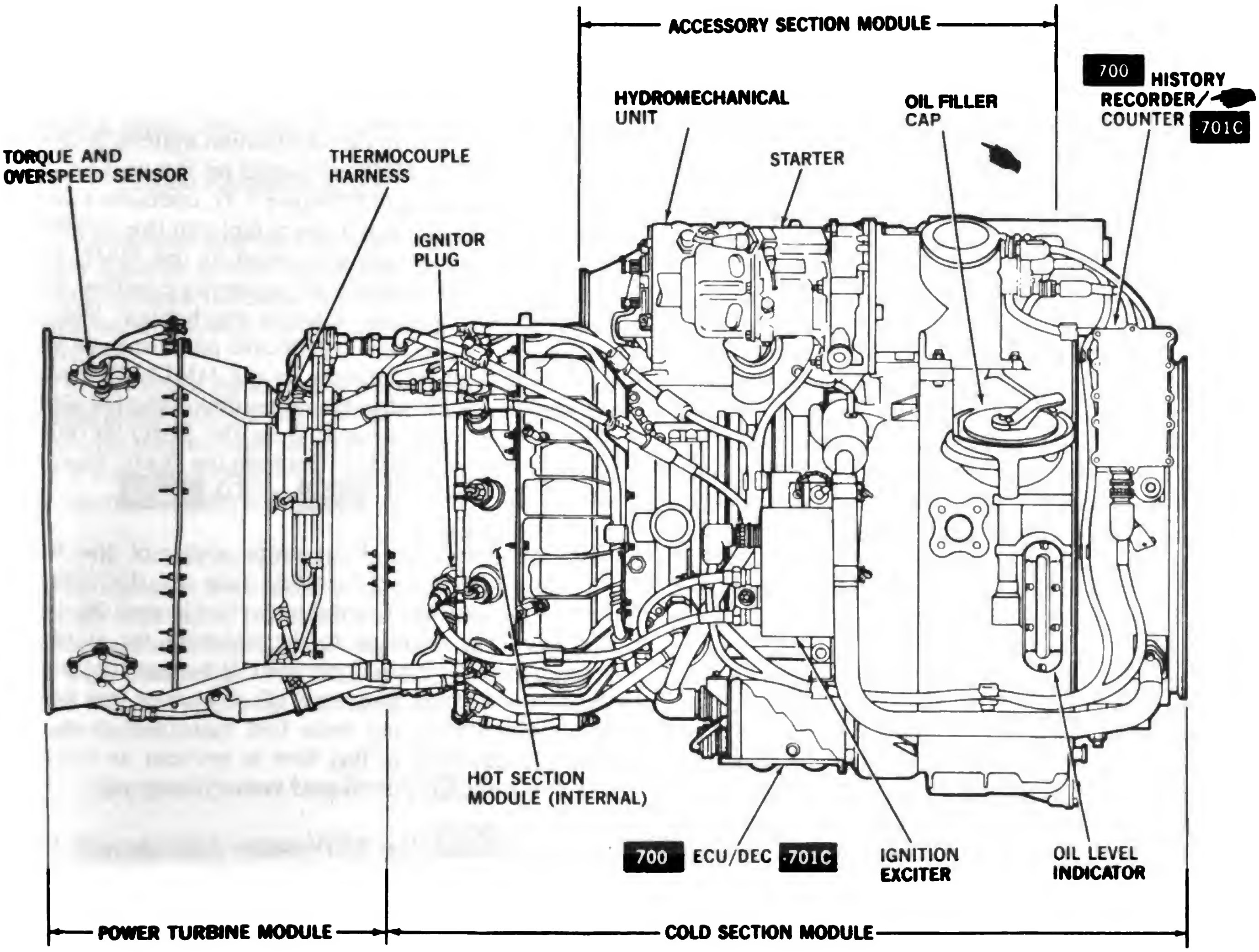
Figure 2-9. Engine T700 (Sheet 1 of 2)



RIGHT SIDE

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Figure 2-9. Engine T700 (Sheet 2 of 2)

number of LRU's. The LRU's mounted on the module are the hydromechanical (HMU) unit, fuel boost pump, oil filter, oil cooler, alternator, oil and scavenge pump, particle separator blower, fuel filter assembly, chip detector, oil filter bypass sensor, radial drive shaft, and sequence valve.

2-47. Engine Fuel Supply System.

The engine fuel supply system consists primarily of the low pressure boost pump, fuel filter, hydromechanical unit (HMU), sequence valve/pressurizing and overspeed unit (POU) 700, or overspeed and drain valve (ODV) -701C.

2-48. Fuel Boost Pump.

A low pressure suction fuel boost pump is installed on the front face of the engine accessory gear box (Figure 2-9). It assures that the airframe fuel supply system is under negative pressure, lessening the potential of fire in case of fuel system damage. It also provides fuel pressure for engine operation above 10,000 feet. A hole in the fuel system piping will not leak fuel out, but rather will allow air in. Lighting of the #1 or #2 FUEL PRESS caution light at idle speed and above could indicate a leak, or failed engine boost pump.

2-49. Fuel Filter.

The fuel filter is a barrier type full flow filter with integral bypass. An electrical switch lights the caution panel #1 FUEL FLTR BYPASS or #2 FUEL FLTR BYPASS lights to indicate filter bypass. In addition, a red button on the filter housing pops out when filter element differential pressure indicates impending bypass. Power for the fuel filter bypass lights is from the No. 1 and No. 2 dc primary busses through circuit breakers marked WARN LTS.

2-50. Fuel Pressure Warning System.

The engine fuel pressure warning system for each engine consists of a pressure switch that turns on the FUEL PRESS caution light. Fuel pressure caution lights, marked #1 FUEL PRESS and #2 FUEL PRESS will light when fuel pressure drops below 9 psi. This light can go on when fuel pressure drops, due to failure of the low pressure boost pump or an air leak in the suction fuel system. The effect will vary depending upon the size of the leak. The effect will be more serious at low engine power. A large enough leak may cause a flameout. Power for the No. 1 engine fuel pressure warning system is supplied by the No. 1 primary dc bus through the NO. 1 ENG WARN LTS circuit breaker on the No. 1 circuit breaker panel. Power for the No. 2 engine fuel pressure warning system is supplied by the No. 2 primary dc bus through the NO. 2 ENG WARN LTS circuit breaker on No. 2 breaker panel.

2-51. Engine Fuel System Components.

Control of fuel to the combustion system is done by the HMU. The HMU, mounted on the rear center of the accessory gear box (Figure 2-9), contains a vane high pressure pump that delivers fuel into the combustor. Various parameters are sensed by the HMU and influence fuel flow and variable geometry position. The HMU responds to two separate mechanical linkage inputs from the cockpit. A collective pitch linkage provides load demand changes to the HMU. The pilot actuates the HMU when he moves the collective pitch. The other linkage input is from the ENG POWER CONT lever to the HMU. Fuel from the HMU flows to a sequence valve/POU 700 or ODV -701C.

a. 700 The POU sends some of the fuel through the fuel start manifold tube to the primer nozzles for light-off. The rest of the fuel is sent through the main fuel manifold to the injectors for starting acceleration and engine operation. It purges fuel from the primer nozzles after light off. It purges fuel from the primer nozzle and main fuel manifold on shutdown. It also reduces fuel flow to prevent an engine overspeed when the overspeed system is tripped.

b. -701C The ODV sends fuel through the main fuel manifold to the injectors for starting acceleration and engine operations. It purges fuel from the main fuel manifold on shutdown. It shuts off fuel flow to prevent an engine overspeed when the overspeed system is tripped. It also shuts off fuel to prevent hot starts when activated by the HSP.

2-52. Engine Alternator. 700

The engine alternator (Figure 2-9) supplies ac power to the ignition exciter and electrical control unit (ECU). It also supplies a signal to the N_g SPEED cockpit indicator. All essential engine electrical functions are powered by the alternator.

a. When the alternator power supply to the ECU is interrupted, a loss of %RPM 1 or 2 and torque, indications will occur, with corresponding engine(s) increasing to maximum power (high side).

b. When the alternator power supply providing the N_g signal is interrupted, a loss of N_g cockpit indication will occur with a corresponding engine out audio signal and warning light.

c. A complete loss of engine alternator power results in affected engine(s) increasing to maximum power (high side) with a loss of cockpit indications of %RPM 1 or 2, torque, N_g, and an engine out audio and warning light. Overspeed protection is still available.

2-52.1. Engine Alternator. 701C

The engine alternator (Figure 2-9) supplies ac power to the ignition exciter and supplies a signal to the N_g SPEED cockpit indicator. All essential engine electrical functions are powered by the alternator.

a. When the alternator power supply to the DEC is interrupted, 400 Hz 120 VAC aircraft power is utilized to prevent engine (high side) failure. There will be a loss of the associated cockpit N_g indication and activation of the engine out light and audio.

b. When the alternator power supply providing the N_g signal is interrupted, a loss of the associated engine N_g indication, illumination of the engine out light, and activation of the engine out audio will occur. Because the DEC can utilize, 400 Hz 120 VAC aircraft power there will be no loss of associated % RPM 1 or 2 and torque indications.

2-53. Electrical Control Unit (ECU). 700

The electrical control unit controls the electrical functions of the engine and transmits operational information to the cockpit. It is a solid-state device, mounted below the engine compressor casing. The ECU accepts inputs from the alternator, thermocouple harness, N_p (% RPM 1 and 2) sensor, torque and overspeed sensors, torque signal from opposite engine for load sharing, feedback signals from the HMU for system stabilization, and a demand speed from the engine speed trim button. The ECU provides signals to the % RPM 1 and 2 indicators, % TRQ meter, TGT indicator, and history recorder.

a. In case of an ECU malfunction, the pilot may override the ECU by momentarily advancing the ENG POWER CONT lever to the LOCKOUT stop, then retarding it to manually control engine power. To remove the ECU from lockout, the ENG POWER CONT lever must be moved to IDLE.

b. The torque matching/load sharing system increases power on the lower-torque engine to keep engine torques approximately equal. The system does not allow an engine to reduce power to match a lower power engine. If an engine fails to the high side, the good engine will only attempt to increase torque upward until its N_p is 3% above the reference N_p.

c. The temperature limiting system limits fuel flow when the requirement is so great that the turbine temperature reaches the limiting value. Fuel flow is reduced to hold a constant TGT. It is normal to see a transient increase above the 850°C TGT when the pilot demands maximum power (Figure 5-1 transient limits). TGT limiting does not prevent overtemperature during engine starts, compressor stall, or when the engine is operated in LOCKOUT (Paragraph 9-3e).

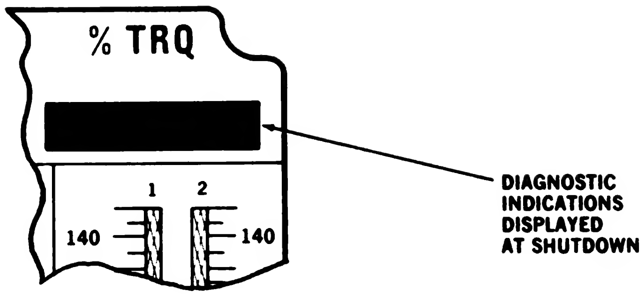
d. The overspeed protection system senses a separate % RPM signal independent of the demand speed governing channel. When an overspeed is sensed, it shuts off fuel flow to the engine by energizing the sequence valve or POU to reduce fuel flow to the engine. This momentarily corrects the overspeed condition. If the original cause of the overspeed (LOCKOUT or malfunction) is not corrected, the N_p will continue to cycle at approximately the overspeed limit.

2-53.1. Digital Electronic Control (DEC). 701C

The digital electronic control unit controls the electrical function of the engine and transmits operational information to the cockpit. It contains a microcomputer processor in a conductive composite molded case. The DEC can be fully powered by either the engine alternator or by the 400 Hz, 120 VAC aircraft power. It incorporates logic that will eliminate the torque spike signal during engine start and shutdown.

a. The DEC accepts inputs from the alternator, thermocouple harness, N_p (% RPM 1 and 2) sensor, torque and overspeed sensors, N_r sensor and collective position transducer for improved transient droop response, torque signal from opposite engine for load sharing, feedback signals from the HMU for system stabilization, and the engine speed trim button for N_p demand speed reference.

b. The DEC provides signals to the % RPM 1 and 2 indicators, % TRQ meter, TGT indicator, and engine history counter. It also provides signal validations or selected input signals within the electrical control system.



SIGNAL FAILED	DIAGNOSTIC INDICATION ON TORQUE METER (±3%)
DEC	15%
Np DEMAND CHANNEL	25%
LOAD SHARE CHANNEL	35%
TGT CHANNEL	45%
ALTERNATOR POWER	55%
Ng CHANNEL	65%
Np CHANNEL	75%
TORQUE AND OVERSPEED CHANNEL	85%
HOT START PREVENTION CHANNEL	95%
AIRCRAFT 400 Hz POWER	105%
COLLECTIVE CHANNEL	115%
Nr	125%

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Figure 2-9.1. Signal Validation - Fault Codes 701C

Signals are continuously validated when the engine is operating at idle and above. If a failure occurred on a selected input signal, the failed component or related circuit will be identified by a preselected fault code (Figure 2-9.1) displayed on the engine torque meter. These codes are defined in terms of engine torque. They are displayed for 4 seconds ON/2 seconds OFF, starting with the lowest code and rotating through all applicable codes, then repeating the cycle. They will only be displayed 30 seconds after both engines are shutdown with 400 Hz, 120 VAC power applied. They may be recalled by maintenance and the engine restarted. The pilot can suppress the fault code display of an engine by depressing the associated cockpit overspeed test button (TEST A/B). He may recall it by again depressing the associated cockpit overspeed test button.

c. In case of a DEC malfunction, the pilot may override the DEC by momentarily advancing the ENG POWER CONT lever to the LOCKOUT stop, then retarding it to manually control engine power. To remove the DEC from lockout, the ENG POWER CONT lever must be moved to IDLE.

d. The torque matching/load sharing system increases power on the lower-torque engine to keep engine torques approximately equal. The system does not allow an engine to reduce power to match a lower power engine. If an engine fails to the high side, the good engine will only attempt to increase torque upward until its Np is 3% above the reference Np.

e. The transient compensation system provides significant droop improvement during some maneuvers by monitoring engine torque, collective rate of change, and Nr speed rate of change

f. The temperature limiting system limits fuel flow when the turbine temperature reaches the 10 minute limiting value. The automatic contingency power limiting will switch the 10 minute temperature limiting to a high single engine temperature limiting value when the opposite engine torque is less than 50%. Fuel flow is regulated to hold a constant TGT. It is normal to see a transient increase above the 903°C TGT limit when the pilot demands maximum power (Figure 5-1.1 transient limits). TGT limiting does not prevent overtemperature during engine starts, compressor stall, or when the engine is operated in LOCKOUT (Paragraph 9-3e).

g. The hot start preventor system (HSP) is a part of the DEC. It prevents overtemperature during engine starts. The HSP system receives N_p, N_g, TGT signals. When N_p and N_g are below their respective hot start reference and TGT exceeds 900°C, an output from the HSP system activates a solenoid in the ODV. This shuts off fuel flow and causes the engine to shut down. The HSP system requires 400 HZ, 120 VAC aircraft power be provided to the DEC. The pilot can disable the HSP for emergency starting purposes by pressing and holding the overspeed test button (TEST A/B) for the engine being started during the engine start sequence.

h. The overspeed protection system senses a separate % RPM signal independent of the demand speed governing channel. When an overspeed is sensed, it shuts off fuel flow to the engine by energizing the ODV. This momentarily corrects the overspeed condition, fuel flow is restored, the igniters are energized, and the engine re-lights. If the original cause of the overspeed (LOCKOUT or malfunction) is not corrected, the N_p will continue to cycle approximately at the overspeed limit.

2-53.2. Hot Start Preventor (HSP). 701C

The HSP system is a part of the DEC, and prevents overtemperature during engine start such as with compressor stall during engine starts. The HSP system receives the power turbine speed (N_p) signal, gas generator speed (N_g) signal, (TGT) signal. When N_p and N_g are below their respective hot start reference and TGT exceeds 900°C, an output from the HSP system activates a solenoid in the ODV. This shuts off fuel flow and causes the engine to shut down. The HSP system will not operate if no aircraft 400 Hz power is provided to the DEC. During an emergency, HSP can be disabled by pressing and holding either one of the overspeed test buttons (TEST A/B) during the starting sequence.

2-54. Ignition System.

The engine ignition system is a noncontinuous ac powered, capacitor discharge, low voltage system. It includes a dual exciter, two igniter plugs, ignition leads, and ENGINE IGNITION keylock switch.

2-55. History Recorder. 700

The engine history recorder is mounted on the right side of the swirl frame (Figure 2-9). It displays four digital counters which records information for maintenance purposes only. The history recorder will only operate with an ECU.

2-55.1. History Counter. 701C

The engine history counter is mounted on the right side of the swirl frame (Figure 2-9). It displays four digital counters which records information for maintenance purposes only. The history counter will only operate with a DEC.

2-56. Thermocouple Harness.

A seven probe harness measures the temperature of the gases at the power turbine inlet. It provides a signal to the ECU 700, or DEC 701C, that relays it to the history recorder 700, or history counter 701C, through the signal data converter (SDC) to the cockpit temperature gage.

2-57. Torque and Overspeed and % RPM Sensors.

Two sensors are installed on the exhaust frame of the engine. One sensor provides the power turbine governor and tachometer signal to the ECU 700, or DEC 701C. The other sensor feeds the torque computation circuit and overspeed protection system.

2-58. Engine Bleed-Air System.

Two bleed-air ports are incorporated on the engine. The outboard port supplies bleed-air to the engine air inlet anti-icing system as described in Section IX. The inboard port ties into the pressurized air system. Air from this port is supplied to the cabin heating system and can be supplied to the other engine for crossbleed starts.

2-59. Engine Anti-Icing Systems.

2-59.1. Engine and Engine Inlet Anti-Icing Systems.

CAUTION

The engine can incur FOD by improper use of these systems and the other anti-ice/deice systems. For example, ice shedding off the windshield can cause FOD damage to the engines.

Do not rely on the ice detector for the rotor blade de-ice system for a signal to turn on the engine anti-ice systems. Temperature/pressure conditions in an engine inlet can cause the inlet to accumulate ice before the ice detector indicates the presence of ice.

a. The engine is anti-iced by two systems; the first described in subparagraph b is called an engine anti-ice system and a second described in subparagraph c called the engine inlet anti-icing system. Both of these systems are turned on by the ENG ANTI-ICE NO. 1 and NO. 2 switch (Figure 2-6).

b. Engine anti-icing is a combination of bleed-air and heated engine oil. Anti-icing is controlled by a solenoid-operated air valve. The engine anti-ice/start bleed valve opens during starting and will remain open at low power settings until engine reaches 88 to 92% N_g, depending on the outside air temperature, with anti-ice OFF. The engine anti-ice/deice system is designed so that in the event of an electrical failure the valve reverts to the anti-icing mode and turns on an advisory light indicating #1 ENG ANTI ICE ON or #2 ENG ANTI ICE ON. Axial compressor discharge air is bled from stage five of the compressor casing, routed through the anti-icing/bleed valve, and delivered to the front frame through ducting. Within the swirl frame, hot air is ducted around the outer casing to each swirl vane splitter lip and inlet guide vanes. The hot air is directed within each vane by a series of baffles. Hot engine oil passing within the scroll vanes in the main frame prevents ice buildup. Water, snow, and solids are carried out through the inlet particle separator discharge system. Switches marked ENG ANTI-ICE NO. 1 or NO. 2 OFF, and ON, control engine and inlet anti-ice. At the ON position, compressor bleed-air is supplied continuously. Power to operate the anti-icing system is by the No. 1 and No. 2 primary dc buses respectively, through circuit breakers, marked ANTI-ICE and ANTI-ICE WARN.

c. The engine air inlets are anti-iced by bleed-air from the engines. Four advisory lights on the caution/advisory panel, marked #1 ENG ANTI-ICE ON, #2 ENG ANTI-ICE ON, #1 ENG INLET ANTI-ICE ON and #2 ENG INLET ANTI-ICE ON are provided for the eninges. The #1 and #2 ENG ANTI-ICE ON advisory lights will go on when the ENG ANTI-ICE No. 1 and ENG ANTI-ICE No. 2 switches are placed ON. When the anti-ice system is operating and an engine is started, the inlet anti-ice valve for that engine will close. The #1 and #2 ENG INLET ANTI-ICE ON advisory lights operate from temperature sensed at the engine inlet fairing. When the temperature reaches about 93°C, the temperature switch will turn on the appropriate ENG INLET ANTI-ICE ON advisory light. If this light goes on with the switches at ENG ANTI-ICE No. 1 and No. 2 OFF, it indicates that heat is being applied to that engine inlet and a malfunction exists. Inlet anti-icing will turn on if dc primary power failure occurs; dc electrical power is applied to keep the valve closed. When operating at temperatures above 4° to 13°C, the NO. 1 and NO. 2 ENG INLET ANTI-ICE will not go on even if the #1 and #2 ENG ANTI-ICE switches are ON. At engine power levels of 10% TRQ per engine and below, full inlet anti-ice capability cannot be provided due to engine bleed limitations. Power to operate the valves is normally provided from the No. 1 and No. 2 dc primary buses, respectively, through circuit breakers marked NO. 1 and NO. 2 ENG ANTI-ICE, respectively. During engine start, power to operate the No. 1 engine inlet anti-ice valve is provided from dc essential bus through a circuit breaker marked No. 1 ENG START CONTR. The #1 and #2 ENG INLET ANTI-ICE ON advisory lights receive power from No. 1 and No. 2 dc primary buses, through circuit breakers, marked No. 1 and No. 2 ENG ANTI-ICE WARN, respectively.

2-60. Engine Oil System.

Lubrication of each engine is by a self-contained, pressurized, recirculating, dry sump system. Included are oil and scavenge pump, emergency oil system, monitored oil filter, tank, oil cooler, and seal pressurization and venting. The oil tank is a part of the main frame. Each scavenge line has a screen at the scavenge pump to aid fault isolation. A chip detector with a cockpit warning light is in the line downstream of the scavenge pump.

2-61. Engine Emergency Oil System.

The engine has an emergency oil system in case oil pressure is lost. Oil reservoirs built into the A and B sumps are kept full during normal operation by the oil pump. Oil bleeds slowly out of those reservoirs and is atomized by air jets, providing continuous oil mist lubrication for the bearings. A #1 ENGINE OIL PRESS or #2 ENGINE OIL PRESS caution panel light will go on when indicated oil pressure drops below 25 psi on helicopters without modified faceplates on instrument panel, or below 20 psi on helicopters with modified faceplates. Power for the caution lights comes from the No. 2 dc primary bus through a circuit breaker marked ENG/WARN.

2-62. Oil Tank.

The oil tank is an integral part of the engine. Tank capacity is 7 US quarts. The filler port is on the right. Oil is supplied to the oil pump via a screen. Oil level is indicated by a sight gage on each side of the tank. Servicing of the tank is required if the oil level reaches the ADD line. Overservicing is not possible because extra oil will flow out the filler port. The scavenge pump returns oil from the sumps and accessory gear box to the oil tank through six scavenge screens, each one labeled for fault isolation.

2-63. Oil Cooler and Filter.

The oil cooler (Figure 2-9) cools scavenge oil before it returns to the tank. Oil from the chip detector passes through the oil cooler and is cooled by transferring heat from the oil to fuel. After passing through the oil cooler, oil enters the top of the main frame where it flows through the scroll vanes. This further cools the oil and heats the vanes for full-time anti-icing. The vanes discharge oil into the oil tank. If the oil cooler pressure becomes too high, a relief valve will open to dump scavenge oil directly into the oil tank. Oil discharged from the oil pump is routed to a disposable-element filter. As the pressure differential across the filter increases, the first indicator will be a popped impending bypass button. As the pressure increases further, this indication will be followed by an indication in the cockpit #1 or #2 oil FILTER

BYPASS, after which a filter bypass will occur. Power for the caution lights is from the No. 1 and No. 2 dc primary buses respectively, through circuit breakers marked WARN LTS. During cold weather starting, or on starting with a partially clogged filter, the high-pressure drop across the filter will cause the bypass valve to open and the caution lights to go on. The impending bypass indicator has a thermal lockout below 38°C to prevent the button from popping. A cold-start relief valve downstream of the filter protects the system by opening and dumping the extra oil to the gear box case.

2-64. Engine Chip Detector.

The chip detector is on the forward side of the accessory gear box. It consists of a housing with integral magnet and electrical connector, with a removable screen surrounding the magnet. The detector attracts magnetic particles at a primary chip detecting gap. A common oil discharge from the scavenge pump is routed to a chip detector wired to a cockpit caution light marked CHIP #1 ENGINE or CHIP #2 ENGINE. If chips are detected, a signal is sent to the cockpit to light a caution light, marked CHIP #1 ENGINE or CHIP #2 ENGINE. Power to operate the engine chip detector system is from the No. 1 and No. 2 dc primary buses respectively, through circuit breakers marked WARN LTS, under the general headings NO. 1 ENG and NO. 2 ENG.

2-65. Engine Start System.

The pneumatic start system uses an air turbine engine start motor for engine starting. System components consist of an engine start motor, start control valve, external start connector, check valves, controls and ducting. Three pneumatic sources may provide air for engine starts: the APU, engine crossbleed, or a ground source. When the start button is pressed, air from the selected source is directed through the start control valve to the engine start motor. The #1 ENG START or #2 ENG START caution light will go on at this time and remain on until the starter drops out. As the engine start motor begins to turn, an overrun clutch engages causing the engine to motor. As the engine alternator begins to turn, electrical current is supplied to the ignition exciter. Ignition will continue until either the ENGINE IGNITION switch is moved to OFF or starter dropout occurs. The ENG POWER CONT lever is advanced to IDLE detent for light-off and acceleration. A starter speed switch wired to the start control valve terminates the start cycle when cutoff speed is reached (52%-65% N_g SPEED) and turns off the starter caution light and engine ignition. Malfunction of the starter speed switch may be overcome by manually holding the start button pressed until reaching 52%-65% N_g SPEED. To drop out the starter, manually pull down on the ENG POWER CONT lever. To abort a start, pull down on the ENG POWER CONT lever and move to OFF in one swift movement. Power to operate the No. 1 engine start control valve is from the dc essential bus through a circuit breaker marked NO. 1 ENG START. Power to operate the No. 2 engine start control valve is from the No. 2 dc primary bus through a circuit breaker marked NO. 2 ENG START CONTR. 701C For the 701C engine only, fuel flow to the engine will be automatically shut off if TGT exceeds 900°C during the start sequence. The hot start preventer can be manually disabled by depressing and holding either of the engine overspeed test buttons during the start sequence.

2-66. Engine Ignition Keylock.

An ENGINE IGNITION keylock is installed on the instrument panel (Figure 2-8), to short out and prevent ignition exciter current flow when the switch is OFF and the starter is on the line. The switch is marked ENGINE IGNITION OFF and ON. When the switch is ON, the shorts are removed from both engine alternators, allowing exciter current to flow when the engine alternator begins to turn. The ENGINE IGNITION is normally ON during flight and turned off at shutdown. One switch serves both engines. If the switch is OFF, neither engine can be started, although motoring capability remains. When an engine is to be motored without a start, make certain the ENGINE IGNITION switch is OFF. To prevent a possible hot or torching start never turn the ENGINE IGNITION switch ON after motoring has started. Abort start procedures must be done to remove excess fuel from the engine if a start was attempted with the switch OFF.

2-67. APU Source Engine Start.

The APU provides an on-board source of air and auxiliary electrical power. The APU bleed-air output is enough to start each engine individually at all required combinations of ambient temperatures and enough to start both engines simultaneously within a reduced range of ambient temperatures (Figure 5-2). The AIR SOURCE HEAT/START switch must be at APU. Refer to Section XII for complete APU description.

2-68. Crossbleed Engine Start System.

Crossbleed engine starts are used when one engine is operating and it is desired to start the other engine from the bleed-air source of the operating engine. To make a crossbleed start, the operating engine must be at least 90% N_g SPEED. When the AIR SOURCE HEAT/START switch is placed to ENG, both engine crossbleed valves will open. Pressing the start button for the engine not operating will cause the start valve for that engine to open at the same time the crossbleed valve for the starting engine will close, and remain closed until starter dropout occurs. At 52%-65% N_g SPEED, the starting engine start valve will close, stopping bleed-air flow to the starter. Power to operate the bleed shutoff valve is from No. 1 dc primary bus through a circuit breaker marked AIR SOURCE HEAT/START.

2-69. External Source Engine Start.

The external start pneumatic port (Figure 2-1) is on the left side of the fuselage. It is the attachment point for a bleed-air line from an external source for engine starting or helicopter heating on the ground. The assembly contains a check valve to prevent engine or APU bleed-air from being vented. The external air source pressurizes the start system up to the engine start control valves, requiring only that electrical power be applied. If an emergency start is made without ac electrical power, No. 1 engine must be started first because the No. 2 engine start control valve will not operate without dc primary bus power.

2-70. Engine Control System.

The engine control system consists of the engine quadrant, load demand system, speed control system and overspeed protective system.

2-71. Engine Control Quadrant.

WARNING

On helicopters not equipped with engine quadrant secondary stops, when moving the ENG POWER CONT lever from FLY toward OFF, care must be exercised at the IDLE position to ensure that the ENG POWER CONT lever engages the IDLE stop unless lever must be moved directly to OFF.

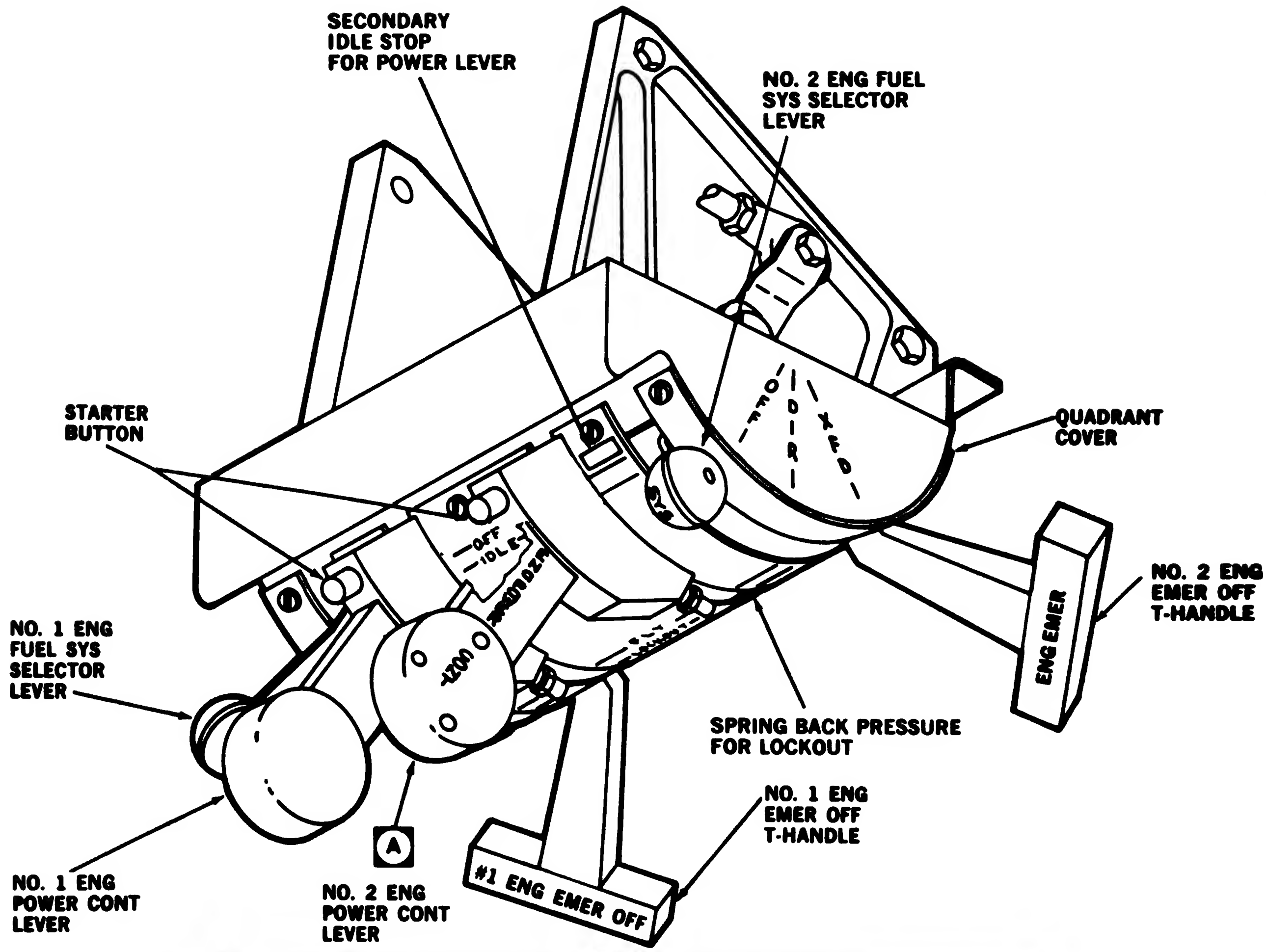
The engine control quadrant (Figure 2-10) consists of two ENG POWER CONT levers, two ENG FUEL SYS selector levers, and two ENG EMER OFF T-handles. A starter button is on each ENG POWER CONT lever. ENG POWER CONT lever has four detent positions: OFF-IDLE-FLY-LOCKOUT. Movement of the ENG POWER CONT levers moves a cable to mechanically shut off fuel or set available N_g SPEED. The lever is advanced to FLY for flight. This ENG POWER CONT lever setting represents the highest power that could be supplied if demanded. Power turbine speed (% RPM 1 or 2) is not governed until the power lever is advanced from IDLE. On helicopters equipped with engine quadrant secondary stop, two stop blocks were added to the quadrant assembly and a latch added to each ENG POWER CONT lever to prevent moving the levers below IDLE detent. When shutdown is required, the ENG POWER CONT lever must be pulled out slightly, at the same time the latch release must be pressed down, then the ENG POWER CONT lever can be moved below IDLE detent. After being moved momentarily to LOCKOUT, the ENG POWER CONT lever is used to manually control N_g SPEED and % RPM 1 or 2. With the ENG POWER CONT lever at LOCKOUT, the automatic TGT limiting system is deactivated and TGT must be manually controlled. The overspeed protection system is not deactivated when at LOCKOUT.

2-72. Load Demand System.

With ENG POWER CONT lever at FLY, the ECU 700 or DEC 701C and HMU responds to collective signals to automatically control engine speed and provide required power. During emergency operations, when the ENG POWER CONT lever is moved to LOCKOUT and then to some intermediate position, the engine will still respond to collective signals.

2-73. Engine Speed Control System.

An engine RPM control switch on the collective grips (Figure 2-11) controls the speed of both engines



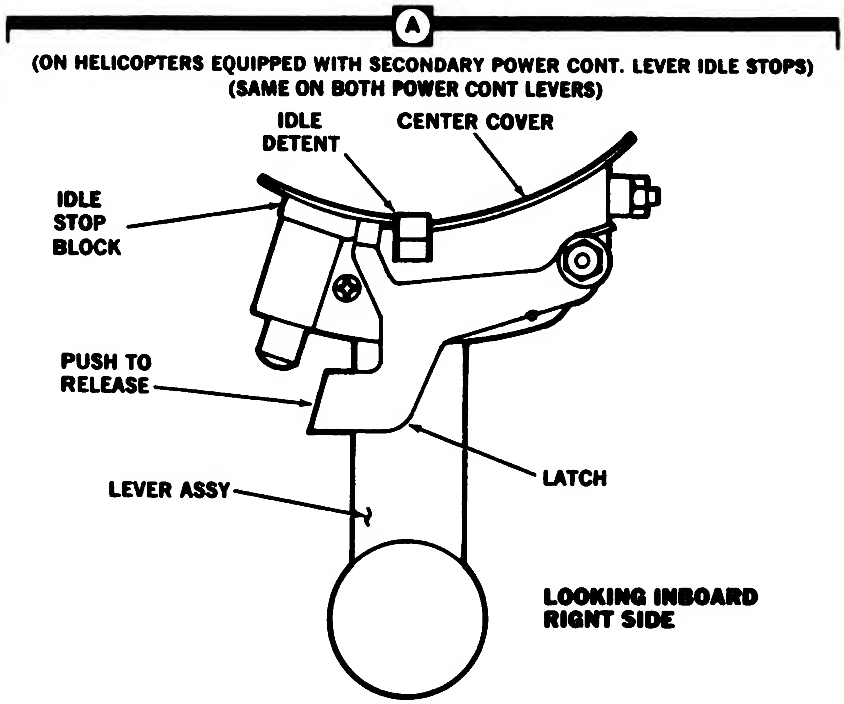


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Figure 2-10. Engine Control Quadrant

simultaneously. There is no individual trim capability. It is used to supply a signal to the ECU 700 , or DEC 701C for controlling % RPM 1 and 2 as required. The ENG RPM control switch allows adjustment between 96% and 100%. The pilot can override the copilot's control. Power for ENG RPM control system is from the No. 2 dc primary bus through a circuit breaker marked SPEED TRIM.

2-74. Engine Overspeed Protection System. 700

Overspeed protection protects the power turbine from destructive overspeeds. The system is set to trigger at 106% ± 1% RPM 1 or 2 and will result in an initial reduced fuel flow and will cycle until the cause of the overspeed is removed or % RPM is reduced manually. Two momentary switches marked NO. 1 and NO. 2 ENG OVSP TEST A and TEST B on the upper console (Figure 2-6), are used to check the circuits. Testing individual circuits A and B indicates that those systems are complete and performing correctly. Dual closing of A and B serves to check out the actual overspeed system itself, the overspeed solenoid and the sequence valve. This check must be done only on the ground. The overspeed protection is not deactivated when in LOCKOUT. Power to operate the overspeed system is from two independent sources: the engine alternators as the primary source, and the No. 1 and No. 2 ac primary buses as alternate backup source in case of alternator failure. Circuit protection is through circuit breakers marked NO. 1 ENG OVSP and NO. 2 ENG OVSP.

2-74.1. Engine Overspeed Protection System. 701C

Overspeed protection protects the power turbine from destructive overspeeds. The system is set to trigger at 120% ± 1% RPM 1 or 2 and will result in a fuel flow shut-off causing the engine to flame out. When % RPM is reduced below the overspeed limit, fuel flow is returned to the engine and engine ignition will come on to provide a relight. This cycle will continue until the overspeed condition is removed.

Two momentary switches marked NO. 1 and NO. 2 ENG OVSP TEST A and TEST B on the upper console (Figure 2-6), are used to check the circuits. Testing individual circuits A and B indicates that those systems are complete and performing correctly. Dual closing of A and B switches serve to check out both the overspeed system, and the overspeed drain valve (ODV). This check must be done only on the ground. The overspeed protection is not deactivated when in LOCKOUT. Power to operate the overspeed system is from two independent sources: the engine alternators as the primary source, and the No. 1 and No. 2 ac primary buses as alternate backup source in case of alternator failure. Circuit protection is through circuit breakers marked NO. 1 ENG OVSP and NO. 2 ENG OVSP.

2-75. Cruise Infrared Radiation (IR) Suppression Kit.

The IR suppression kit (Figure 2-2) commonly referred to as cruise IR suppressor has no moving parts. It improves helicopter survivability, when installed, by providing protection against heat-seeking missiles. The IR suppressor kit reduces the helicopter's IR signature by mixing ram air with the engine exhaust gases, and by blocking line-of-sight view of hot metal parts. The IR suppressor channels exhaust gases through a sheet metal core mounted within a fiberglass honeycomb sandwich-constructed nacelle. The suppressor core is constructed of short segments; each successive segment, in the direction of gas flow, has a larger cross-sectional area than the previous one. The inside surface of each segment is coated with low-reflectance material. Cooling air, entering the ram inlet scoop, is ducted around the suppressor core and passes through the gaps between overlapping core segments, providing film-cooling of the core surface. The engine exhaust plume is cooled internally by mixing the core film-cooling air, and externally by cross-flow mixing with ambient freestream at the suppressor exit. The core turns outboard to prevent line-of-sight seeking of the hot engine turbine and rear frame and to direct the engine exhaust into the free-stream air at a 75° angle to promote rapid exhaust mixing/cooling. Installation of each engine suppressor requires removal of the standard engine exhaust module and aft fairing. The engine and engine cowling remains in place. Engine and APU accessibility are not affected by the installation of the IR suppressors.

2-76. Hover Infrared Suppressor Subsystem (HIRSS).

The hover IR suppressor (Figure 2-2) provides improved helicopter survivability from heat-seeking missiles throughout the flight envelope. The HIRSS kit has no moving parts. It contains a three-stage removable core which reduces metal surface and exhaust gas temperature radiation and prevents line-of-sight viewing of hot engine surfaces. The HIRSS channels hot exhaust gasses through the three-stage core and inner baffle to induce the flow of cooling air from the engine bay and the inlet scoops. The three-stage core and inner baffle cold surfaces are coated with low-reflectance material. For further cooling, hot exhaust gas is ducted outboard and downward by the engine, away from the helicopter by the exhaust deflector, where additional cooling air is provided by the main rotor downwash. Installation of each HIRSS module requires removal of the standard engine exhaust module and aft cabin door track fairings. HIRSS modules are installed on the basic airframe equipped with HIRSS fixed provisions by two airframe mounts. The aft fairings are installed using existing mounting points and hardware. While operating in a non-hostile environment, the inner baffle can be removed to enhance helicopter performance.

2-77. Engine Instruments.

The instrument displays (Figure 2-8) consist of engine oil temperature, engine oil pressure, TGT, gas generator (N_g SPEED), power turbine % rpm 1 or 2 speed, rotor speed (% RPM R), engine torque (% TRQ), and FUEL QTY to provide the pilots with engine and subsystem monitoring. Continuous indications of those parameters are indicated on vertical scales, digital readouts and caution lights. Instruments without low range turn-off feature: % TRQ, TGT, N_g SPEED, ENG OIL TEMP and XMSN TEMP will remain on as parameter increases and go out as it decreases (Figure 5-1). Power for lighting the displays is from the No. 1 and No. 2 ac primary and No. 1 and No. 2 dc primary buses through the signal data converters.

2-78. Engine Oil Temperature Indicator.

Each engine has an oil temperature sensor wired through the signal data converter to a vertical scale instrument, marked ENG OIL TEMP, on the central display unit; and to an engine oil temperature caution light, marked ENG OIL TEMP, on the caution/advisory panel.

2-79. Engine Oil Pressure Indicator.

Each engine has an engine oil pressure transmitter, downstream of the oil filter, that sends readings to a vertical scale indicator, marked ENG OIL PRESS, on the instrument display panel; and to an engine oil pressure caution light, marked ENGINE OIL PRESS, on the caution panel. The lower precautionary and prohibited ranges will go out when reaching the bottom of the normal range. It may be possible that during IDLE operations, the ENG OIL PRESS caution light will go on. As pressure increases above 100 psi the respective prohibited scale changes to red.

2-80. TGT Temperature Indicator.

The TGT indicating system consists of thermocouples transmitting to a TGT indicator. The indicator assembly has two digital readouts that indicate precise temperatures.

2-81. Gas Generator Speed (N_g) Indicator.

The N_g SPEED indicating system shows N_g speed for each engine. The system consists of one alternator winding and N_g SPEED vertical scale instrument, on the instrument panel, giving percent rpm. Digital readouts for N_g SPEED are at the lower section of the instrument face plate. The three-digit readouts provide a closer indication of N_g SPEED.

2-82. Engine Power Turbine/Rotor Speed Indicator.

Power turbine and rotor speed are indicated for each engine on a single instrument marked % RPM 1 R 2 on the display panel with three vertical scales (Figure 5-1). Power turbine speed is indicated in % RPM 1 or 2 and rotor speed % RPM R. Rotor speed is sensed by a speed sensor on the right accessory module. Power turbine speed is sensed by a speed sensor on the engine exhaust frame. At the top of the panel are three warning lights that indicate varying degrees of rotor overspeed. These lights remain on, once tripped, and must be manually reset.

2-83. Torque Indicator.

The (% TRQ) system shows the amount of power the engine is delivering to the main transmission. A torque sensor mounted on the exhaust case measures the twist of the power turbine shaft, and transmits this signal to the ECU, and signal data converter into the TRQ indicator marked % TRQ on the display panel, displaying readings for both engines. Digital readouts giving torques for each engine are at the top of the indicator. A photocell on the lower center of the display will automatically adjust the lighting of the % rpm and torque indicators with respect to ambient light.

Section IV FUEL SYSTEM

2-84. **Fuel Supply System.**

A separate suction fuel system is provided for each engine. Fuel is stored in two interchangeable, crashworthy, ballistic-resistant tanks. The fuel system consists of lines from the main fuel tanks, firewall-mounted selector valves, prime/boost pump and fuel tanks, and engine-driven suction pumps. The prime boost pump primes all fuel lines if prime is lost, and also acts as an APU boost for APU starts and operation. A selector valve, driven by cable from the ENG FUEL SYS selector lever on the engine control quadrant (Figure 2-10) permits operation of either engine from either fuel tank. The engines and APU are suction fed, the APU is fed from the left main fuel tank by a separate fuel line. All fuel lines are routed in the most direct manner. The fuel line network includes self-sealing breakaway valves that contain fuel in case of helicopter crash or malfunction. All engine fuel lines are self-sealing.

2-85. Fuel Tanks.

Both fuel tanks are crashworthy, self-sealing and interchangeable. Each tank contains a pressure refuel/defuel valve, fuel quantity and low-level sensors, high-level shutoff valve, low-level shutoff valve, check valve sump drain, and a self-sealing breakaway vent valve. (Refer to Table 2-2 for tank capacity.) Fuel tank drains are in the sumps to permit removal of sediment and water and provide fuel sampling. Fuel sampling is primarily done with a thumb-operated handpump fuel sampling kit (Figure 2-26) containing 5 feet of plastic tubing. The tubing is placed in a guide tube inside the fuel tank and is directed to the bottom of the tank. The handpump is stroked and fuel is drawn from the tank, with contaminants at the bottom. When sampling is completed, the tubing is emptied, rolled, and stowed with the pump on the gravity refueling door. Fuel sampling of the range extension fuel tanks is done in the same manner.

2-86. Engine Fuel System Selector Control.

Each fuel system has a selector valve which is manually operated through the ENG FUEL SYS selector lever on the overhead engine control quadrant (Figure 2-10). There is an ENG EMER OFF T-handle on each side of the quadrant which is arranged so that pulling the handle engages the ENG FUEL SYS selector lever, bringing it to OFF. The ENG FUEL SYS selectors are connected to the fuel selector valves with low-friction flexible push-pull cables. Each lever can be actuated to three positions: OFF, DIR, and XFD. With the selectors at OFF, the control valves are closed, allowing no fuel flow to the engines. When the selectors are moved forward to DIR, the selector valves are opened, providing fuel flow for each engine from its individual fuel tank. If a tank is empty, or you wish to equalize fuel in the tanks, the ENG FUEL SYS selector of the engine that normally feeds from the empty or low-level tank is moved to XFD. This connects that engine to the other tank through the crossfeed system. A check valve in each crossfeed line prevents air from an inoperative engine's fuel line crossing to the operating one.

2-87. Fuel Filter.

The engine fuel filter has a bypass valve and bypass warning device. The filter is mounted on the forward left side of the engine accessory gear box. An impending bypass warning is incorporated on the filter housing in the form of a popout button. The bypass valve opens to assure continuous fuel flow with a blocked filter. At the same time the valve opens, an electrical switch closes to light the #1 or #2 FUEL FLTR BYPASS caution light. Power to operate the bypass warning system is from the No. 1 and No. 2 dc primary buses through circuit breakers marked NO. 1 ENGINE and NO. 2 ENGINE WARN LTS, respectively.

2-88. Engine Fuel Prime System.

A toggle switch on the upper console, marked FUEL PUMP, FUEL PRIME and APU BOOST (Figure 2-6), when moved to FUEL PRIME, energizes the prime/boost pump and solenoid valves to each main engine fuel supply line and to the solenoid valve for the APU fuel feed system. Advisory panel indication is displayed during this mode by a light marked PRIME BOOST PUMP ON. Helicopter prime pump capacity is not enough to prime an engine when the opposite engine is running. Engines should therefore be primed individually with both engines off. The prime/boost pump is actuated and the engine prime valve is opened whenever the engine starter is operating. This provides fuel pressure to aid in a successful engine start. When the engine speed reaches starter dropout speed, engine fuel prime valve will close and the prime/boost pump will also stop operating if the FUEL PUMP switch is

OFF. Power to operate the prime boost system is from the battery bus through a circuit breaker marked FUEL PRIME BOOST.

2-89. Fuel Quantity Indicating System.

All internal fuel is continuously gaged with the FUEL QTY gage system (Figure 2-8). The system consists of two tank unit sensors (probes), one in each tank, a dual channel fuel quantity gage conditioner, and a dual channel low-level warning system. The tank units are connected to the fuel quantity gages marked FUEL QTY 1-2 on the Central display panel. A separate total fuel quantity readout numerically displays the total quantity of fuel on board. The system may be checked out by pressing the FUEL IND TEST pushbutton on the miscellaneous switch panel. The vertical scales of the FUEL QTY indicator and the digital readout should show a change, and the #1 and #2 FUEL LOW caution lights on the caution/advisory panel should flash. When the button is released, the scales and digital readout will return to the original readings. The fuel quantity indicating system is powered by the No. 1 ac primary bus through a circuit breaker, marked NO. 1 AC INST.

2-90. Fuel Low Caution Light.

Two low-level sensors, one on each probe, provide signals which activate two low-level caution lights indicating #1 FUEL LOW or #2 FUEL LOW. Those lights flash when the fuel level decreases to approximately 172 pounds in each tank. The illumination of these lights do not mean a fixed time period remains before fuel exhaustion, but is an indication that a low fuel condition exists. The fuel-low caution lights are powered by the No. 1 dc primary bus through a circuit breaker marked FUEL LOW WARN.

2-91. Fuel Boost Pump.

The helicopter fuel system contains an electrically-operated submerged fuel boost pump in each fuel tank. When the pumps operate, they provide pressurized fuel to the engine fuel inlet port if engine fuel pressure drops below the minimum operating pressure. Each boost pump is controlled by a switch on the FUEL BOOST PUMP CONTROL panel (Figure 2-7). The two-position switch for each pump, marked ON-OFF, activates the pump for continuous operation to maintain a head of fuel pressure at the engine fuel inlet port, regardless of engine boost pump discharge pressure. A pump-on advisory light near each control switch indicates pump operation. Boost pump light activation is controlled by the respective fuel pump pressure. Two advisory lights on the FUEL BOOST PUMP control panel indicates the respective pump is operating. A check valve in each pump discharge line prevents fuel recirculation during fuel boost operation, and prevents loss of engine fuel line prime. NO. 1 or NO. 2 FUEL PRESS caution light going on is also an indicator to turn on boost pumps. Boost pump operation is required when operating with JP-4 fuel. Pump operation should be limited to minimize helicopter operation with pressurized fuel lines. Power to operate the boost pumps is provided from the NO. 1 and NO. 2 ac primary buses, respectively, through circuit breakers on the mission readiness circuit breaker panel, marked NO. 1 and NO. 2 BOOST PWR.

2-92. Refueling/Defueling.

A pressure refueling and defueling system provides complete refueling and defueling of both tanks from one point on the left side of the helicopter (Figure 2-26). Closed circuit refueling uses the pressure refueling system and its components. No electrical power is required for the system during refueling or defueling. The tank full shutoff valve is float-operated. A dual high-level shutoff system acts as back up for each other. The two high-level float valves close, causing a back pressure to the fueling/defueling valve at the bottom of the tank, closing the refuel valve. The tank empty automatic shutoff system is a function of the low-level float valve opening to allow air to be drawn into the line, closing the defuel valve. A filler neck between the fuselage contour and the fuel cell is a frangible (breakaway) connection. Gravity fueling is done through filler neck on each side of the fuselage for the respective tanks. Gravity defueling capability is provided through the drains.

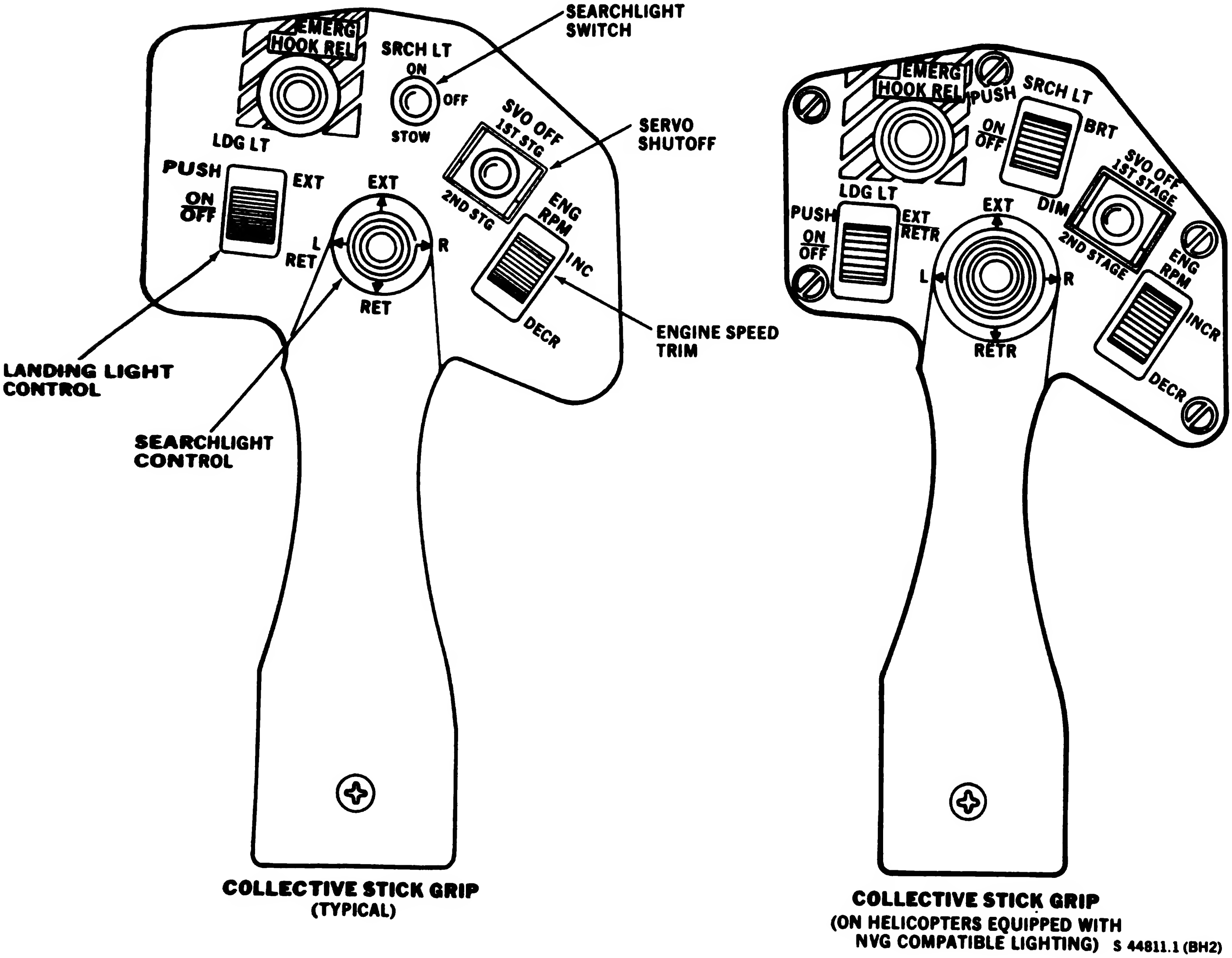


Figure 2-11. Collective and Cyclic Grips (Sheet 1 of 2)

Section V FLIGHT CONTROLS

2-93. Flight Control Systems.

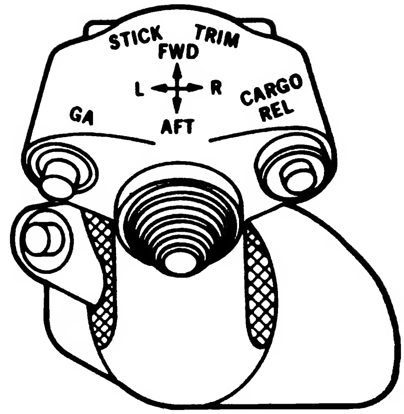
NOTE

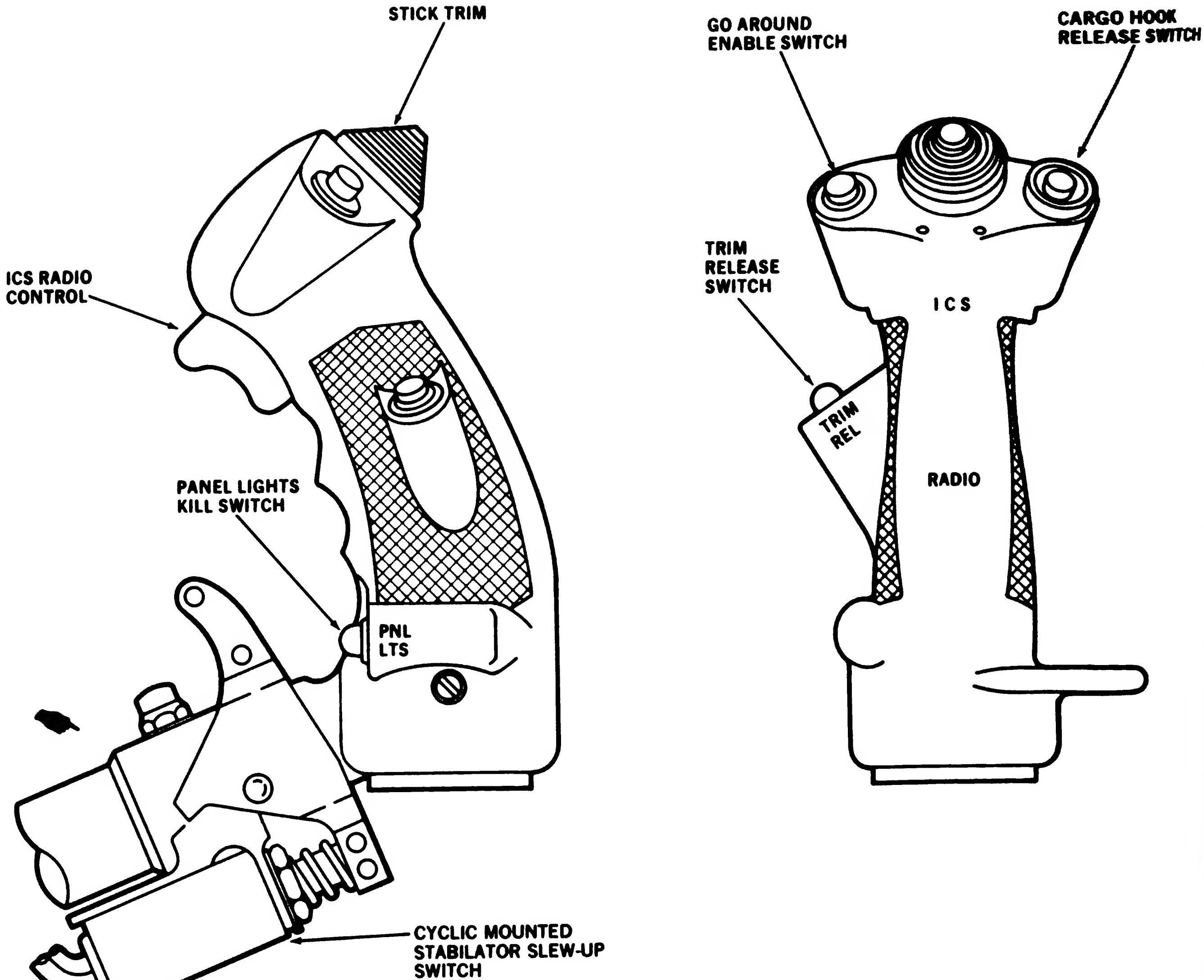
Flight near high power RF emitters such as microwave antennas or shipboard radar may cause uncommanded AFCS and/or stabilator control inputs. Electromechanical interference (EMI) testing has shown that the master caution light may illuminate before or simultaneously with any uncommanded stabilator trailing edge movement, with 4° or 5° of movement being the maximum.

The primary flight control system consists of the lateral control subsystem, the longitudinal control subsystem, the collective pitch control subsystem, and the directional control subsystem. Control inputs are transferred from the cockpit to the rotor blades by mechanical linkages, and hydraulic servos. Pilot control is assisted by stability augmentation system (SAS), flight path stabilization (FPS), boost servos, pitch bias actuator and pitch, roll, and yaw trim. Dual cockpit controls consist of the cyclic stick collective stick and pedals. The pilot and copilot controls are routed separately to a combining linkage for each control axis. Outputs from the cockpit controls are carried by mechanical linkage through the pilot-assist servos to the mixing unit. The mixing unit combines, sums, and couples the cyclic, collective, and yaw inputs. It provides proportional output signals, through mechanical linkages, to the main and tail rotor controls.

2-94. Cyclic Stick.

Lateral and longitudinal control of the helicopter is by movement of the cyclic sticks through push rods, bellcranks, and servos to the main rotor. Movement in any direction tilts the plane of the main rotor blades in the same direction, thereby causing the helicopter to go in that direction. Each cyclic stick grip (Figure 2-11) contains a stick trim switch, marked STICK TRIM





CYCLIC STICK GRIP
(TYPICAL)

S 44811.2 (C2)

Figure 2-11. Collective and Cyclic Grips (Sheet 2 of 2)

FWD, L, R and AFT, a go around switch, marked GA, trim release switch, marked TRIM REL, a panel light kill switch, marked PNL LTS, a cargo release switch, marked CARGO REL, and a transmitter ICS switch, marked RADIO and ICS. Refer to major systems for a complete description of switches on the cyclic grip.

2-95. Collective Pitch Control Stick.

The collective sticks change the pitch of the main rotor blades, causing an increase or decrease in lift on the entire main rotor disc. A friction control on the pilot's lever can be turned to adjust the amount of friction and prevent the collective stick from creeping. The copilot's stick telescopes by twisting the grip and pushing the stick aft to improve access to his seat. Each collective stick has a grip (Figure 2-11) with switches and controls for various helicopter systems. These systems are: landing light control, marked LDG LT PUSH ON/OFF EXT and RET; searchlight controls, marked SRCH LT ON, OFF, STOW, EXT, L, R, and RET; servo shutoff control switch, marked SVO OFF 1ST STG and 2ND STG; engine speed trim switch, marked ENG RPM INC and DECR; and cargo hook emergency release switch, marked EMERG HOOK REL. All switches are within easy reach of the left thumb. For a complete description of switches and controls, refer to major system description.

2-96. Mixing Unit.

a. A mechanical mixing unit provides control mixing functions which minimizes inherent control coupling. The four types of mechanical mixing and their functions are:

1. Collective to Pitch - Compensates for the effects of changes in rotor downwash on the stabilator caused by collective pitch changes. The mixing unit provides forward input to the main rotor as collective is increased and aft input as collective is decreased.

2. Collective to Yaw - Compensates for changes in torque effect caused by changes in collective position. The mixing unit increases tail rotor pitch as collective is increased and decreases tail rotor pitch as collective is decreased.

3. Collective to Roll - Compensates for the rolling moments caused by changes in tail rotor thrust. The mixing unit provides left lateral input to the main rotor system as collective is increased and right lateral input as collective is decreased.

4. Yaw to Pitch - Compensates for changes in the vertical thrust component of the canted tail rotor as tail rotor pitch is changed. The mixing unit provides forward input to the main rotor system as tail rotor pitch is increased and aft input as tail rotor pitch is decreased.

b. Collective/Airspeed to Yaw - This mixing is in addition to collective to yaw mechanical mixing. It helps compensate for the torque effect caused by changes in collective position. As airspeed decreases, the opposite occurs. It has the ability to decrease tail rotor pitch as airspeed increases and the tail rotor and cambered fin become more efficient. The SAS/FPS computer commands the yaw trim actuator to change tail rotor pitch as collective position changes. The amount of tail rotor pitch change is proportional to airspeed. Maximum mixing occurs from 0 to 40 knots. As airspeed increases above 40 knots, the amount of mixing decreases until 100 knots, after which no mixing occurs.

2-97. Deleted.

2-98. Tail Rotor Control.

The tail rotor control system determines helicopter heading by controlling pitch of the tail rotor blades. Inputs by the pilot or copilot to the control pedals are transmitted through a series of control rods, bellcranks, a mixing unit, control cables and servos to the pitch change beam that changes blade pitch angle. Hydraulic power to the tail rotor servo is supplied from NO. 1 or the backup hydraulic systems.

2-99. Tail Rotor Pedals.

The pedals contain switches that, when pressed, disengage the heading hold feature of FPS below 60 KIAS. Adjustment for pilot leg length is done by pulling a T-handle, on each side of the instrument panel, marked PED ADJ. The pedals are spring-loaded and will move toward the operator when unlocked. Applying pressure to both pedals simultaneously will move the pedals for desired leg position. The handle is then released to lock the pedal adjusted position.

2-100. Flight Control Servo Systems.

The servos are mounted on the upper deck above the cabin area forward of the main gear box in the control access. Three main rotor servos with two independent redundant stages have only the input linkage in common. Should one stage become inoperative due to pressure loss, a bypass valve within the depressurized stage will open, preventing a hydraulic lock. Tail rotor control loads are reacted by a two-stage tail rotor servo mounted on the tail gear box. With the TAIL SERVO switch at NORM, the first stage of this servo is powered by the NO. 1 hydraulic system; the second stage is powered by the backup system when the switch is at BACK-UP. Should the first stage become inoperative, the backup pump will come on and power the second stage. All aerodynamic loads are then reacted by the second stage. Electrical interlocks prevent both flight control servos from being turned off simultaneously. The servo switches marked SVO OFF 1ST STG 2ND STG are on the pilot and copilot collective stick grips (Figure 2-11). If the input pilot valve to the servo becomes jammed, bypass automatically occurs. Automatic bypass is indicated to the pilot by lighting of the associated PRI SERVO PRESS caution light.

2-101. Flight Control Servo Switch.

First and second stage primary servo systems are controlled by the servo switch, marked SVO OFF, on the pilot's and copilot's collective stick grips (Figure 2-11). The marked switch positions are 1ST STG and 2ND STG. The servo systems normally operate with the switch in the unmarked center (on) position. To turn off the first stage primary servos, the SVO OFF switch is placed to 1ST STG. To turn off the second stage servo, the switch is placed to 2ND STG. The systems are interconnected electrically so that regardless of switch position, a system will not shut off unless there is at least 2350 psi in the remaining system. The servo shutoff valve operates on current from the No. 1 and No. 2 dc primary buses through circuit breakers marked SERVO CONTR.

2-102. Flight Control Servo Low-Pressure Caution Lights.

The first, second, and tail rotor stage servo hydraulic low-pressure caution lights are marked #1 PRI SERVO PRESS, #2 PRI SERVO PRESS, and #1 TAIL ROTOR SERVO, and will go on if the pressure is below its respective switch setting, or if the servo pilot valve becomes jammed. The servo switches and warning lights operate on direct current from the No. 1 and No. 2 dc primary buses through circuit breakers, marked NO. 1 SERVO WARN and NO. 2 SERVO WARN, respectively.

2-103. Pilot-Assist Servos.

Pilot assist servos are normally powered by the NO. 2 hydraulic system. If the No. 2 hydraulic pump fails, the pilot assist servos are powered by the backup hydraulic pump. The following units are pilot-assist servos, collective, yaw, and pitch boost servos, which reduce control forces; and three (pitch, roll, yaw) SAS actuators which transfer the output of the SAS controllers into control actuations.

2-104. Boost Servo.

There are three boost servos, collective, yaw, and pitch, installed between the cockpit controls and mixing unit, which reduce cockpit control forces. The collective and yaw boost servos are turned on and off by pressing the button marked BOOST on the AUTO FLIGHT CONTROL switch panel (Figure 2-12). The pitch boost servo is turned on when SAS 1 or SAS 2 is on. The boost shutoff valves receive power from the dc essential bus through a circuit breaker, marked SAS BOOST.

2-105. Pilot-Assist Controls.

An AUTO FLIGHT CONTROL panel (Figure 2-12), in the lower console, contains the controls for operating the pilot-assist servos and actuators. The panel contains SAS 1, SAS 2, BOOST, TRIM FAILURE ADVISORY lights/switches, and FPS switch, to actuate these controls as required. STICK TRIM and TRIM REL switches on the cyclic sticks, are manually operated by either pilot or copilot.

2-106. Automatic Flight Control System (AFCS).

The AFCS enhances the stability and handling qualities of the helicopter. It is comprised of four basic subsystems: Stabilator, Stability Augmentation System (SAS), Trim Systems, and Flight Path Stabilization (FPS). The stabilator system improves flying qualities by positioning the stabilator by means of electromechanical actuators in response to collective, airspeed, pitch rate and lateral acceleration inputs. The stability augmentation system provides short term rate damping in the pitch, roll, and yaw axes. Trim/FPS System provides control positioning and force gradient functions as well as basic autopilot functions with FPS engaged.

2-107. Deleted.

2-108. Stability Augmentation System (SAS).

The SAS enhances dynamic stability in the pitch, roll, and yaw axes. In addition, both SAS1 and SAS2 enhance turn coordination by deriving commands from lateral accelerometers which together with roll rate signals are outputed in their respective yaw channels automatically at airspeeds greater than 60 knots. The SAS1 amplifier circuitry operates on 28 vdc power from the dc essential bus through a circuit breaker marked SAS BOOST providing excitation for the electronic components within the amplifier. AC power from the ac essential bus through a circuit breaker marked SAS AMPL is also required for normal operation of the SAS. The SAS amplifier uses the vertical gyro roll output to derive roll attitude and rate for the roll SAS commands and an ac-powered yaw rate gyro for the yaw SAS commands. Loss of ac power to the vertical gyro or SAS amplifier causes erratic operation of SAS1 due to loss of the reference for the ac demodulators. When this condition is encountered, the pilot must manually disengage SAS1. In case of a malfunction of the SAS2 function, the input will be removed from the actuator and the SAS2 fail advisory light on the AUTO FLIGHT CONTROL panel will go on. If the malfunction is of an intermittent nature the indication can be cleared by simultaneously pressing POWER ON RESET switches. If the malfunction is continuous, the SAS2 should be turned off. With SAS1 or SAS2 off, the control authority of the stability augmentation system is reduced by one-half (5% control authority). Malfunction of the SAS1 system may be detected by the pilot as an erratic motion in the helicopter without a corresponding failure advisory indication. If a malfunction is experienced, SAS1 should be turned off. With SAS1 off, stability augmentation is reduced to about 5%. SAS actuator hydraulic pressure is monitored. In case of loss of actuator pressure, or if both SAS1 and SAS2 are off, the SAS OFF caution light will go on. With SAS off, repeated activation of the trim release system may activate the master caution light. This is not an indication of a failure in the system.

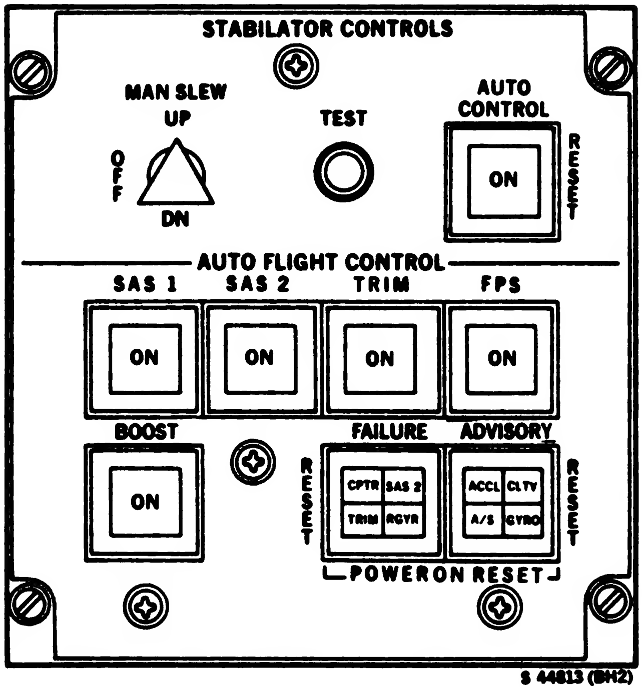


Figure 2-12. Automatic Flight Control System (AFCS) Switch Panel

NOTE

As the vertical gyro comes up to speed or when the system is shutdown, the derived pitch/roll rate signal which feeds SAS1 will cause small oscillations in pitch and roll SAS actuators. This is a temporary situation and can be eliminated by turning SAS1 off.

2-109. Trim System.

When the TRIM is engaged on the AUTO FLIGHT CONTROL panel, the pitch, roll and yaw trim systems are activated to maintain position of the cyclic and tail rotor controls. Proper operation of the yaw trim requires that the BOOST on the AUTO FLIGHT CONTROL panel be on. The tail rotor and lateral cyclic forces are developed in the electromechanical yaw and roll trim actuators. Both yaw and roll trim actuators incorporate slip clutches to allow pilot and copilot control inputs if either actuator should jam. The forces required to break through the clutch are 80-pounds maximum in yaw and 13 pounds maximum in roll. The longitudinal force is developed by an electrohydromechanical actuator operated in conjunction with the SAS/FPS computer. When the pilot applies a longitudinal or lateral force to the cyclic stick with TRIM engaged, a combination detent and gradient force is felt. The pilot may remove the force by pressing the thumb-operated trim release button on the pilot/copilot cyclic grip. The pedal gradient maintains pedal position whenever the trim is engaged. By placing feet on the pedals, the pedal switches are depressed and the gradient force is removed. The pedals may then be moved to the desired position and released. The pedals will be held at this position by the trim gradient. The pedal trim gradient actuator also includes a pedal damper. The pedal damper is engaged continuously, independent of electric power and the TRIM switch on the AUTO FLIGHT CONTROL panel. If a malfunction occurs in the trim system, operation is continuously monitored by the SAS/FPS computer, which shuts off the affected axis, and the TRIM and FLT PATH STAB caution lights will go on if the malfunction is detected. If the malfunction is of an intermittent nature, the indication may be cleared by simultaneously pressing both POWER ON RESET switches. In addition to the trim release button, a four-way trim switch on each cyclic stick establishes a trim position without releasing trim. With TRIM engaged, the trim position is moved in the direction of switch movement. The cyclic is moved by the trim switch in one direction at a time. When FPS is engaged, the trim switch changes the pitch and roll attitude reference instead of the cyclic stick position reference. The trim system release feature permits the pilot or copilot to fly the helicopter with light stick forces. The push-on/push-off TRIM switch on the flight control panel or the TRIM REL switches on the pilot/copilot cyclic grips may be used to release trim. When the switch is ON, the trim system provides gradient and detent holding force for pitch, roll, and yaw. When turned OFF, the trim system is released and light cyclic control forces are present.

2-110. Flight Path Stabilization (FPS).

a. Proper FPS operation requires that the BOOST, TRIM and SAS-1 and/or SAS-2 functions have been selected on the AUTO FLIGHT CONTROL panel. Although not required for proper operation, the FPS performance will be improved by the proper operation of the stabilator in the automatic mode. To use the FPS features, the pilot first assures that BOOST, SAS and TRIM are on and operating, and then turns the FPS switch on. The desired pitch and roll attitude of the helicopter may be established in one of these ways:

(1) Pressing the trim switch to slew the reference attitude to the desired attitude.

(2) Pressing the TRIM REL button on the pilot/copilot cyclic grip, manually flying the helicopter to the desired trim condition, and releasing the TRIM REL button.

(3) Overriding the stick trim forces to establish the desired trim condition, and then neutralizing stick forces by means of the trim switch.

b. The trim attitude, once established, will be automatically held until changed by the pilot. At airspeeds greater than 60 knots, the pitch axis seeks to maintain the airspeed at which the trim is established, by variation of pitch attitude. When pitch attitude is changed by means of the trim switch, there is a delay from the time that the trim switch input is removed until the new reference airspeed is acquired. This is to allow time for the helicopter to accelerate or decelerate to the new trim speed. The yaw axis of the FPS provides heading hold at airspeeds less than 60 knots and heading hold or turn coordination at airspeeds greater than 60 knots. For heading hold operation at airspeeds less than 60 knots, the helicopter is maneuvered to the desired heading with feet on pedals. When trimmed at the desired heading, the pilot may remove feet from pedals, at which time the existing heading becomes the reference, which is automatically held. To change heading, the pilot may activate one or both pedal switches, trim up on the desired heading and remove feet from pedals. At airspeeds greater than 60 knots, heading hold will be automatically disengaged, and coordinated turn engaged under these conditions:

(1) TRIM switch is actuated in the lateral direction.

(2) TRIM REL switch is pressed and roll attitude is greater than prescribed limits.

(3) About 1/2 inch cyclic displacement and a roll attitude of about 1.5°. Heading hold is automatically reengaged and turn coordination disengaged upon recovery from the turn when the lateral stick force, roll attitude, and yaw rate are within prescribed limits.

c. To make a coordinated turn, the pilot enters a turn in one of these ways:

(1) Changing reference roll attitude by pressing the TRIM switch in the desired lateral direction.

(2) Pressing TRIM REL on the cyclic grip and establishing the desired bank angle with feet off pedal switches.

(3) Exerting a lateral force on the cyclic stick to achieve the desired bank angle, and then neutralizing the force with the trim switch.

(4) Keeping a lateral force on the cyclic stick for the duration of the turn.

d. In each of these ways the ball should remain automatically centered during the entry and recovery from the turn. If feet are on the pedals, care must be taken not to apply too much force to the pedals to oppose their motion. If the pilot intentionally miscoordinates the helicopter, the result will be a pedal force roughly proportional to sideslip. The pilot may release the pedal force by pressing the cyclic TRIM REL button with feet on pedals. During transition through 60 knots airspeed, the pilot may feel a slight pedal motion due to a switching transient which may occur when the commanded coordinated turn pedal position differs slightly from the pilot-commanded position. The FPS monitoring is automatic. If a malfunction is detected, the FPS FAIL caution light will go on and the FPS will either continue to operate in a degraded mode, such as without heading hold, or without airspeed hold; or may cease to function altogether. The pilot must take over manual flight of the helicopter, and may either turn the FPS off or evaluate performance to determine the degree and type of degradation, and continue flight with the remaining features. To help evaluate the nature of the degradation, eight failure advisory indicators are displayed on the flight control panel. These tell the pilot the type of sensor or actuator which has experienced the failure. If a light goes on, it may be turned off by pressing the lighted switch. All failure advisory lights will be on at initial application of power. The pilot may attempt to clear the indication of temporary malfunction by simultaneously pressing both POWER ON RESET and FAILURE RESET switches. If the FPS FAIL caution light goes off, if may be assumed that normal operation is restored. All FPS functions are provided by automatically moving the cockpit controls.

2-111. Stabilator System.

NOTE

Stabilator amplifiers utilize filters which will result in the stabilator amplifier sensing zero airspeed for 1.5 - 2 seconds following restoration of aircraft power. This may also occur during the brief power interruption experienced when switching from Main to APU generators. During this time the stabilator will drive trailing edge down. After this time the stabilator will drive to the appropriate angle.

a. The helicopter has a variable angle of incidence stabilator to enhance handling qualities. The automatic mode of operation positions the stabilator to the best angle of attack for the existing flight conditions. After the pilot engages the automatic mode, no further pilot action is required for stabilator operation. Two stabilator amplifiers receive airspeed, collective stick position, pitch rate, and lateral acceleration information to program the stabilator through the dual electric actuators. The stabilator is programmed to:

(1) Align stabilator and main rotor downwash in low speed flight to minimize nose-up attitude resulting from downwash.

(2) Decrease angle of incidence with increased airspeed to improve static stability.

(3) Provide collective coupling to minimize pitch attitude excursions due to collective inputs from the pilot. Collective position sensors detect pilot collective displacement and programs the stabilator a corresponding amount to counteract the pitch changes. The coupling of stabilator position to collective displacement is automatically phased in beginning at 30 KIAS.

(4) Provide pitch rate feedback to improve dynamic stability. The rate of pitch attitude change of the helicopter is sensed by a pitch rate gyro in each of the two stabilator amplifiers and used to position the stabilator to help dampen pitch excursions during gusty wind conditions. A sudden pitch up due to gusts would cause the stabilator to be programmed trailing edge down a small amount to induce a nose-down pitch to dampen the initial reaction.

(5) Provide sideslip to pitch coupling to reduce susceptibility to gusts. When the helicopter is out of trim in a slip or skid, pitch excursions are also induced as a result of the canted tail rotor. Lateral accelerometers sense this out of trim condition and signal the stabilator amplifiers to compensate for the pitch attitude change (called sideslip to pitch coupling). Nose left (right slip) results in the trailing edge programming down. Nose right produces the opposite stabilator reaction.

b. The above features are provided via inputs to dual electric actuators which position the stabilator. Failure of one actuator will restrict total maximum movement of the stabilator to about 35° if failure occurs full DN, or about 30° if failure occurs full up. The stabilator electrical screw actuators receive power from the dc essential bus and No. 2 dc primary bus through circuit breakers marked STAB PWR. Since the dc essential bus is powered by the battery, it is possible to manually slew one of the two actuators using battery power only. If the stabilator is slewed UP using battery power, it must be manually slewed back down using battery power to get a normal engagement of the automatic mode. Otherwise, when only one actuator is slewed, it causes a very large mismatch between the two actuator positions. This is detected by the fault monitor and shuts down the automatic mode upon attempted engagement. Automatic control function sensors, airspeed sensors, pitch rate gyros, collective position sensor, and lateral accelerometer receive power from the ac essential bus and No. 2 ac primary bus through circuit breakers marked STAB CONTR.

2-112. Stabilator Control Panel.

The stabilator control panel (Figure 2-7), on the lower console, provides electrical control of the stabilator system. The panel contains a MAN SLEW switch, a TEST button, and AUTO CONTROL switch with a push-to-reset feature. The automatic mode will allow the stabilator to be automatically operated from about 39° trailing edge down to 9° trailing edge up. Manual operation is also restricted to these limits. If a malfunction occurs in the automatic mode, the system will switch to manual, ON will go off in the AUTO CONTROL window, and the STABILATOR caution and MASTER CAUTION lights will go on and a beeping tone will be heard in the pilot's and copilot's headphones. It may be possible to regain the auto mode by pressing the AUTO CONTROL RESET. If the automatic mode is regained, ON will appear in the AUTO CONTROL switch window and the caution lights will go off. The stabilator automatic mode is held in the energized state within the stabilator control amplifier. On certain occasions during interruption of dc power, such as switching of generators, it is possible to have conditions where the stabilator automatic mode may shut down. If the automatic mode shuts down during flight because of an ac power failure, the helicopter shall be slowed to 80 KIAS before power is restored. In this case the STABILATOR AUTO CONTROL switch may be pressed to re-engage the auto mode. The copilot's STAB POS indicator may vary from the pilot's indicator as much as 2°. If the automatic mode is not regained, the MASTER CAUTION must be reset, which turns off the beeping tone, and the stabilator controlled throughout its range with the MAN SLEW switch. When initial power is applied to the stabilator system, it will be in automatic mode. The TEST switch is used to check the AUTO mode fault detector feature and is inoperative above 60 KIAS. When pressed, control of the stabilator should go to the manual mode.

2-113. Stabilator Position Indicator.

Two STAB POS indicators (Figure 2-8) are on the instrument panel. They give the pilot and copilot a remote indication of stabilator position. In AUTO CONTROL mode during airspeed acceleration, the stabilator indicator should begin moving at 30 KIAS, and should be passing through 25° at 60 KIAS. During airspeed deceleration, the stabilator will start moving DN at 80 KIAS, and should be about 39° by 30 KIAS and should continue automatic adjustment throughout the flight. The indicator range is marked from 45° DN to 10° up. The stabilator position indicator system is powered from the ac essential bus 26V through a circuit breaker marked STAB IND.

2-113.1. Cyclic-Mounted Stabilator Slew Up Switch.

Installed on each cyclic stick below the grip (Figure 2-11) is a pull-type stabilator manual slew up switch. The switch provides the pilot and copilot with rapid accessibility to stabilator slew up. The cyclic slew switch is wired in parallel with the stabilator panel MAN SLEW-UP switch position. When the switch is actuated, the stabilator trailing edge will begin to move up and continue until the up limit stop is reached or the switch is released.

Section VI HYDRAULIC AND PNEUMATIC SYSTEM

2-114. Hydraulic System.

The three hydraulic systems are designed to provide full flight control pressure. The components of the hydraulic systems are three hydraulic pump modules, two transfer modules, a utility module, three dual primary servos, one dual tail rotor servo, four pilot-assist servos, an APU accumulator, an APU handpump, and a servicing handpump. There are three hydraulic pressure supply systems, number 1, number 2, and backup. All are completely independent and each is fully capable of providing essential flight control pressure for maximum system redundancy. Complete redundancy is accomplished by the backup pump providing hydraulic power to both number 1 and/or number 2 systems if one or both pumps fail. If two systems lose pressure, there will be a slight restriction in the maximum rate of flight control movement due to only one pump supplying both stages with hydraulic power. An automatic turnoff feature is provided. When the SVO OFF switch (Figure 2-11) is moved to 1ST STG or 2ND STG position, that stage of the primary servos is turned off. When the SVO OFF switch (Figure 2-11) is moved to 1ST STG, the first stage of the primary servos is turned off. A malfunction in the second stage will cause first stage (which was turned off) to automatically turn back on in case the backup system does not take over the function of the failed second stage. If the second stage is initially turned off, the sequence is reversed. An additional hydraulic handpump is provided for APU start system.

NOTE

The following listed caution lights may momentarily flicker when the applicable listed switch is activated; this is considered normal.

SUBSYSTEM	CAUTION LIGHT
SAS 1 or SAS 2 switch on	#2 PRI SERVO PRESS #2 HYD PUMP BOOST SERVO OFF
SAS/BOOST HYD switch on	#2 PRI SERVO PRESS #2 HYD PUMP SAS OFF
TAIL SERVO switch BACKUP	#1 PRI SERVO PRESS #1 HYD PUMP
HYD LEAK TEST switch NORM after RESET	#1 and #2 PRI SERVO PRESS #1 and #2 HYD PUMP

2-115. Hydraulic Pump Modules.

The hydraulic pump modules are combination hydraulic pumps and reservoirs. The No. 1, No. 2, and backup pump modules are identical and interchangeable with each other. The No. 1 pump module is mounted on and driven by the left accessory module of the main transmission. The No. 2 pump module is mounted on and driven by the right accessory transmission module. The backup pump module is mounted on and driven by an ac electric motor. The reservoir part of each pump module has a level indicator window marked EMPTY, REFILL, and FULL. A pressure relief and bleed valve protects the pump from high pressure in the return system. The pump has two filters: a pressure filter and a return filter. A red indicator button on each filter will pop out when pressure goes up 70 ± 10 psi above normal. The pressure filter has no bypass. The return filter has a bypass valve that opens when return pressure reaches 100 ± 10 psi. Each pump has three check valves: one at the external ground coupling, one at the pressure side, and one at the return side. A fluid quantity switch, mounted on top of each pump module, senses fluid loss for that system. When the piston in the pump module moves down to the REFILL mark, the piston closes the switch, turning on a caution light marked RSVR LOW. A depressurization valve in the backup pump module allows the motor to get up to rated speed before a load is applied. When the backup pump motor is turned on, the depressurization valve in the backup pump module destrokes the output pressure of the pump to 700 psi. A half-second after the pump motor is started the valve closes, allowing the pump to develop 3000 psi output pressure. Each hydraulic pump has two temperature sensitive labels mounted on the side. When a temperature level is reached a circle turns black. There are two types of labels used on the pumps. When a maximum temperature level is exceeded an entry shall be made on DA Form 2408-13. The aircraft should not be flown until appropriate maintenance action has been taken.

2-116. Number 1 Hydraulic System.

Number 1 hydraulic system operates with the rotor turning, and supplies the first stage of all primary servos and the first stage of the tail rotor servo. The system components are an integrated pump module, a transfer module, first stage primary servos, and first stage tail rotor servo. The primary servos are controlled by the SVO OFF switch (Figure 2-11). The switch can turn off either first or second stage of the primary servos but not both at the same time. First stage tail rotor servo can be manually turned off by a two-position switch marked TAIL SERVO, on the miscellaneous switch panel (Figure 2-7). If the fluid quantity of the number one pump reservoir becomes low, a microswitch will complete an electrical circuit to close the first stage tail rotor servovalve. If fluid continues to be lost and the #1 HYD PUMP caution light goes on, the first stage tail rotor shutoff valve will open, allowing backup pressure to supply first stage tail rotor. The logic modules automatically control the hydraulic system. The tail rotor servo is a two-stage servo but, unlike the primary servos, only one stage is pressurized at a time.

2-117. Number 2 Hydraulic System.

The number 2 hydraulic system, which also operates with the rotor turning, supplies the second stage primary servo and the pilot-assist servos. System components are the integrated pump module, transfer module, second stage primary servos, and pilot-assist modules. Second stage primary servos can be manually turned off by the SVO OFF switch. The pilot-assist servos cannot be turned off collectively, but SAS TRIM and BOOST servos can be manually turned off by switches on the AUTO FLIGHT CONTROL panel. If fluid quantity of the number 2 pump reservoir becomes low, the pilot-assist servo becomes inoperative. If fluid continues to be lost, the #2 HYD PUMP caution light will go on.

2-118. Backup Hydraulic System.

CAUTION

Whenever the No. 1 ac generator is inoperative (failed, or not on line) and the BACKUP PUMP PWR circuit breaker is out for any reason, ac electrical power must be shut off before resetting BACKUP PUMP PWR circuit breaker. Otherwise, it is possible to damage the current limiters.

The backup hydraulic pump system supplies emergency pressure to the number 1 and/or number 2 hydraulic systems whenever a pressure loss occurs. It also supplies pressure to the number 2 stage of the tail rotor servo in case of a loss of pressure in the first stage of the tail rotor servo or #1 RSVR low indication. This system supplies hydraulic pressure to all flight control components during ground checkout. The backup system also provides a hydraulic pressure for automatic recharging of the APU start system accumulator. The backup hydraulic system pump module is driven by an electric motor which can be powered by any adequate three-phase ac power source. An internal depressurizing valve in the backup pump module reduces the output pressure of the pump upon startup of the electric motor. This valve unloads the electric motor by reducing torque requirement at low rpm. After about 0.5 second when main generator is operating, or 4 seconds when operating from APU generator or external power, the valve is closed and 3000 psi pressure is supplied to the hydraulic system. This sequence reduces the current demand during backup system start-up. Pressure sensing switches in the number 1 and number 2 transfer modules constantly monitor the pressure output of the number 1 and number 2 pumps. Loss of pressure initiates the backup operation. The system then provides emergency pressure to maintain full flight control capability. A WOW switch on the left main landing gear provides automatic operation of the backup pump when the helicopter is in the air, regardless of BACKUP HYD PUMP switch position, and disables the backup pump thermal switch. A pressure sensing switch at the tail rotor monitors supply pressure to the first stage tail rotor servo. The backup pump can supply pressure to the first stage tail rotor servo if the number 1 pump loses pressure. This gives the pilot a backup tail rotor servo even with the loss of the primary hydraulic supply, or #1 HYD RSVR LOW. If a leak in a primary servo system depletes the backup system fluid, the backup reservoir level sensing switch will turn on the BACKUP RSVR LOW caution light, and the pilot must manually turn off the leaking primary system.

2-119. Transfer Modules.

The No. 1 and No. 2 transfer modules connect hydraulic pressure from the pump modules to the flight control servos. Each module is an integrated assembly of shutoff valves, pressure switches, check valves, and restrictor. The modules are interchangeable.

2-120. Hydraulic Leak Detection/Isolation System.

The leak detection/isolation (LDI) system protects the flight control hydraulic system by preventing loss of hydraulic fluid. The LDI system uses pressure switches and fluid level sensors for monitoring pump hydraulic fluid level, and pump pressure for primary and tail rotor servos, and pilot-assist servos. When a pump module reservoir fluid level switch detects a fluid loss, the logic module operates the required shutoff valve(s) to isolate the leak and turns on the backup pump. In the cockpit the RSVR LOW caution light for that system lights. Backup pump and shutoff valve(s) operation is automatic through the logic module. If the leak continues, the SVO OFF switch must be moved to the appropriate off position. By placing the HYD LEAK TEST switch to TEST, all leak detection/isolation system components are checked electrically. After a leak test has been made, the HYD LEAK TEST switch must be moved to RESET momentarily, to turn off caution and advisory lights that were on during the test. The BACKUP PUMP ON advisory light will remain on for about 90 seconds. Refer to Chapter 8 Section II for test procedure. Except for the HYD LEAK TEST switch, the hydraulic leak system consists of components of 1st stage, 2nd stage and backup hydraulic systems. A WOW switch contact prevents hydraulic leak tests from being made in flight. Power to operate the hydraulic leak test system is from the No. 2 dc primary bus through a circuit breaker, marked No. 2 SERVO CONTR under the general heading No. 2 and dc essential bus through a circuit breaker, marked BACKUP HYD CONTR.

2-121. No. 1 Transfer Module.

This module has a transfer valve, a pressure switch, a 1st stage primary shutoff valve, a 1st stage tail rotor shutoff valve, a restrictor, and check valves. The transfer valve is spring-loaded to the open or normal position. If 1st stage hydraulic pressure is lost, the valve automatically transfers backup pump pressure to the 1st stage system. The 1st stage primary shutoff valve lets the pilot or copilot shut off 1st stage pressure to the primary servos and prevents both stages from being shut off at the same time. The pressure switch lights the #1 HYD PUMP light on the caution advisory panel when pressure drops to 2000 psi and also sends a signal to a logic module that pressure is lost in the 1st stage hydraulic system. The restrictor allows fluid to circulate for cooling under no-flow conditions. If a fluid leak develops past the transfer module, the check valves prevent fluid loss on the return side of the transfer module.

2-122. No. 2 Transfer Module.

The No. 2 transfer module is like the No. 1 module except that it supplies 2nd stage pressure. The pilot assist shutoff valve turns off pressure to the pilot assist module. The 2nd stage primary servo shutoff valve turns off pressure to the 2nd stage of the primary servos. The pressure switch turns on the #2 HYD PUMP caution light on the caution/advisory panel when 2nd stage system pressure is below 2000 psi, and also sends a signal to a logic module that pressure is lost in the 2nd stage system.

2-123. Utility Module.

The utility module connects hydraulic pressure from the backup pump to the No. 1 and No. 2 transfer modules, the 2nd stage of the tail rotor servo, and the APU accumulator. A pressure switch on the module senses the backup pump operating and turns on the BACK-UP PUMP ON advisory light on the caution advisory panel. If the flow rate through the module to the APU accumulator goes over 1-1/2 gpm, a velocity fuse shuts off flow.

2-124. Logic Modules.

Two logic modules, one in the left relay panel and the other in the right relay panel, are used to control the operation of the hydraulic systems. The logic modules continually monitor the operation of the hydraulic systems by inputs received from pressure switches, fluid level switches on the pump modules, and inputs received from control switches in the hydraulic system. The outputs of the logic modules will either turn on lights on the caution/advisory panel notifying the pilot of a failure, and/or turn off one or more valves due to a system malfunction. All switching functions of the hydraulic logic modules are automatic, except as shown by a dagger (†) which indicates crewmember action (Figure 2-13).

2-125. Reservoir Fill System.

A handpump and manual selector valve are on the right side upper deck of the helicopter for system servicing. Refer to Figure 2-26 for servicing. The three

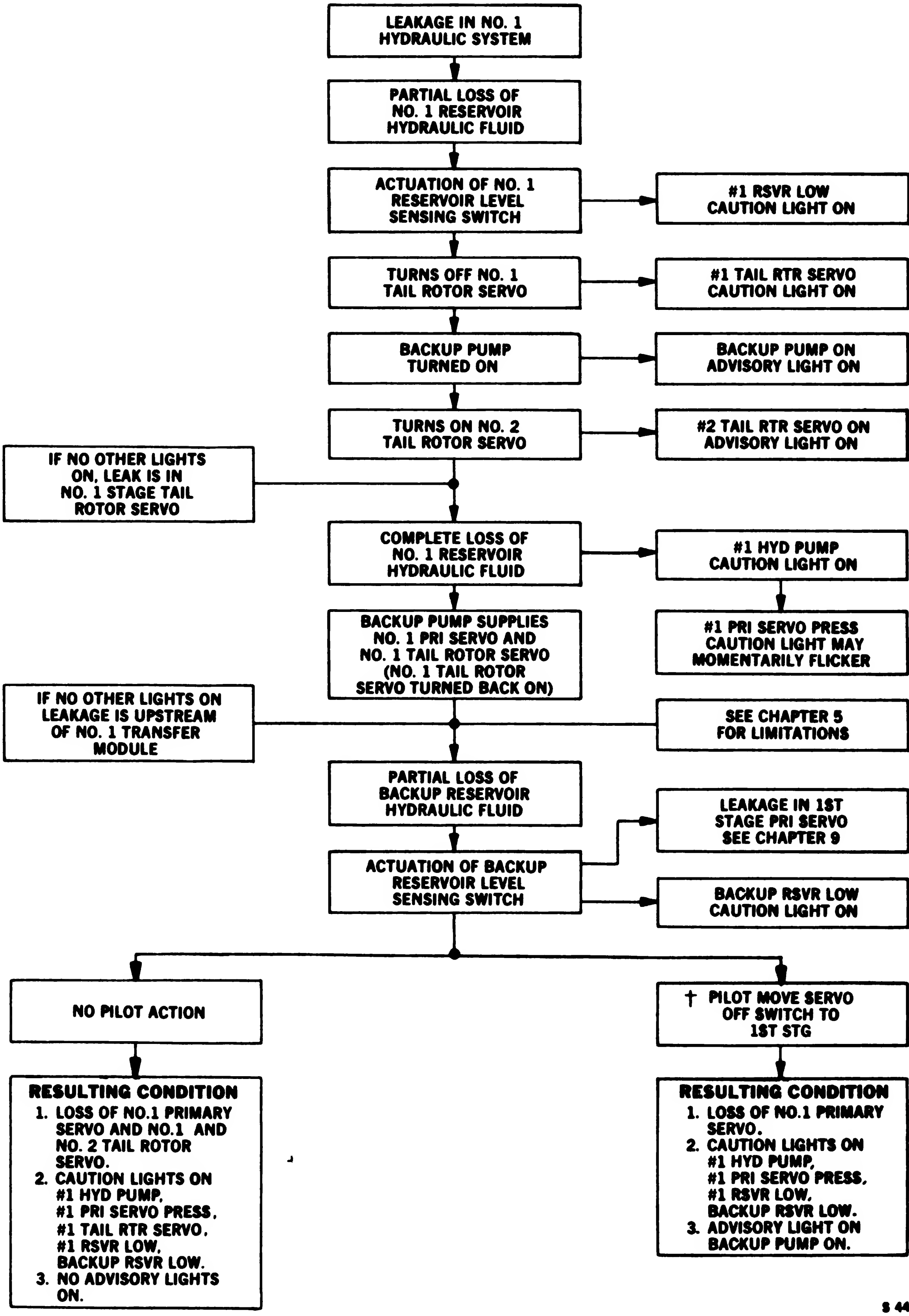


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Figure 2-13. Hydraulic Logic Module Operation Principle (Sheet 1 of 2)

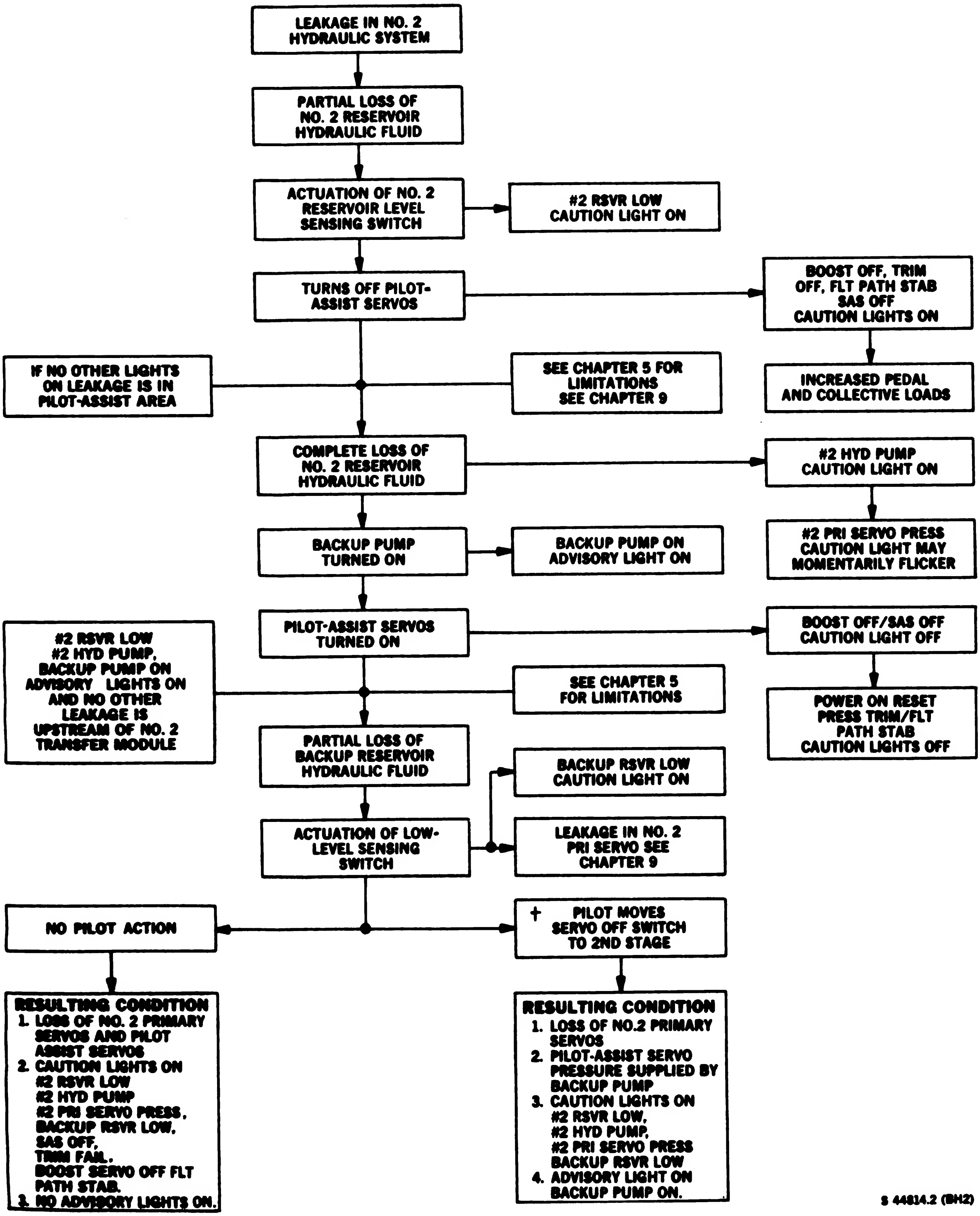


Figure 2-13. Hydraulic Logic Module Operation Principle (Sheet 2 of 2)

hydraulic system reservoir levels can be seen from the fill pump location. The handpump reservoir contains a sight gage above the handpump crank. A 1-quart level mark indicates a requirement for refill. Refer to Section XV this chapter for servicing.

2-126. Pneumatic Subsystem.

A pneumatic subsystem operating from bleed-air furnished by the main engines, the APU, or an external pneumatic power source, is used to drive the main engine starter, for heating system operation and external extended range tank fuel transfer. Bleed-air from the main engines is used for engine inlet anti-icing subsystem operation. The heating subsystem and the extended range fuel tanks uses bleed-air supplied by the main engines during flight, and on the ground by the main engines, APU, or external source. The subsystem contains check valves at each bleed-air source, and a shutoff valve at each main engine.

Section VII POWERTRAIN SYSTEM

2-127. Powertrain.

The powertrain consists of inputs from two engines, a main transmission, intermediate gear box, tail gear box and connecting drive shafting. Power from the engines is transmitted to the main transmission module through input modules. The main transmission is mounted on top of the cabin between the two engines (Figure 2-1). It mounts and powers the main rotor head, changes the angle of drive from the engines, reduces rpm from the engines, powers the tail rotor drive shaft and drives the accessory module. The main transmission consists of five modules: two input modules; the main module; and two accessory modules. The main transmission has a built-in 3° forward tilt.

2-128. Input Module.

The input modules are mounted on the left and right front of the main module and support the front of the engines. They contain an input bevel pinion and gear, and a freewheel unit. The freewheel unit allows engine disengagement during autorotation, or in case of a nonoperating engine, the accessory module will continue to be driven by the main rotor. The input module provides the first gear reduction between engine and main module.

2-129. Accessory Module.

One accessory module is mounted on the forward section of each input module. Each accessory module provides mounting and drive for an electrical generator and a hydraulic pump package. A rotor speed sensor is mounted on the right accessory module and provides signals for the VIDS. An additional rotor speed sensor is mounted on the left accessory module which provides input signals to the DEC for improved transient droop response. UH-60L

2-130. The Main Module.

The main module contains the necessary gearing to drive the main rotor and tail rotor systems. It provides a reduction in speed from the input module to the main module and the tail drive shaft.

2-131. Main Transmission Lubrication System.

UH-60A

EH

CAUTION

Prolonged nose-down attitudes of 5 degrees or more may cause high main transmission oil temperature.

The transmission incorporates an integral wet sump lubrication system that provides cooled, filtered oil to all bearing and gears. The ac generators on the accessory modules also receive oil for cooling. Oil under pressure is supplied through internally cored oil lines, except for the pressure and return lines of the oil cooler. Refer to servicing diagram for oil specification and servicing (Table 2-2). The lubrication system includes two lubrication pumps that are combination pressure and scavenge types operating in parallel. The main transmission may run at cruise flight for 30 minutes with loss of all oil. Main transmission oil pressure may fluctuate when the aircraft is known to be in a nose-up attitude (i.e., slope landings or hover with an extreme aft C.G.). Pressure regulating and bypass valves protect the lube system by returning excess high pressure oil back to the inlet side of the pump. A two-stage oil filter and various strainers in the sump prevent contamination. The oil filter has a visual impending bypass indicator (red button) that protrudes when the first stage filter becomes contaminated. When the button pops the filter element must be replaced to reset. A thermal lockout prevents button popping when oil is cold and thick. The oil cooler uses a blower driven by the tail rotor drive shaft to cool oil before it enters the various modules. The oil cooler has a thermostatic bypass valve that directs oil flow around the cooler when the oil temperature is below 71° ± 1°C. Other warning and monitoring systems are on the main transmission: MAIN XMSN OIL TEMP and PRESS caution lights, and XMSN TEMP and PRESS oil temperature gages. An oil pressure switch on the left accessory module, the farthest point from the pumps, causes the MAIN XMSN OIL PRESS caution light to go on when the pressure drops to 14 ± 2 psi. The transmission oil temperature warning system is triggered by an oil temperature sensor at the oil cooler input to the main module, near the tail takeoff drive shaft flange. A caution light, MAIN XMSN OIL TEMP goes on when transmission oil temperature reaches 120°C. Temperature for the gage is sensed between the sump and the pump. Pressure readings are taken at the main module manifold. Electrical power for the warning systems, except chip detection, is from the No. 2 dc primary bus, through the MAIN XMSN circuit breaker on the overhead circuit breaker panel.

2-132. Transmission Oil Temperature Indicator.

The transmission oil temperature indicator marked XMSN TEMP is a part of the central display unit (Figure 2-8). Refer to Chapter 5 for limitations. Power to operate the temperature indicator and MAIN XMSN OIL TEMP caution light is provided from the No. 1 and No. 2 ac primary buses through the signal data converters and the No. 2 dc primary bus through a circuit breaker, marked MAIN XMSN.

2-133. Transmission Oil Pressure Indicator.

The transmission oil pressure indicator, marked XMSN PRESS is a part of the central display unit (Figure 2-8). Refer to Chapter 5 for limitations. Power to operate the pressure indicator and MAIN XMSN OIL PRESS caution light is provided from the No. 1 and No. 2 ac primary buses through the signal data converter and No. 2 dc primary bus through a circuit breaker, marked MAIN XMSN.

2-134. Chip Detector/Fuzz Burn-Off System.

The chip detectors are connected to a 30 second time delay relay which will energize when a chip has been present for approximately 30 seconds. The 30-second time delay relay ensures that a warning is not given for transient conditions or due to normal wear particles that could wash away or burn off. Fuzz burn-off feature will be deactivated when the oil temperature reaches 140°C. However, magnetic detection will remain to turn on the CHIP caution light(s).

2-135. Transmission Chip Detector System.

The transmission chip detector system consists of fuzz suppression chip detectors on the left and right input, left and right accessory modules, and the main gear box module, and caution lights marked CHIP INPUT MDL-LH, CHIP INPUT MDL-RH, CHIP ACCESS MDL-LH, CHIP ACCESS MDL-RH or CHIP MAIN MDL SUMP. Five chip detectors provide warning of chips in any of five areas of the main transmission system. Detectors in each module are wired in parallel to constantly monitor for metal contamination. Each chip detector incorporates a self-sealing provision so that it can be removed for visual inspection without loss of oil. A fuzz burn-off feature eliminates false warning due to fuzz and small particles. When a chip is detected and will not burn off, the metal particle triggers the detection system and a caution light will go on. The magnetic plugs of the chip detector system will attract ferrous metal chips at any of the detector locations. A chip caution light will light whenever a particle is detected. The pilot or maintenance personnel must check the caution/advisory panel before removing power, to determine the location of the chip. On some helicopters, should the particle be washed from the detector, a holding circuit will keep the caution light on until power is removed. The chip detector for the main module sump rests in the lowest point of the oil system. The system is powered by the dc essential bus through a circuit breaker on the upper console circuit breaker marked CHIP DET.

2-136. Tail Drive System.

Six sections of drive shaft connect the main module to the tail rotor gear box. The shafts drive the oil cooler blower and transmit torque to the tail rotor. Each shaft is dynamically balanced tubular aluminum. Multiple disc (flexible) couplings between sections eliminate universal joints. The shafts are ballistically tolerant if hit by a projectile and are suspended at four points in viscous-damped bearings mounted in adjustable plates and bolted to fuselage support brackets.

2-137. Intermediate Gear Box.

Mounted at the base of the pylon is the oil-lubricated intermediate gear box (Figure 2-1). It transmits torque and reduces shaft speed from the main gear box to the tail gear box. The intermediate gear box may run at cruise flight for 30 minutes, with loss of all oil. An internal metal fuzz suppression chip/temperature sensor detects metal particles and gear box overtemperature conditions, to light caution panel lights marked CHIP INT XMSN and INT XMSN OIL TEMP.

2-138. Tail Gear Box.

The oil-lubricated tail gear box (Figure 2-1) at the top of the tail pylon transmits torque to the tail rotor head. The gear box mounts the tail rotor, changes angle of drive and gives a gear reduction. It also enables pitch changes of the tail rotor blades through the flight control system. The gear box housing is magnesium. The tail gear box may run at cruise flight for 30 minutes with loss of all oil. An internal fuzz suppression metal chip/temperature sensor detects metal particles and gear box overtemperature conditions, to light caution panel lights, marked CHIP TAIL XMSN and TAIL XMSN OIL TEMP.

2-139. Intermediate and Tail Gear Box Chip/Temperature Systems.

The intermediate and tail gear boxes contain identical chip/temperature sensors that indicate in the cockpit when the gear box temperature is too high, or a chip is present. The chip detectors incorporate a fuzz burn-off feature which eliminates false warning due to fuzz and small particles. When a chip is detected and will not burn off, a caution light on the caution/advisory panel will go on, indicating CHIP INT XMSN or CHIP TAIL XMSN. Power to operate the chip system is provided from the dc essential bus through a circuit breaker marked CHIP DET. The oil temperature sensor is a bimetal strip that reacts to temperatures. When the oil temperature reaches 140°C a switch closes to turn on a caution capsule in the cockpit, marked INT XMSN OIL TEMP or TAIL XMSN OIL TEMP. Power to operate the oil temperature system is from the No. 2 dc primary bus through a circuit breaker marked MAIN XMSN.

Section VIII MAIN AND TAIL ROTOR GROUPS

2-140. Rotor Systems.

The rotor system consists of a main rotor and tail rotor. Both systems are driven by the engines through the transmission system, with pitch controlled by the flight control system.

2-141. Main Rotor System.

The main rotor system consists of four subsystems: main rotor blades, hub, flight controls and the bifilar vibration absorber. Four titanium-spar main rotor blades attach to spindles which are retained by elastomeric bearings contained in one-piece titanium hub. The elastomeric bearing permits the blade to flap, lead and lag. Lag motion is controlled by hydraulic dampers and blade pitch is controlled through adjustable control rods which are moved by the swashplate. When the rotor is not turning, the blades and spindles rest on hub mounted droop stops. Upper restraints called antiflapping stops retain flapping motion caused by the wind. Both stops engage as the rotor slows down during engine shutdown. Blade retaining pins can be pulled from the blade spindle joint and the blades folded along the rear of the fuselage. The bifilar vibration absorber reduces rotor vibration at the rotor. The absorber is mounted on top of the hub and consists of a four arm plate with attached weights. Main rotor dampers are installed between each of the main rotor spindles modules and the hub to restrain hunting (lead and lag motions) of the main rotor blades during rotation and to absorb rotor head starting loads. Each damper is supplied with pressurized hydraulic fluid from a reservoir mounted on the side of each damper. The reservoir has an indicator that monitors the reserve fluid. When the damper is fully serviced, the indicator will show full gold.

2-142. Main Rotor Blades.

Four main rotor blades use a titanium spar for their main structural member. The structure aft of the spar consists of fiberglass skin, Nomex honeycomb filler and a graphite/fiberglass trailing edge. The leading edge of each blade has a titanium abrasion strip, the outboard portion of which is protected by a replaceable nickel strip. Electro-thermal blankets are bonded into the blades leading edge for deicing. A Blade Inspection Method (BIM®) indicator (Figure 2-14), is installed on each blade at the root end trailing edge to visually indicate when blade spar structural integrity is degraded. If a spar crack occurs, or a seal leaks, nitrogen will escape from the spar. When the pressure drops below minimum the indicator will show red bands. A manual test lever is installed on each BIM indicator to provide a maintenance check. The blades are

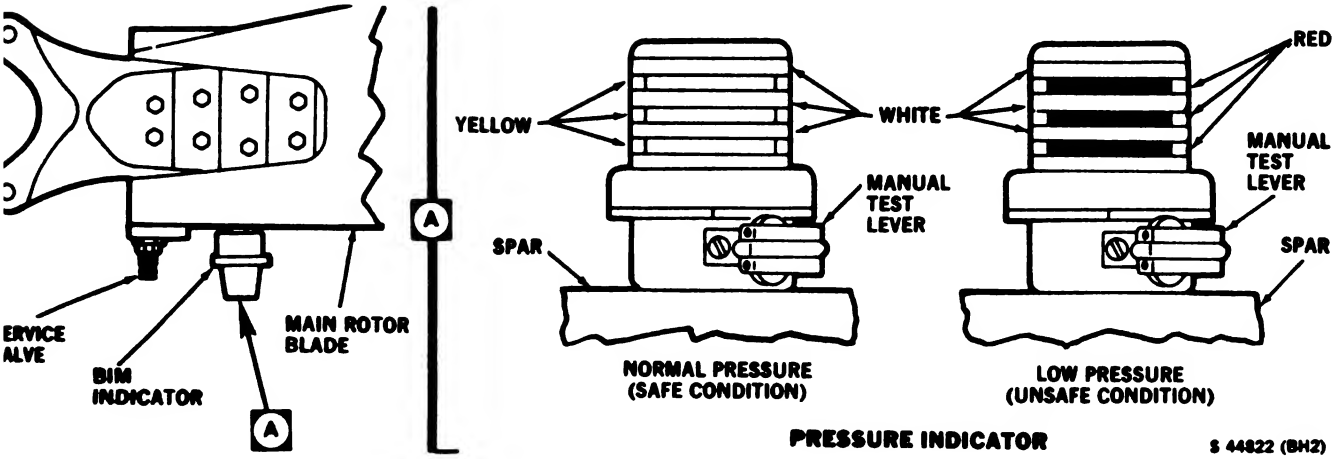


Figure 2-14. Main Rotor Blade and BIM System

attached to the rotor head by two quick-release expandable pins, that require no tools to either remove or install. To conserve space, all blades can be folded to the rear and downward along the tail cone. When mooring, the blades can be tied down with a fitting on the bottom of each blade.

2-143. Main Rotor Gust Lock.

The gust lock prevents the blades from rotating when the helicopter is parked. The gust lock is designed to withstand torque from one engine at IDLE, and thus allow engine maintenance checks independent of drive train rotation. The locking system consists of a locking handle at the rear of the cabin (Figure 2-5) a GUST LOCK caution light on the caution/advisory panel (Figure 2-8), a locking device and teeth on the tail rotor takeoff flange of the main transmission. The lock shall only be applied when the rotor system is stationary; it can only be released when both engines are shut down. The No. 1 dc primary bus powers the warning light through a circuit breaker marked, LIGHTS ADVSY.

2-144. Tail Rotor System.

A cross-beam tail rotor blade system provides anti-torque action and directional control. The blades are of graphite and fiberglass construction. Blade flap and pitch change motion is provided by deflection of the flexible graphite fiber spar. This feature eliminates all bearings and lubrication. The spar is a continuous member running from the tip of one blade to the tip of the opposite blade. Electro-thermal blankets are bonded into the blade leading edge for deicing. The tail rotor head and blades are installed on the right side of the tail pylon, canted 20° upward. In addition to providing directional control and anti-torque reaction, the tail rotor provides 2.5% of the total lifting force in a hover. A spring-loaded feature of the tail rotor control system will provide a setting of the tail rotor blades to about 7.5° (left pedal) for balance flight at cruise power setting in case of complete loss of tail rotor control.

2-145. Tail Rotor Quadrant/Warning.

The tail rotor quadrant contains microswitches to turn on a caution light marked TAIL ROTOR QUADRANT if a tail rotor cable becomes severed. Spring tension allows the quadrant to operate in a normal manner. Electrical power to operate the warning system is provided from No. 1 dc primary bus through a circuit breaker marked T RTR SERVO WARN.

Section IX UTILITY SYSTEMS

2-146. Windshield Wipers.

Two electrically-operated windshield wipers are installed, one on the pilot's windshield and one on the copilot's windshield (Figure 2-1). Both wiper arms are driven by a common motor through flexible drives and converters. Power to operate the windshield wiper system is from No. 1 ac primary bus through a circuit breaker, marked WSHLD WIPER.

2-147. Windshield Wiper Control.

CAUTION

To prevent possible damage to windshield surface, do not operate windshield wipers on a dry windshield.

Control of the windshield wipers is through a spring-loaded rotary switch on the upper console (Figure 2-6). The switch is labeled WINDSHIELD WIPER, with marked positions PARK-OFF-LOW-HI. When the switch is turned from OFF to LOW or HI, the wipers will operate at the corresponding speed. The wipers will stop at any position when the switch is turned OFF. When the switch is turned to PARK, the wipers will return to the inboard windshield frame and stop. When the switch is released, it will return to OFF.

2-148. Windshield Anti-ice/Defogging System.

CAUTION

Continued use of a faulty windshield anti-ice system may result in structural damage (delamination and/or cracking) to the windshield.

Do not allow ice to accumulate on the windshield, as ice shedding can cause engine FOD.

Pilot's, copilot's and center windshield (on helicopters equipped with center windshield anti-ice system) are electrically anti-iced and defogged. Transparent conductors imbedded between the laminations provide heat when electrical power is applied. The temperature of each panel is controlled to a heat level of about 43°C. The windshield anti-ice system fault monitoring circuit prevents windshield burnout when the windshield surface heat is above 43°C. If heat increases, the monitor circuit will turn off the system. Three switches, one for the pilot, one for the copilot and one for the center windshield (when equipped), are on the upper console (Figure 2-6) with markings of WINDSHIELD ANTI-ICE-PILOT-OFF-ON, and COPILOT-OFF-ON. On helicopters equipped with center windshield anti-ice an additional switch to control the center windshield is marked WINDSHIELD ANTI-ICE CTR-OFF-ON. Power to operate the anti-icing system is provided by the No. 1 and No. 2 ac primary buses through circuit breakers marked PILOT WSHLD ANTI-ICE and CPLT WSHLD ANTI-ICE. On helicopters equipped with center windshield anti-ice, pilot and center windshield anti-ice circuit breakers are marked WINDSHIELD ANTI-ICE PILOT and CTR. Power to control the anti-ice system is provided by the No. 1 and No. 2 dc primary buses through the anti-ice control switches. The system is protected by circuit breakers marked WSHLD ANTI-ICE. On helicopters equipped with center windshield anti-ice system, control circuit breakers for pilot's and center windshields are marked WINDSHIELD ANTI-ICE PILOT and CTR.

NOTE

If the APU generator is the sole source of ac-generated power, the backup pump and the windshield anti-ice cannot be used simultaneously.

2-149. Pitot Heater.

Pitot tube heat is provided by heating elements within each pitot tube head. Power to operate both heating elements is controlled by a single switch on the upper console, marked PITOT HEAT OFF and ON. When the switch is placed ON, current flows to the heating elements. Current sensors in the circuits sense the current flow and keep the caution lights, marked LFT PITOT HEAT and RT PITOT HEAT, turned off. If a heating element fails, the current sensor will detect no current flow, and turn on the caution light for that pitot tube. Power to operate the pitot tube heaters is provided from the No. 2 primary ac bus for the right pitot tube, through a circuit breaker marked RIGHT PITOT HEAT, and from the No. 1 primary ac bus for the left pitot heat, through a circuit breaker marked LEFT PITOT HEAT. Power to operate the caution lights is provided from the No. 1 primary dc bus through a circuit breaker, marked NO. 1 ENG ANTI-ICE.

2-150. Deleted.

2-151. Rotor Blade De-Ice Kit.

The rotor blade de-ice kit (Figure 2-15) consists of the following: de-ice control panel, de-ice test panel, system controller, power distributor, main and tail sliprings, main and tail blade heating elements, droop stop heaters, caution lights, outside air temperature (OAT) sensor, a modified ambient temperature sense line and an icing rate meter subsystem. The blade de-ice system provides improved mission performance in icing conditions by applying controlled electrical power to integral heating elements in the main and tail rotor blades, causing the ice bond layer to melt, allowing symmetrical ice shedding. Droop stop heaters apply heat to the droop stop hinge pins, to prevent icing and permit proper operation. The heaters are electrically powered continuously whenever the blade de-ice system is operating, either with the

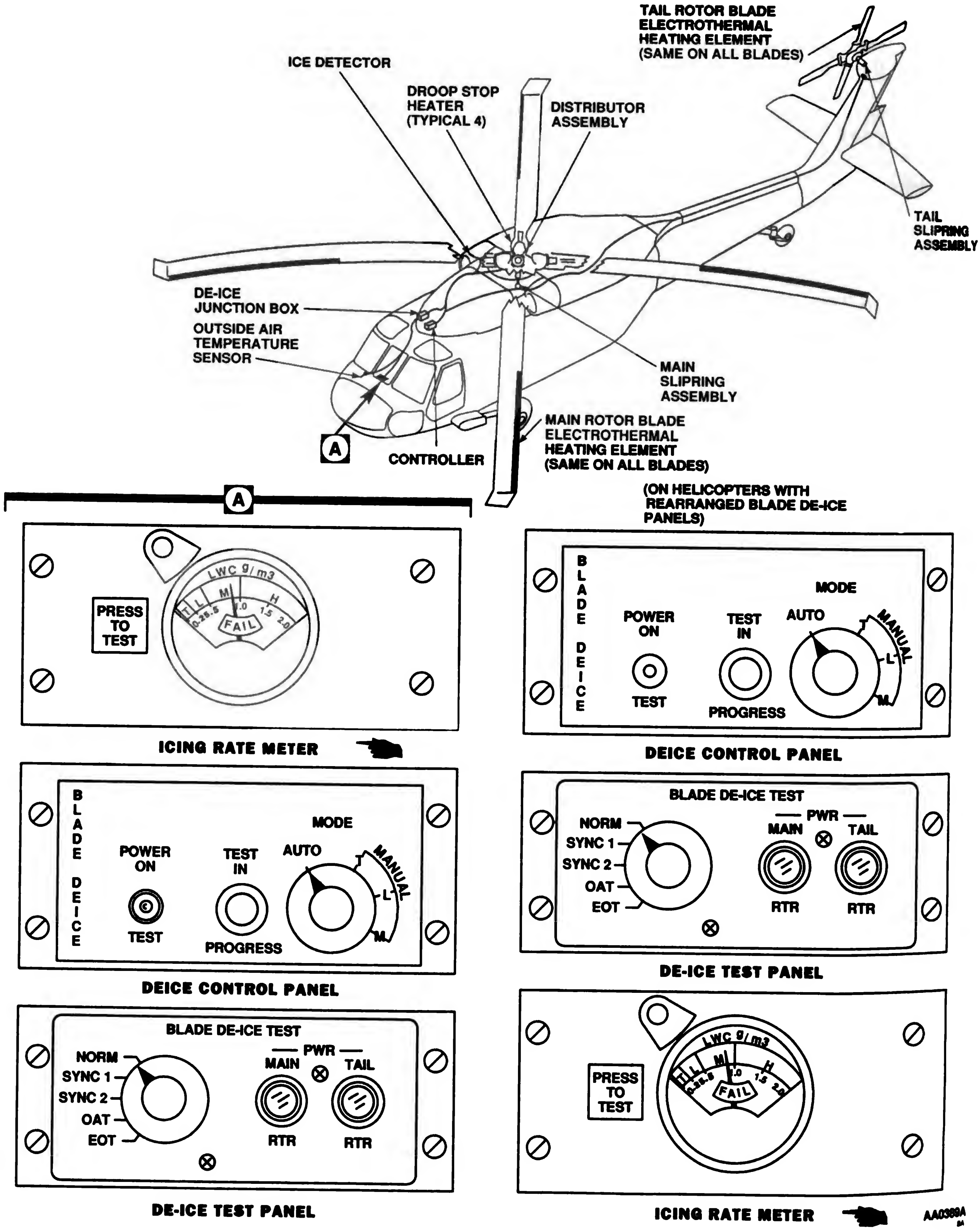


Figure 2-15. Rotor Blade De-Ice Kit

power switch ON, or the system in the TEST mode. The blade de-ice system, excluding element-on-time (EOT) failure may be ground checked using the APU generator. To prevent generator overload when only the APU generator is operating, an interlock system is installed to inhibit blade de-ice test if the backup pump is operating. If the backup pump should go on during the test cycle, the MR DE-ICE FAIL caution light will go on immediately, alerting the crew to an invalid test attempt. The test cycle must then be initiated again. The OAT sensor, installed below the windshield, provides a signal to the controller for heating EOT of the rotor blades. The signal is developed by a passive OAT sensor using a platinum resistance temperature detector as the sensing element. The lower the OAT sensor resistance, the longer EOT will be. To reduce power requirements, the blades are de-iced in cycles. Power to operate the blade de-ice is provided from the No. 1 and 2 ac primary buses through circuit breakers, marked ICE-DET, DE-ICE CNTRLR, and DE-ICE PWR TAIL ROTOR, on the mission readiness circuit breaker panel in the cabin. Main blade de-ice power is routed through current limiters in the de-ice junction box. When one main generator is inoperative, de-ice power can be supplied by the APU generator.

2-152. Blade De-ice System Operation.

The ice detector is operational anytime power is applied to the helicopter. The ice detector senses ice accumulation on a vibrating probe by a change in probe frequency. The frequency change is processed by the ice rate meter. The ice rate meter provides a visual display of icing intensity, T (trace), L (light) blue, M (moderate) yellow, and H (heavy) red. Also, the ice rate meter sends a signal to the ICE DETECTED caution light when the BLADE DE-ICE POWER switch is off, informing the pilot of the requirement to turn on the system. When the system has been turned on by placing the POWER switch ON, the ice detector aspirator heater is turned on, and the ICE DETECTED caution light is turned off. If the MODE switch is at AUTO, the rate meter sends an ice rate signal to the controller. The controller processes the ice rate signal to produce heater element-off-time, and the OAT signal to produce the heater EOT. The controller sends command signals through the main rotor sliprings to the system distributor which responds to controller signals by switching power in sequence to the main rotor blade heater zones. Tail rotor blade power is switched directly by the controller and sent through the tail rotor sliprings to the tail rotor blades. A tail blade distributor is not required since the power is applied to the four tail blades simultaneously. The de-ice control panel contains a rotary switch which allows automatic or manual control of blade heater element-off-time. In AUTO (automatic), the ice rate signal is passed on to the controller, which results in off-time variations proportional to the ice rate. In MANUAL, T, L, or M, fixed signals are transmitted to the controller, resulting in fixed element-off-time. Ice rate subsystem malfunctions are indicated by appearance of a FAIL flag on the rate meter face, requiring operation of the blade de-ice system in one of the three manual modes. MANUAL mode should also be used when the rate meter has no indicated malfunction, but any of these three conditions has occurred: 1. Pilot has determined by his judgment of ice intensity that the ice rate system is inaccurate. 2. Torque required has increased to an unacceptable level. 3. helicopter vibration has increased to an unacceptable level. During a single main generator failure, blade de-ice will be dropped until the APU is started and the GENERATORS APU switch is placed ON. Even though the GENERATORS APU switch is ON and providing power to the blade de-ice system, the APU GEN ON advisory light will not be on because of one main generator operating.

2-153. Blade De-ice System Control Panel.

All controls for operating the rotor blade de-ice system are on the BLADE DE-ICE system control panel (Figure 2-15). Controls are described as follows:

CONTROL/ INDICATOR	FUNCTION
POWER switch TEST	Electrically test main and tail rotor de-ice system for one test cycle.

CONTROL/ INDICATOR	FUNCTION
ON	Turns on power to blade de-ice controller and turns off ICE DETECTED caution light.
OFF	Turns off de-ice system.
TEST IN PROGRESS	Green light goes on during test cycle. At end of test cycle, light should go off.
MODE SELECTOR	
AUTO	System off-time is controlled by ice rate signal.
MANUAL	Gives pilot manual control of system off-time.
T	Sets a fixed element-off-time for trace icing.
L	Sets a fixed element-off-time for light icing.
M	Sets a fixed element-off-time for moderate icing.

2-154. Blade De-ice Test.

The BLADE DE-ICE TEST panel (Figure 2-15) allows the pilot to check the blade de-ice system for failures that are otherwise dormant during the normal TEST mode, but that can allow abnormal operation during use. The panel accomplishes this by introducing selected failure signals into the system and requiring the de-ice controller built-in-test circuitry to function in a specific manner. The blade de-ice test should be done during the ground checkout before each flight when blade de-ice use is anticipated. In the NORM position, the test panel allows system test to be done without the introduction of false failure signals. Thus, the system should complete its self checkout cycle without failure indications on the caution panel. In the SYNC 1 and SYNC 2 positions, the test panel interrupts the distributor sync line and provides the controller with a false sync input. The controller must interpret these false signals as indications of distributor failure, and produce MR DE-ICE FAIL caution light for both cases. In the OAT position, the test panel short circuits the OAT SENSOR INPUT TO THE CONTROLLER. BITE circuitry within the controller must sense the simulated failure and turn on both the MR DE-ICE FAIL and TR DE-ICE FAIL caution lights. In the EOT position, the test panel biases BITE circuitry in the controller and the OAT sensor to simulate malfunctioning primary EOT timing circuits. The biased BITE circuit is thus deceived into believing that the primary circuits are in error. The controller must turn on both the MR DE-ICE FAIL and TR DE-ICE FAIL lights when this occurs. The test panel also functions automatically during blade de-ice system use to sense contradictory signals from the de-ice power circuits. If electrical power remains applied to either the main or tail rotor heating elements after the controller signals a FAIL condition or when the system is OFF, then the corresponding PWR monitor light on the BLADE DE-ICE TEST panel turns on. The light informs the crew that further action is required to isolate the de-ice loads indicated. The test panel provides a reliability check of critical de-ice system functions. The pilot, after doing the indicated tests properly, can be confident that the de-ice system primary and BITE electronics are functioning within specified tolerances.

2-155. Blade De-ice Test Panel.

The control for selecting test functions of the blade de-ice system is on the BLADE DE-ICE TEST panel (Figure 2-15). Two PWR lights on the panel warn of power malfunctions of the main and tail rotor de-ice. Control and indicators are as follows:

CONTROL/ INDICATOR	FUNCTION
NORM	Provides a signal path for normal operation.
SYNC 1	Provides a signal to the controller to verify operation of synchronization check circuitry when POWER switch is at TEST.
SYNC 2	Provides an open circuit to the controller to verify operation of synchronization check circuitry when POWER switch is at TEST.
OAT	Short circuits the OAT sensor to check BITE circuit sensing a fault when POWER switch is at TEST.

CONTROL/ INDICATOR	FUNCTION
EOT	Disables BITE circuits in controller and OAT sensor to simulate a malfunctioning primary EOT timing circuit when POWER switch is ON and MODE select switch is at M (moderate)
PWR MAIN RTR light	Indicates a malfunction has occurred in the main rotor primary power.
PWR TAIL RTR light	Indicates a malfunction has occurred in the tail rotor primary power.

2-156. Blackout Curtains.

Curtains are provided to cover the cabin windows and the opening between the pilot's compartment and the cabin. Velcro tape is bonded to the cabin structure and the curtains with an adhesive. Loops are attached to the curtains to aid removal.

2-157. Wire Strike Protection System.

On helicopters equipped with wire strike protection provisions, the system (Figure 2-1) is a simple, lightweight, positive system with no motorized or pyrotechnic components used to cut, break, or deflect wires that may strike the helicopter in the frontal area between the tires and fuselage, and between the fuselage and main rotor in level flight. Protection is provided against horizontal strung wire at 60° - 90° to the flight path by cutting or deflecting a wire without exceeding the structure criteria by cutting or deflecting as applicable, of wire up to 3/8-inch diameter, 1 × 7 strand steel cable having a ultimate strength of up to 11,000 pounds. The system consists of nine cutters/deflectors located on the fuselage and landing gear/support. They are: upper cutter on the rear of the sliding fairing, the pitot cutter/deflector on the front of the sliding fairing, windshield post and wiper deflectors, door hinge deflector, step extension and step deflector, landing gear joint deflector, main landing gear cutter/deflector, and tail landing gear deflector.

2-157.1. Flight Data Recorder (On Helicopters Equipped with Flight Data Recorder Kit).

The flight data recorder system installed in the aft transition avionics compartment is a crash survivable digital tape recorder providing 25 hours of recorded data on a continuous loop magnetic tape. Flight data input to the recorder is sent from different locations throughout the helicopter. The recorder begins to record data as soon as AC and DC essential power is supplied to the helicopter. Electrical power to operate the data recorder system is provided from the DC ESNTL BUS and AC ESNTL BUS through circuit breakers marked FLT REC on the mission readiness circuit breaker panel. There are no controls provided to the pilot or copilot for control of the recorder.

2-158. Deleted.

2-159. Data Compartments.

Data Compartments are on each cockpit door (Figure 2-4).

2-160. Troop Seats.

Cabin troop seats (Figure 2-16) will accommodate up to 12 troops including the crew chief and gunner. There are mounting provisions for three additional seats. Each seat has a lap belt and torso harness, for restraint in four directions. The seats are designed to protect the occupant in a crash. This is done by an attenuating system consisting of an energy-absorbing telescopic leg brace combined with two rotary attenuators on the seat back support cables. Refer to Chapter 6 for troop seat installation.

2-161. Door Locks.

Key door locks are installed on each of the cabin, cockpit and avionics compartment doors. A common key is used to lock and unlock the doors from the outside to secure the helicopter. Each crew chief/gunner sliding window is locked from the inside only.

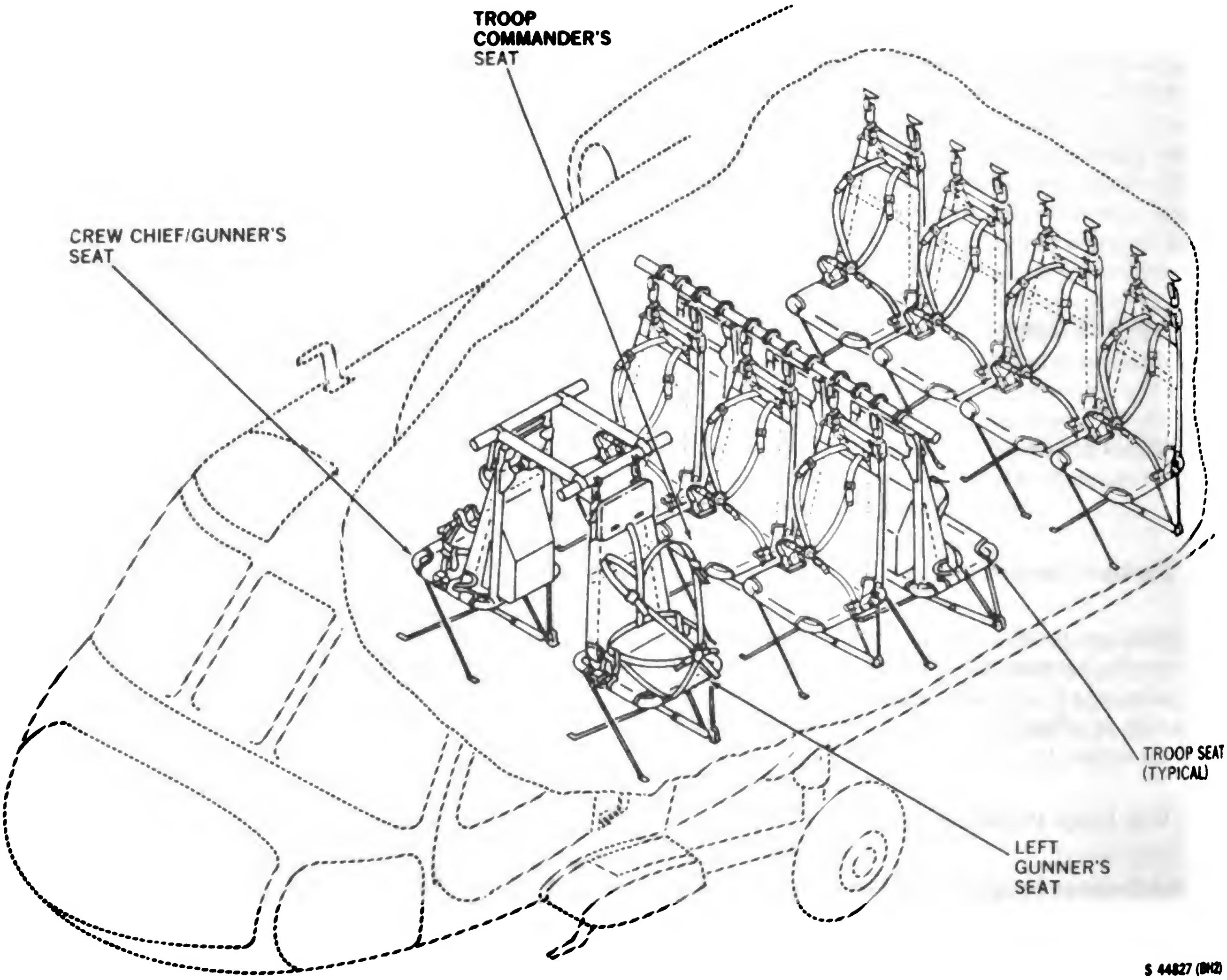


Figure 2-16. Troop Seats UH

Section X HEATING, VENTILATING, COOLING, AND ENVIRONMENTAL CONTROL UNIT

2-162. Heating System.

The subsystem consists of a heated air source, cold air source, mixing unit, temperature sensing unit, overtemperature sensor, controls, ducting and registers. The heating system is a bleed-air system and bleed-air supplied in flight by the main engines, and on the ground by the main engines or the APU. An external connector allows connection of an external ground source in to the pneumatic system, that can provide heat when connected. Power to operate electrical components of the heating system is by the No. 1 dc primary bus through a circuit breaker, marked AIR SOURCE HEAT/START.

2-163. Winterized Heater.

The winterized heater consists of a high bleed-air flow mixing valve and a modulation valve. The mixing valve is of enough capacity to keep the interior temperature of the helicopter at +4°C, to ambient temperatures down to −54°C. The mixture sensor controls air mixing to allow control of temperature used for cabin heat. Bleed-air is mixed with ambient air to get the desired temperature selected by the variable temperature control on the HEATER control panel (Figure 2-6). Bleed-air is regulated with the modulation valve for downstream mixing with ambient air when the HEATER control switch is ON. Overtemperature is prevented by two overtemperature sensors that de-energize solenoid valves when bleed-air temperature reaches about 90° to 96°C at the inlet to the mixing valve or in the mixing chamber. The temperature sensors control current flow to the on-off solenoid and the winterization solenoid to hold them energized, allowing bleed-air to flow to the mixing chamber. When the ENG ANTI-ICE switch is placed ON or a dc power failure occurs, the winterization solenoid will de-energize. An interlock system between engine anti-ice system and the heater winterization solenoid valve prevents engine overbleed by reducing bleed-air flow to the heater when an ENG ANTI-ICE switch is ON. Operation of the winterization heating system is the same as in Paragraph 2-165.

2-164. Heat and Ventilation Controls.

A variable control air mixing valve assembly is used to control the temperature of air for cabin heating in the helicopter. Bleed-air from the engine, APU, or external source is mixed with ambient air to obtain the desired temperature determined by the setting of the sensor in the downstream air flow. Regulation of the diaphragm position is by a solenoid. Should the HEAT control switch (Figure 2-6) be turned OFF, or dc power fail, bleed-air will shut off. The valve also has a thermal protective switch that de-energizes the solenoid if mixed air temperature is over 90° to 96°C. The mixture temperature sensor downstream of the mixing valve regulates flow output temperature. The sensor is regulated from the cockpit through a control linkage at the overhead console. The temperature control is marked HEATER OFF, MED, and HI. Ventilation is controlled through a panel on the upper console marked VENT BLOWER. When the switch is placed ON, dc power to the solenoid allows bleed-air to mix with outside air.

2-165. Normal Operation.

a. APU or engine - start. (Refer to paragraph 8-21 or 8-22.)

b. AIR SOURCE HEAT/START switch - as required. ENG if engine is operating; OFF for heat from external power unit.

c. HEATER ON OFF switch - ON.

d. VENT BLOWER switch - OFF for maximum heat.

e. HEATER control - as desired.

2-166. Ventilation System.

The helicopter is ventilated by an electrically-operated blower system controlled through the VENT BLOWER control panel on the upper console (Figure 2-6). The VENT BLOWER switch is marked OFF and ON. When ON, the blower forces ambient air into the cabin ducts. The No. 2 ac primary bus powers the blower through a circuit breaker, marked HEAT & VENT. It is also controlled by dc power from the No. 2 dc primary bus through the VENT BLOWER switch protected by a circuit breaker, marked HEAT & VENT. Ram air vents for cooling the cockpit area are on each side of the upper console and at the front of the lower console (Figure 2-4) and are controlled by turning the nozzle to control the opening.

2-167. Normal Operation.

a. APU, rotor or external power - operating.

b. VENT BLOWER switch - ON.

2-168. Air Conditioner System. EH

The vapor-cycle system (air conditioner) cools the cabin and cockpit areas. It consists of a heli-rotor compressor, evaporator, condenser, associated valves, protective pressure and temperature switches, a filter, service valves, a liquid indicator and an electrical control system. A sight glass in the liquid line downstream of the filter drier is a visual indicator of Freon liquid movement through the line. The temperature controller assembly, in the aft cabin, processes the input signals from the temperature selection rheostat in the cockpit and the cabin temperature sensor, and provides the power to the hot gas bypass valve solenoid. The electrical control box, in the transition section, contains the relays, time delays, elapsed time meter and fault indicators for the vapor-cycle system. The control box routes the power to the electrical components. Inputs from the remote control and temperature controller are channeled to their respective electrical interface in the control box. Across the front of the enclosure are four fault indicators HI and LO PRESS, and HI and LO TEMP, which are tripped to indicate red when a fault is received. These indicators provide visual signals of a fault occurring, even if it is only temporary, and they can be manually reset for reuse by pressing in the fault indicator. The air conditioner system is protected to prevent evaporator freezing. The system may be operated at any ambient temperature without causing damage, shown in Figure 2-17. Power to operate the air conditioner system is provided from the No. 2 ac primary bus and controlled from the No. 1 dc primary bus through a breaker marked ECS CONTR. Control of the air conditioner is through the ECS control panel on the upper console (Figure 2-6). The panel contains a temperature control rheostat with an increasing arrow indicator to COOL, two mode selection switches marked COOL-OFF-FAN and HTR-OFF-ON. The temperature control rheostat is used with the COOL switch to set the desired cabin temperature. Placing switch to COOL will cause AIR COND ON advisory light to illuminate. Selection of the COOL mode on the cockpit AIR COND control panel starts a phased sequence of events leading to full operation of the air conditioner system. To prevent a sudden surge in 115 vac power, the major electrical components are started at spaced intervals.

2-169. Auxiliary Heater System. EH

Incorporated in the air conditioner plenum chamber is an auxiliary heating system to supplement the bleed air heater. The electrically operated heater is controlled by a switch on the upper console ECS control panel marked HTR ON & OFF. The heater element will operate continuously as long as the switch is ON. With the HTR switch ON and the AIR COND switch placed in the FAN position the CABIN HEAT ON advisory light will illuminate. An overtemperature protection is provided at 205°F if there is a heater malfunction.

2-170. Ventilation System. EH

In addition to the standard ventilation system, the EH-60A has a ventilation system which operates in conjunction with the air conditioning system. The system is controlled from the ECS control panel on the upper console (Figure 2-6). When the AIR COND RECIRC switch is placed in the FAN position, fresh air is drawn from outside the helicopter into the plenum chamber, mixed with inside air and circulated through the helicopter.

POWER SOURCE	AIR CONDITIONING SYSTEM OPERATION
APU GENERATOR (AIRCRAFT ON GROUND)	• AIR CONDITIONING INTERRUPTED IF: (1) BACKUP PUMP IS ON. OR (2) WINDSHIELD ANTI-ICE IS ON. • WINDSHIELD ANTI-ICE INTERRUPTED WHEN BACKUP PUMP IS ON.
APU GENERATOR (AIRCRAFT IN FLIGHT)	• AIR CONDITIONING INTERRUPTED WHILE AIRCRAFT IN AIR • WINDSHIELD ANTI-ICE INTERRUPTED WHEN BACKUP PUMP IS ON.
DUAL MAIN GENERATOR (NO. 1 AND NO. 2) (AIRCRAFT IN FLIGHT OR ON GROUND)	• AIR CONDITIONING, BACKUP PUMP, AND WINDSHIELD ANTI-ICE CAN OPERATE SIMULTANEOUSLY.
SINGLE GENERATOR OR EXTERNAL AC POWER (WEIGHT ON OR OFF WHEELS)	• AIR CONDITIONING INTERRUPTED IF: (1) BACKUP PUMP IS ON.

Figure 2-17. Air Conditioning System Power Source Priority EH

Section XI ELECTRICAL POWER SUPPLY AND DISTRIBUTION SYSTEMS

2-171. Electrical Power Systems.

Alternating current (ac) is the primary source of power. The primary electrical system consists of two independent systems, each capable of supplying the total helicopter power requirements. The prime source of each system is a 115/200 vac generator. A subsystem feeds two independent ac primary buses and an ac essential bus. A portion of each ac primary bus load is converted to 28 volts direct current (vdc) by two 200 ampere ac/dc converters. The 28 vdc is distributed by two independent dc primary buses and a dc essential bus. Emergency power is provided by a generator driven by the auxiliary power unit (APU). The APU generator is capable of supplying all flight-essential ac and dc bus loads. In addition, the APU generator can supply power to the blade de-ice system (when installed) if one main generator should fail. Should a second generator fail, the blade de-ice load will be dropped and the APU generator will power the remaining ac bus loads. An electric power priority feature allows either the No. 1 and No. 2 main generator to automatically supersede the APU generator, which, in turn, automatically supersedes external power. A 24-volt battery provides backup dc power.

2-172. DC Power Supply System.

Primary dc power is obtained from two converters (transformer-rectifiers) with a battery as the secondary power source. There is no external dc power connector (Figure 2-18).

2-173. Converters.

Two 200-ampere converters, each normally powered by the No. 1 and No. 2 ac primary buses respectively, turn ac power into dc power and reduce it to 28 volts. The converter output is applied to the No. 1 and No. 2 dc primary buses whenever ac power is applied to the ac primary buses. If one converter's output is lost, the converter load will be transferred to the operating system, and a caution light, marked #1 CONV or #2 CONV will go on. Power to light the caution light is provided by the battery bus through a circuit breaker marked, AC CONV WARN.

2-174. Battery.

A 24-volt dc 5.5 ampere hour 20-cell battery provides secondary or emergency dc power. The battery is in the cabin section behind the copilot. It supplies dc power to the BATT and BATT UTIL buses (Figure 2-18) for operating dc essential equipment during primary dc malfunction. Power to the battery bus is controlled by the BATT switch on the upper console. It has marked positions OFF and ON. The battery utility bus is connected directly to the battery. During No. 1 and No. 2 dc primary source malfunction, the dc essential bus is powered by the battery bus as long as the battery is at least 35% charged and the battery switch is on. When only battery power is available, the battery life is about 22 minutes day and 14 minutes night for a battery 80% charged. The BATT switch should be ON when either external power, APU generator or main generator power is applied to the helicopter. This will recharge the battery. When the battery is the sole source of dc power, the BATT switch should be turned off immediately upon obtaining a BATT LOW CHARGE caution light. A malfunction of both dc primary sources will light caution lights marked #1 and #2 CONV. If the BATT switch is left ON, the battery will be completely discharged in less than 3.5 hours. If the maintenance light and both cockpit utility lights are left on, the battery will be completely discharged in less than 7 hours. Power to light the caution light is from the battery utility bus through a circuit breaker marked BATT & ESNTL DC WARN EXT PWR CONTR.

2-175. DC Monitor Bus. EH

The dc monitor bus is normally energized by the No. 1 and No. 2 converters when the generators are operating, and is powered by the No. 2 converter when operating from external power (Figure 2-18). If either converter should fail, the bus will be automatically dropped from the system.

2-176. Quick Fix Power. EH

Mission equipment dc power is provided from the No. 2 dc primary bus, and is controlled by Q/F PWR switch on the upper console.

2-177. Battery Charger/Analyzer.

A charger-analyzer system restores the battery charge and determines the condition of the battery. The system charges the battery through a converter whenever ac power is available on the helicopter and the BATT switch is ON. The analyzer system monitors battery charge and lights a caution light indicating BATTERY LOW CHARGE when the charge lowers to 35% to 45% of battery capacity. If battery charge continues to lower, at 30% to 40% of battery capacity, the dc essential bus will be disconnected from the battery. At 35% capacity the battery can provide two APU starts. Another analyzer circuit monitors battery temperature. When the internal temperature reaches 70°C, or if a battery cell dissimilarity condition exists, a caution panel light will go on, indicating BATTERY FAULT. Then the charger/analyzer should automatically disconnect the battery from the charging circuit. As a backup, placing the BATT switch OFF removes input power to the charger/analyzer. By placing battery switch OFF, the increasing temperature may be checked.

2-178. DC and AC Circuit Breaker Panels.

The circuit breaker panels (Figure 2-19) protect the power systems. One is above and to the rear of each pilot and copilot, one is on the lower console, and two are on the upper console. The ac essential bus contains one additional panel. The circuit breakers provide both ac and dc protection. Popping of a circuit breaker indicates too much current is being drawn by a component in the circuit that is powered through the circuit breaker. Unnecessary recycling of circuit breakers, or using circuit breakers as a switch should not be done.

2-179. AC Power Supply System.

A primary ac power system (Figure 2-20) delivers regulated three phase, 115/200 vac, 400 Hz. Each system contains a 30/45 kilovolt-ampere generator mounted on and driven by the transmission accessory gear box module, a current transformer, a generator control unit, and current limiter, all of which are interchangeable. System outputs are applied to the NO. 1 and NO. 2 AC PRI BUS. Caution lights will go on, indicating #1 GEN or #2 GEN whenever generator output is interrupted. Another caution light goes on, indicating ACESS BUS OFF when there is no power to the ac essential bus. Individual generator controls are provided on the upper console (Figure 2-6), with marked positions of TEST, OFF/RESET, and ON. A generator main bearing caution system is installed on each main generator to light caution light, marked #1 GEN BRG or #2 GEN BRG, to indicate a worn or

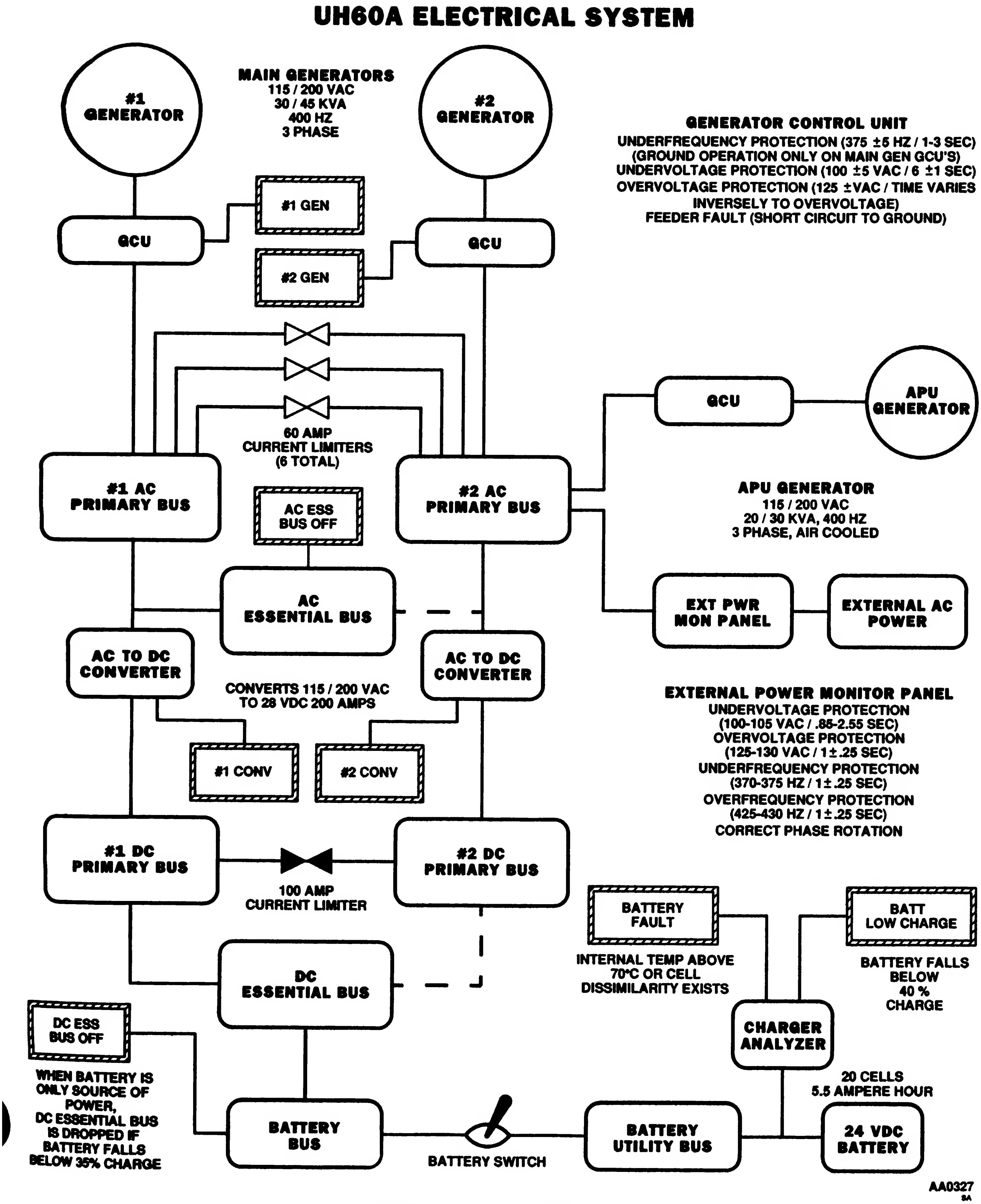
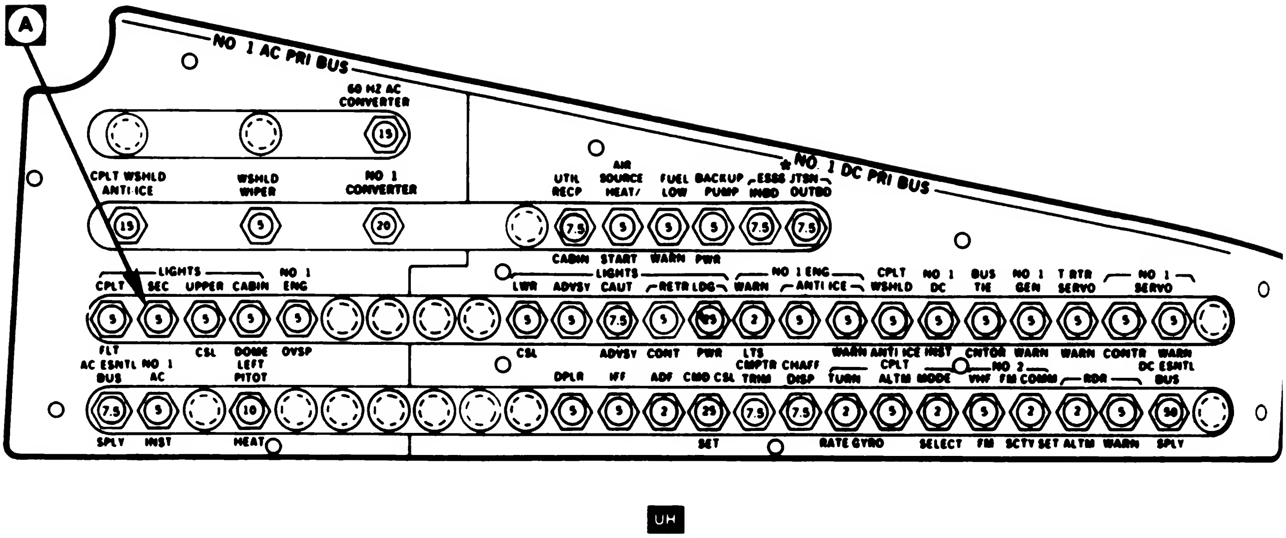
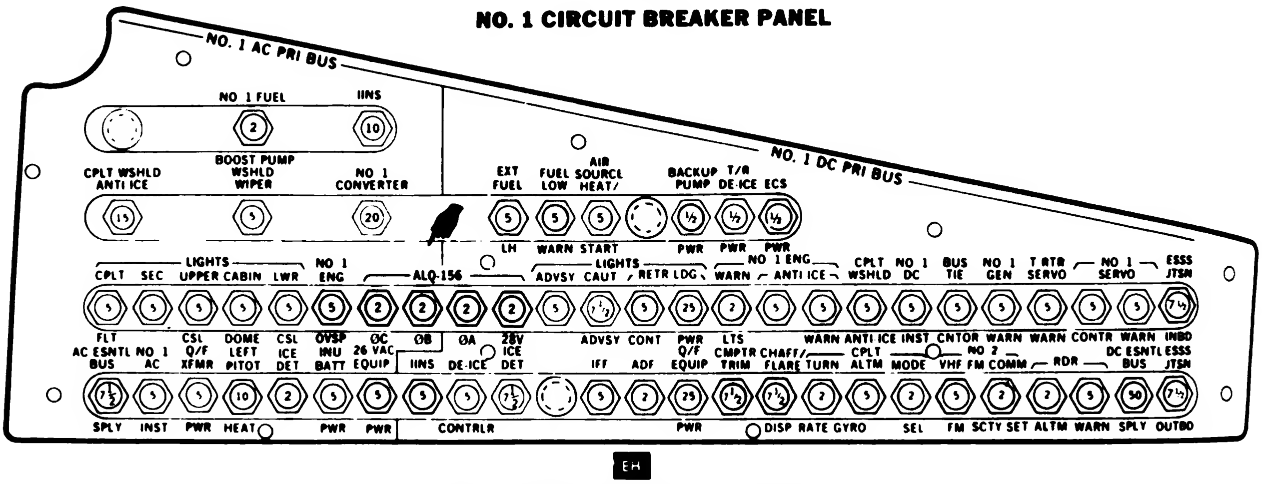


Figure 2-18. Electrical System

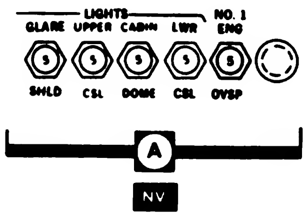
Pages 2-64 and 2-65 Deleted.



NO. 1 CIRCUIT BREAKER PANEL



NO. 1 CIRCUIT BREAKER PANEL



NOTES
1. ON HELICOPTERS PRIOR TO SERIAL NO. 81-23579 NOT MODIFIED BY MWO 55-1520-237-50-25.
2. ON HELICOPTERS PRIOR TO SERIAL NO. 81-23579 MODIFIED BY MWO 55-1520-237-50-25 AND HELICOPTERS SERIAL NOS. 81-23579 AND SUBSEQUENT.
3. CIRCUIT BREAKERS WITH ASTERISK (*) ARE ON HELICOPTERS SERIAL NOS. 82-23748 AND SUBSEQUENT.

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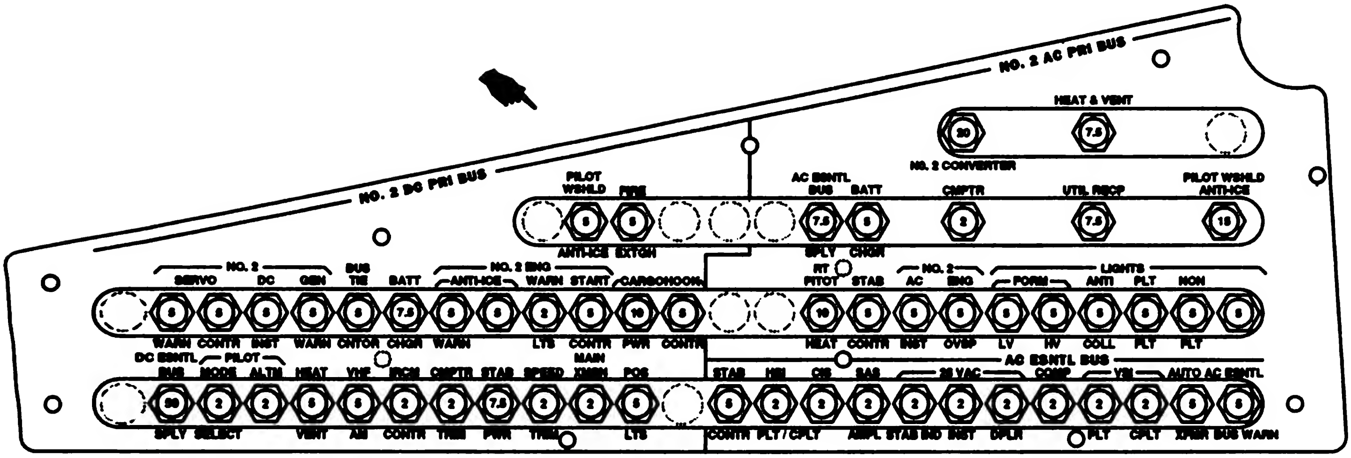
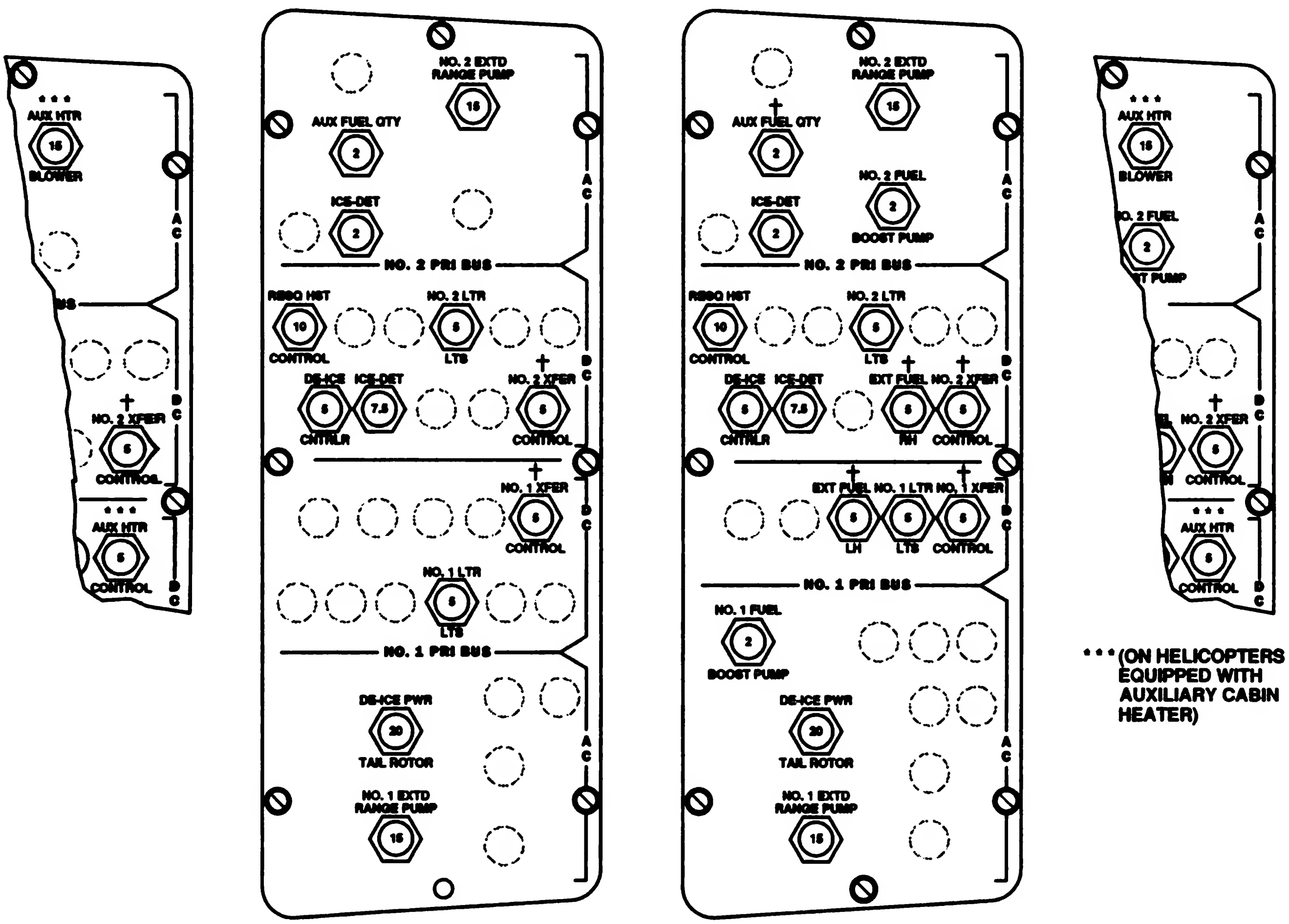
Figure 2-19. DC and AC Circuit Breaker Panels (Typical) (Sheet 1 of 4)



UH

NO. 2 CIRCUIT BREAKER PANEL



(NOTE 1)

† = ES

(NOTES 2 AND 3)

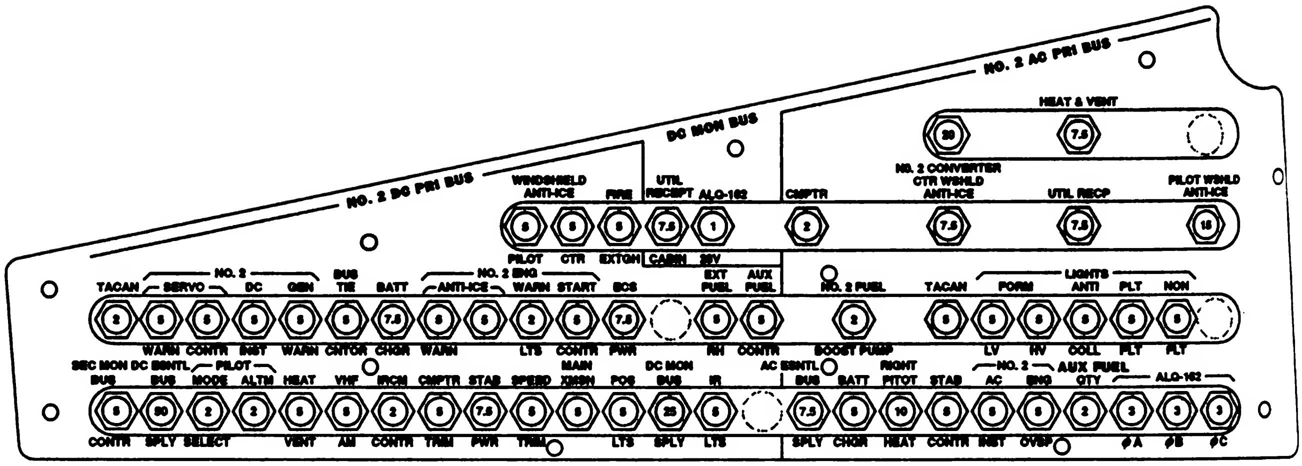
* * * (ON HELICOPTERS EQUIPPED WITH AUXILIARY CABIN HEATER)

UH

MISSION READINESS CIRCUIT BREAKER PANELS (CABIN)

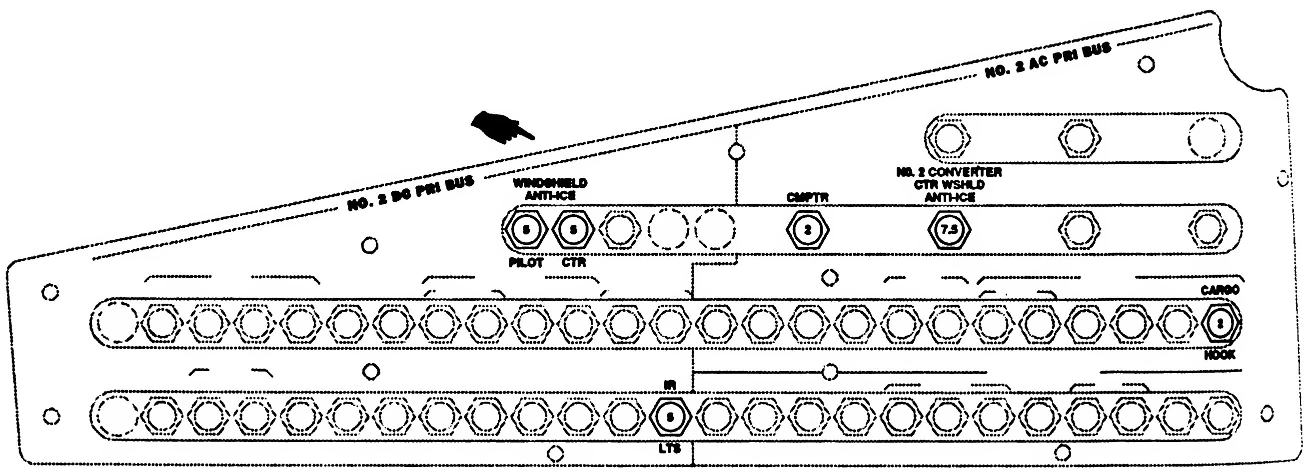
AA0353_2

Figure 2-19. DC and AC Circuit Breaker Panels (Typical) (Sheet 2 of 4)



EH

PILOT'S CIRCUIT BREAKER PANEL



NV

PILOT'S CIRCUIT BREAKER PANEL

NOTE

ON HELICOPTERS EQUIPPED WITH NVG COMPATIBLE LIGHTING UNSHADED AREAS DENOTES NVG DIFFERENCES BETWEEN UH60-A AND UH-60A EQUIPPED WITH NVG

AA0353_3

Figure 2-19. DC and AC Circuit Breaker Panels (Typical) (Sheet 3 of 4)

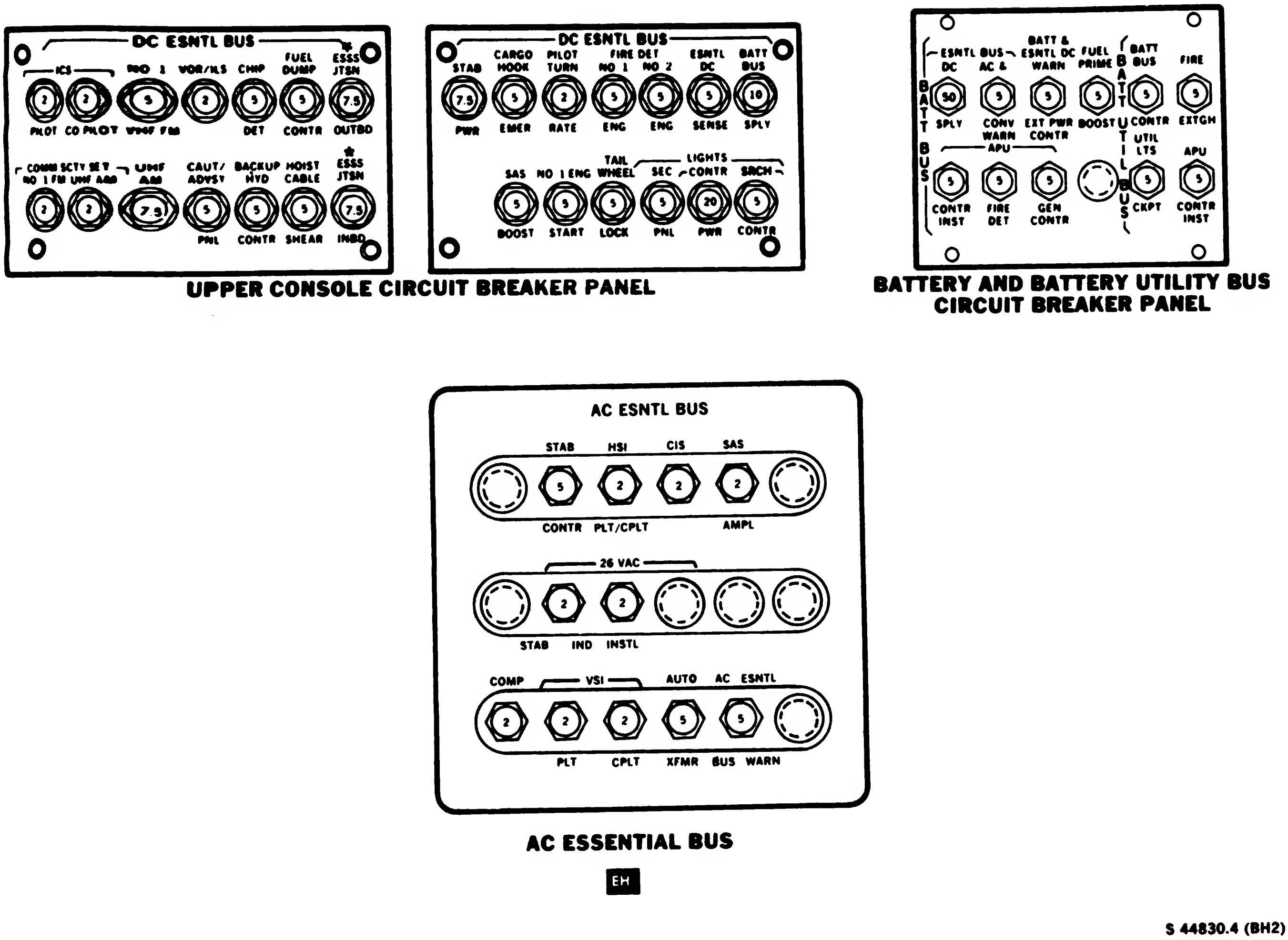


Figure 2-19. DC and AC Circuit Breaker Panels (Typical) (Sheet 4 of 4)

failed bearing. The caution light will remain on until power is removed. The auxiliary bearing will allow 10 additional hours of operation after the light goes on. Therefore, it should not be a cause for mission abort. Power to operate the caution system is provided from the No. 1 and No. 2 dc primary buses, through circuit breakers, marked NO. 1 GEN WARN and NO. 2 GEN WARN, respectively.

NOTE

When the GEN BRG caution light remains on for more than 1 minute, make an entry on the DA Form 2408-13.

2-180. Generator Control Units (GCU).

The GCUs monitor voltage from the No. 1, No. 2 and APU generators and take the generator(s) off-line where malfunctions occur. Underfrequency protection is disabled in flight by the WOW switch.

2-181. AC Secondary Bus. EH

The ac secondary bus is powered by the No. 1 and No. 2 generators when they are operating and their outputs are acceptable (Figure 2-18). Current limiters protect the system from excessive current draw. If the No. 1 and No. 2 generators are off, the APU generator will supply the ac secondary bus if the output is acceptable, the backup hydraulic pump is off, the blade deice is off, and the weight of the helicopter is on the wheels. The ac secondary bus can also receive power from external power when the weight of the helicopter is on the wheels, and the No. 1, No. 2 and APU generators are off, and the backup hydraulic pump is not operating.

2-182. Auxiliary AC Power System.

An auxiliary ac power system (Figure 2-18), is a backup ac power source, providing electrical power for ground checkouts. The system consists of a 115 vac three-phase, 400 Hz 20/30kVA, air-cooled generator mounted on and driven by the APU, a current transformer and a generator control unit. If the primary ac generators are not operating, the auxiliary ac power output will be applied through contactors to the No. 2 primary ac bus and through contactors and current limiters to the No. 1 primary ac bus. An advisory light on the caution/advisory panel will go on, indicating APU GEN ON when the APU generator is operating, and the APU generator switch is ON. APU GEN ON light will be on only when supplying power to the system, it will be off at any time either No. 1 generator or No. 2 generator is supplying power. The generator control switch on the upper console (Figure 2-6), has marked positions of TEST, OFF/RESET, and ON.

NOTE

If the APU generator is the sole source of ac generated power, all equipment may be operated, except that when the backup pump is on, the windshield anti-ice is prevented from being used.

2-183. Generator Control Switches.

Generators are controlled by a three-position generator switch on the upper console (Figure 2-6). The switch ON position energizes the generator and permits connection of generator ac output to the ac loads. TEST permits you to test the generator ac output without connecting to the generator loads. OFF/RESET de-energizes the generator and permits generator recycling if the generator is disabled and disconnected from its loads. The control switch is manually placed to RESET and then back to ON.

2-184. External AC Power System.

An external ac power connector, on the right side of the helicopter (Figure 2-1), accepts ground source of 115 vac, three-phase, 400 Hz power. The system is controlled by a switch on the upper console (Figure 2-6), marked EXT PWR RESET OFF and ON. External power will be introduced into the system if acceptable external power is connected, the external power switch is ON, and no other generating source is operating. An advisory light on the caution/advisory panel will go on, indicating EXT PWR CONNECTED, whenever external power is connected to the helicopter.

CAUTION

Do not connect a source of dc power to the external ac connector.

Figure 2-20 and Pages 2-71 and 2-72 Deleted.

Section XII AUXILIARY POWER UNIT

2-185. Auxiliary Power Unit (APU) System.

The auxiliary power unit system (Figure 2-21) consists of an auxiliary power unit (APU), accessories, controls, a monitoring system, and a starting system. The APU system provides pneumatic power for main engine starting and cabin heating, and electrical power for ground and emergency in-flight electrical operations. APU system accessories include a prime/boost pump, hydraulic accumulator, hydraulic handpump, hydraulic start motor, and ac generator. The hydraulic accumulators and handpump, in the aft midsection cabin ceiling (Figure 2-5), provide the hydraulic pressure for driving the APU starter. If the APU does not start, the hydraulic accumulator can be recharged by pumping the hydraulic handpump. The hydraulic utility module and backup pump, on the left forward deck within the main rotor pylon, will automatically recharge the depleted hydraulic accumulator for the next APU start. The APU controls are in the cockpit on the upper console. Indicator lights on the caution/advisory panel provide cockpit monitoring of the APU. An indicator panel in the cabin monitors APU faults and will indicate reason for APU shutdown on BITE indicators. The BITE indicators are incorporated in the APU electronic sequence unit (ESU), and will indicate reasons for APU shutdown. Those indicators can be monitored during APU operation without interrupting normal operating systems. During a start, the ESU compares input signals from speed, time, and temperature sensors on the APU to specified values stowed in the ESU memory, and performs functional steps as a result of the comparison. The system also provides for APU protective shutdown in case of turbine overspeed, underspeed, high exhaust temperature, low oil pressure, or loss of electrical power or sequence failure. Each major sequence step will have a visual indication of go/no-go. The ESU samples predetermined parameters of exhaust temperature, turbine speed and oil pressure. If any one of the predetermined values are exceeded, the APU will shut down, and appropriate BITE indication is made. On helicopters modified with improved ESU, if a momentary malfunction occurs (i.e., a power interruption other than switching of the APU CONTR switch) the APU will shut down and the APU CONTR switch must be placed at OFF and then back ON, to restart the APU. There is also an output signal to the caution/advisory panel to turn on the APU ON advisory light, indicating the APU is operating. Powerto operate the APU and ESU is provided from the BATT and BATT UTIL BUS through circuit breakers, marked APU CONTR INST.

2-186. APU.

The auxiliary power unit (Figure 2-21) consists of a gas turbine shaft power section, a reduction gear drive, and appropriate controls and accessories. The accessory gear box provides an axial pad with a 12,000 rpm output drive for the APU ac generator, rpm pad for mounting the APU start motor, rpm drive pad for the APU fuel assembly. A magnetic pickup mounted on the accessory gear box senses engine speed. The APU is lubricated by a self-contained oil system. Refer to Figure 2-26 for servicing.

2-187. APU Controls.

The APU control, on the upper console (Figure 2-6), consists of a CONTR switch and an APU fire extinguisher T-handle. The APU CONTR switch, with marked positions OFF and ON, controls the operation of the APU. Placing the switch ON starts the APU and allows it to operate. The APU is off when the switch is OFF. APU FAIL caution light will be on any time the APU automatically shuts down. The APU OIL TEMP HI is on when APU oil temperature is above normal range. During ground operation at high ambient temperatures the APU OIL TEMP HI light may go on. If this occurs, the APU should be shut down immediately to prevent damage. After a 30-minute cooling period, the oil level should be checked. If O.K., the APU may be restarted. The control system receives electrical power from the BATT BUS through the circuit breaker marked APU CONTR INST on the lower console. When illuminated, the APU T-handle warns the pilot/ copilot of a fire in the APU compartment. When the T-handle is pulled, it turns off fuel to the APU, sends a stop signal to the ESU, arms the fire extinguisher system, and sets the extinguisher direction control valve to the APU. During APU starts using battery power, if the fire extinguisher is required, FIRE EXTGH RESERVE must be used. The T-handle microswitch receives electrical power from the BATT UTIL BUS through a circuit breaker marked FIRE EXTGH on the lower console circuit breaker panel.

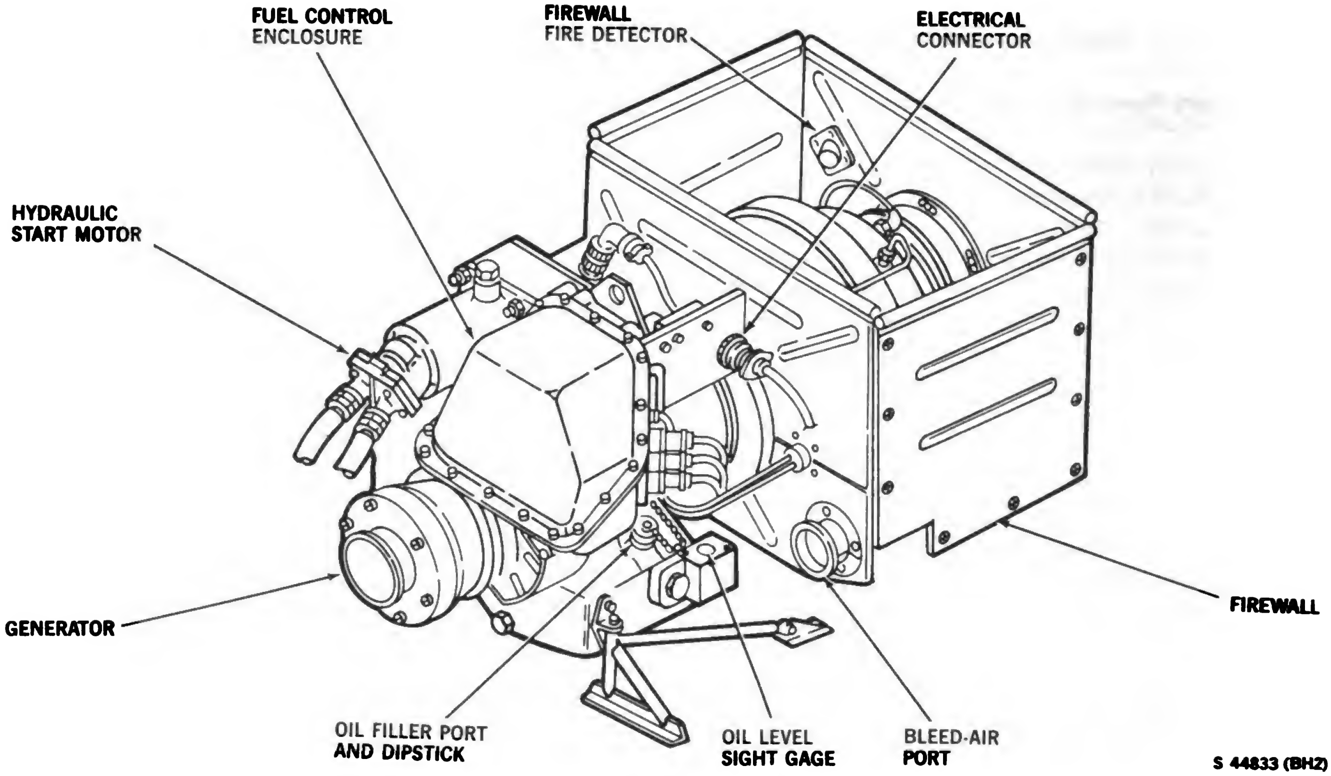


Figure 2-21. Auxiliary Power Unit (APU) (Typical)

2-188. APU Fuel Control System (On Helicopters Equipped with T-62T-40-1 APU).

This system consists of a fuel pump and a control assembly. The fuel pump is protected by a filter. Fuel pump output flow passes through another filter before entering the control assembly. A governor and flow metering valve controls fuel flow to the engine during ignition, permitting automatic starting under all ambient conditions, and controls the turbine at a constant speed once it has accelerated to operating speed. An electronic speed sensing device provides automatic fuel flow, ignition, and operation of the APU.

2-188.1 APU Fuel Control System (Helicopters Equipped with GTC-P36-150 APU.)

The fuel control system includes a fuel pump and metering section. The fuel pump is protected by an integral inlet filter. Fuel pump output flow passes through a filter screen before entering the metering assembly. Fuel pump discharge pressure is limited by an ultimate relief valve which, when activated, bypasses fuel flow back to the pump inlet. Fuel metering is accomplished by the torque motor metering valve as a function of an electrical signal from the electronic sequence unit (ESU). For accurate fuel metering, a constant, pressure drop across the metering valve is maintained by the differential pressure regulating valve. The fuel solenoid valve is energized by the ESU following the initiation of APU start. This allows fuel to flow to the engine. The fuel control assembly subsequently provides fuel according to a preprogrammed schedule to effect efficient acceleration. The fuel solenoid valve will close completely without visible leakage from the minimum operating fuel pressure to 110% of the maximum operating fuel pressure.

2-189. APU Fuel Supply System.

APU fuel is supplied to the APU from the left main fuel tank. The FUEL PUMP switch must be at APU BOOST for all APU operation, except engine priming. The APU prime/boost shutoff valve is a two-position, open-closed unit mounted on the APU compartment firewall where it also functions as a firewall shutoff valve. The valve is pilot-operated from the upper console FUEL PUMP switch as well as by the FIRE EXT APU T-handle. If the APU does not start and the APU

ACCUM LOW advisory light is not on, the manual over-ride lever on the accumulator manifold should be pulled to attempt another start, and held until the APU has reached self-sustaining speed.

2-190. Accumulator Recharge.

The accumulator recharge cycle starts when the APU has reached operational speed and the APU-driven generator comes on the line. The pressure switch for the accumulator causes the APU ACCUM LOW light to go on and the backup system pump to devel-op pressure. The APU accumulator pressure should be at least 2800 psi before attempting an APU start. The accumulator is recharged from the backup pump which runs for 90 seconds after the accumulator low-pressure switch is actuated. When the winterization kit is installed, an additional identical accumulator is installed in parallel with the original accumulator. Discharge and recharge of the added accumulator is the same, except a 180-second recharge cycle for the two accumulators will take place when the accumulator pressure switch senses low accumulator pressure. Both accumulators are charged or discharged simultaneously. If the accumulators do not fully charge during the first 180 seconds of the backup pump operating cycle, the pump will continue to operate in 180-second segments, or until the BACKUP PUMP PWR circuit breaker is pulled, or 115 vac power is removed. The backup system pump shuts down after recharge, unless required for other purposes. Should the accumulator pressure drop, the backup system pump restarts to replenish the accumulator charge. The rate of accumulator charge is limited to protect the backup system from possible depletion due to ballistic damage to the APU start system. Should the APU not start, the accumulator may be recharged by these methods, after the APU CONTR switch is OFF. An electric ground cart powering the backup hydraulic pump or a hydraulic ground cart connected to the backup hydraulic system through the ground test quick-disconnects or by using the handpump in the aft upper cabin. The APU CONTR switch should not be turned ON again or the BATT switch turned OFF until after the ESU BITE indicators have been checked. The handpump may also be used to top off the accumulator charge if the charge has dropped due to a low temperature condition. A pressure gage mounted in the aft cabin (Figure 2-5) indicates the charge. Check valves prevent draining of the accumulator charge through the system.

Section XIII LIGHTING

2-191. Interior Lighting.

On helicopters not equipped with NVG compatible lighting, there is a choice of red or white lights for helicopter interior lighting. The interior lighting system consists of cockpit dome lights, utility lights and cabin dome lights (Figures 2-5 and 2-22). Helicopters equipped with NVG compatible lighting has a choice of selecting either white or NVG compatible blue-green lighting for the cockpit dome, instrument panel glare shield, utility lights and cabin dome lights.

2-192. Night Vision Goggles (NVG) System.

On helicopters equipped with NVG system, but without NVG compatible lighting, the PNL LTS switch on the pilot's and copilot's cyclic stick grips (Figure 2-11) are used with NVG. They disable these lights:

a. CARGO HOOK EMER REL TEST.

b. RESCUE HOIST CONTROL SQUIB IND.

c. Both VSIs advisory lights (GA, DH, and MB).

d. MODE SEL and CIS MODE SEL.

e. Both radar altimeters (HI, LO, and digits).

f. STABILATOR AUTO CONTROL switch.

g. TAIL WHEEL lock switch.

h. AUTO FLIGHT CONTROL panel switches.

i. Chaff system control panel.

j. BLADE DE-ICE SYSTEM TEST IN PROGRESS.

k. IRCM panel indicator lights (helicopters prior to serial No. 78-22987).

l. Lower console panel lights.

m. ENG EMER OFF and APU T-handles lights may reduce in intensity.

Caution/advisory and warning panel lights are dimmed when the PNL LTS switch is pressed. Additional light intensity adjustment is required for operation with NVG. When in panel light kill mode, the caution/advisory and warning panels light level may be further adjusted with the MA WARN and CAUT ADVSY NVG DIMMING controls. The dimming may be placed in an out-of-synchronization condition, whereas when the PNL LTS switch is pressed, some lights will reduce in intensity and others will increase in intensity. To correct the condition, the caution/advisory should be placed at high intensity using the PNL LTS switch. Power is then removed from the helicopter and then reapplied, or the LTS LWR CSL circuit breaker may be cycled to re-establish synchronization. Power for the

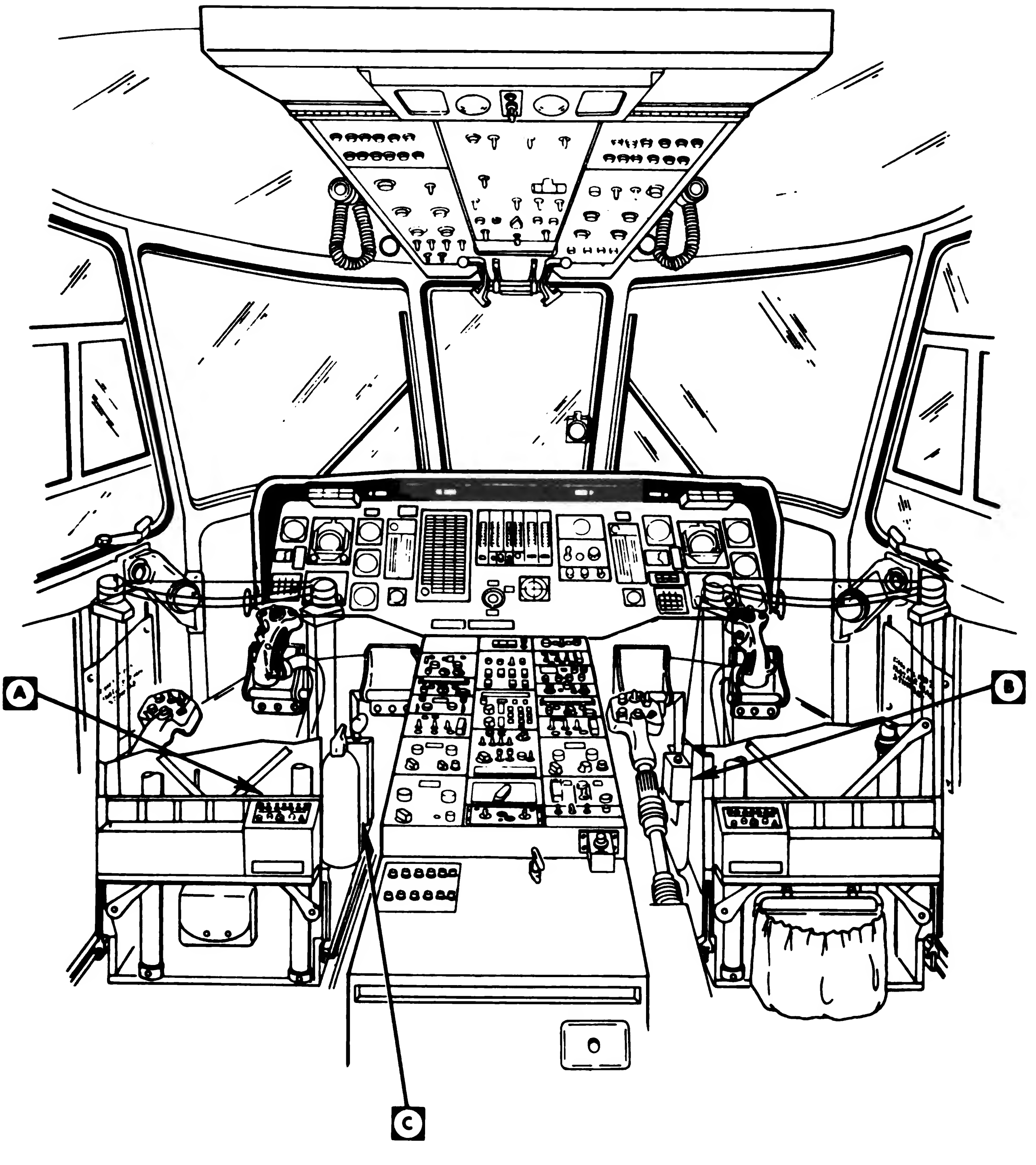


Figure 2-22. Cockpit Lighting (Sheet 1 of 2) NV EH

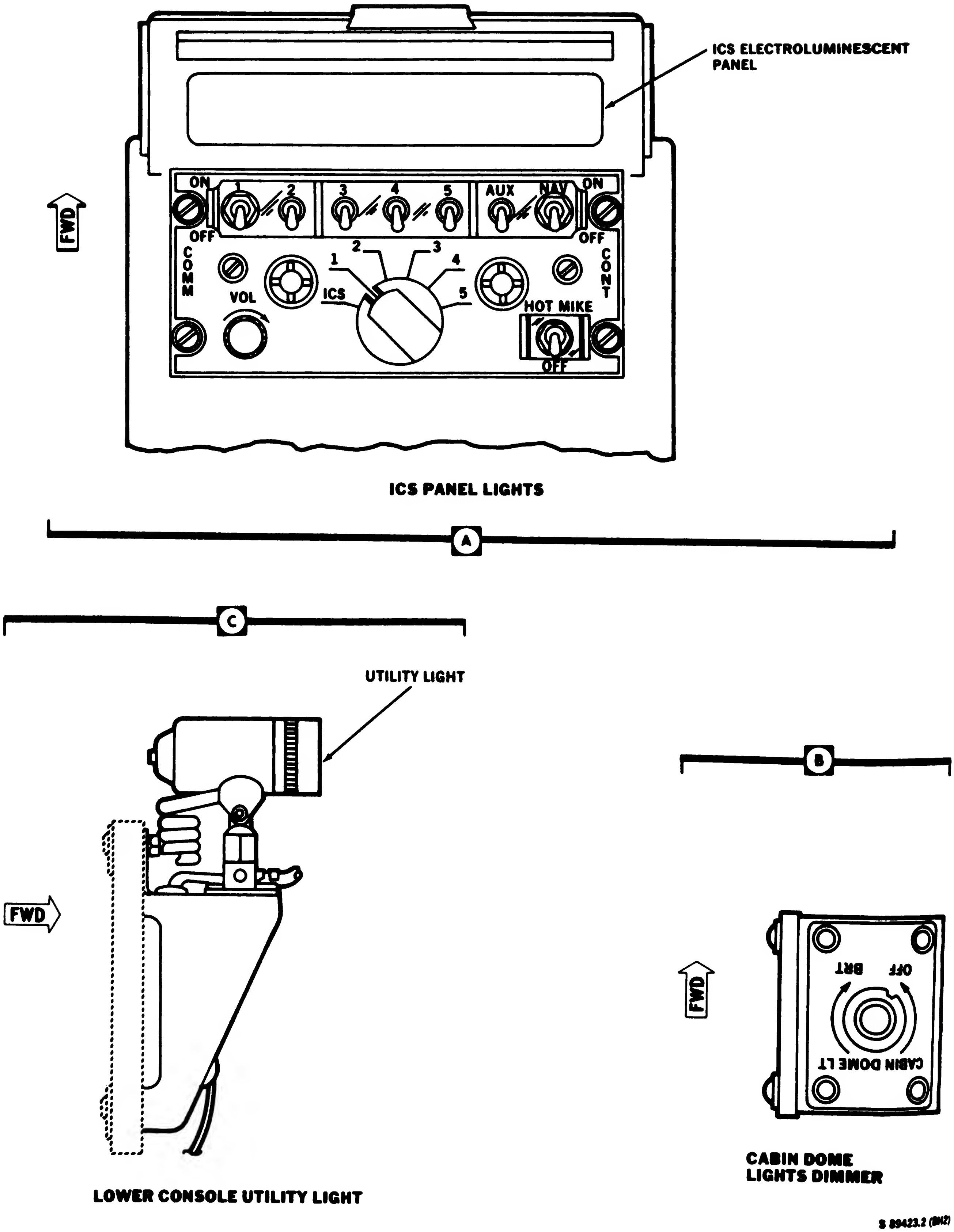


Figure 2-22. Cockpit Lighting (Sheet 2 of 2) NV EH

ights NVG kill system is supplied by the NO. 1 dc primary bus, through a circuit breaker marked LIGHTS PWR CSL. The following lights or indicator are not dimmable and require other means to maintain NVG compatibility: Pilot and copilot overspeed lights SDC failure lights, APX-100 lights, Doppler MEM and MAL lights.

2-193. Before Flight Check.

Prior to night vision goggle flight, a check shall be made to make certain the lighting systems are prepared in accordance with Safety of Flight Message and TM 55-1520-237-23. Taping of the Master Warning Panel is mandatory prior to NVG flight. See TM 55-1520-237-23, Appendix H. At conclusion of NVG operations, the tape shall be removed, the panel lights switch shall be activated, and the lighting rheostats shall be adjusted for normal use.

2-194. NVG Lighting System.

The NVG lighting system consists of interior NVG blue-green lighting. Exterior lighting consists of cargo hook well area electroluminescent lighting, infrared formation and position lights, and attachable/detachable controllable searchlight filter. A dimming feature is incorporated in the searchlight system to provide dimming through the collective SRCH LT PUSH ON - OFF, BRT, DIM switch. The position and formation lights have IR emitters installed within close proximity to the regular installed lights to enhance outside viewing with night vision goggles.

2-195. Cockpit Floodlights.

On helicopters not equipped with NVG lighting, two red and two white cockpit floodlights are on the overhead cockpit floodlight panel, marked RED, REMOTE, and WHITE (Figure 2-6). A rotary dimmer control for each color is marked SECONDARY LIGHTS RED, OFF, BRT, and CKPT FLOOD WHITE, OFF, BRT. If the selector switch is placed to RED or WHITE, the selected color will go on at a fixed intensity. One light of the color not selected may be adjusted to any desired intensity. To adjust intensity of both lights individually, the selected switch must be placed to REMOTE; the intensity level of the desired light may then be adjusted by the SECONDARY LIGHTS or CKPT FLOOD LIGHTS control. Helicopters equipped with NVG compatible lighting, secondary lights are controlled by a switch marked BLUE, OFF, WHITE (Figure 2-22). Power is supplied from the dc essential bus through a circuit breaker marked LTS SEC PNL. Six lights installed in the instrument panel glare shield provide secondary lighting for the instrument panel. The lights are mechanically dimmed by a control on the upper console labeled GLARE SHIELD with marked positions OFF and BRT. Power to operate the glare shield lights is provided from the No. 1 ac primary bus through a circuit breaker, marked GLARE SHLD.

2-196. Flight Instrument Lights.

Instrument lights are grouped into flight instrument and nonflight instruments. The flight instrument lights are divided into pilot's and copilot's. On helicopters not equipped with NVG compatible lighting, lights are controlled by individual rotary intensity controls (Figure 2-6), marked INSTR LTS PILOT FLT OFF and BRT, and COPLT FLT INST LTS, OFF and BRT. The nonflight instrument lights operate in the same manner as the flight instrument lights. The nonflight lights intensity are controlled by a rotary control, marked INSTR LTS NON FLT, OFF and BRT. On helicopters equipped with NVG compatible lighting, instrument lighting is provided by instrument bezels with NVG compatible lights. The radar altimeters lighting incorporates dimming controls on the instrument panel, marked RAD ALT DIMMING for pilot's and copilot's radar altimeters (Figure 2-8). The vertical instrument display system has NVG compatible information panel lighting to make those instruments compatible with the NVG system. Power to operate the instrument lights is provided by the No. 2 ac primary bus through circuit breakers marked LIGHTS PLT FLT and LIGHTS NON FLT, and NO. 1 ac primary bus, through a circuit breaker marked LIGHTS CPLT FLT.

2-197. Lighted Switches Dimmer.

On helicopters equipped with NVG compatible lighting, a dimmer control labeled LIGHTED SWITCHES (Figure 2-6) is provided on the upper console to reduce illumination level of the following panel lighted switches: Pilot and copilot mode select, tailwheel lock, CIS mode select, automatic flight control and No. 1 and No. 2 FUEL BOOST PUMP on lights. The caution advisory panel must be in DIM mode.

2-198. Upper and Lower Console Lights.

On helicopters not equipped with NVG compatible lighting, upper and lower console lights provide illumination of control panels. Each panel is lit by integral lights, and controlled by rheostats on the upper console marked CONSOLE LT, UPPER and LOWER with marked positions OFF and BRT. Power to operate the console lights is provided from the No. 1 ac primary bus through a circuit breaker marked LIGHTS UPPER CSL and No. 1 dc primary bus through a circuit breaker marked LIGHTS LWR CSL. On helicopters equipped with NVG compatible lighting, upper console, cockpit flood secondary lights, engine control quadrant, flight control panel, miscellaneous switch panel, boost pump control panel, ESSS related panels, range extension fuel management panel, retransmission control and rescue hoist panels and compass are illuminated from the No. 1 ac primary bus through dimmer controls marked CONSOLE LT UPPER and LOWER. Circuits are protected by circuit breakers marked' UPPER CNSL LTS and LOWER CNSL LTS. All other lower console panels are illuminated by the lower console auxiliary utility light next to the copilot's seat.

2-199. Utility Lights.

On helicopters not equipped with NVG compatible lighting, two portable cockpit utility lights with coiled cords are attached to the upper console by removable brackets (Figure 2-22), one on each side of the console. The lights may be adjusted on their mountings to direct the light beams or they may be removed and used portably. The utility lights are controlled by a rheostat or a pushbutton on the end of each casting. The lens casting of the lights may be turned to change from white to red and/or spot to flood. On helicopters equipped with NVG compatible lighting, all utility lights are dual (blue/green-white) mode. An auxiliary utility light, located at the right rear of the copilot's seat, is used to illuminate some panels on the lower console for night flight. On helicopters equipped with a transition equipment bay, a utility light is installed on the bay shelf to provide bay lighting. The utility lights operate in the same manner as above. Make certain cockpit utility lights are OFF when not in use. The utility lights operate from the battery utility bus through a circuit breaker marked UTIL LTS CKPT.

2-200. Cabin Dome Lights.

On helicopters not equipped with NVG compatible lighting, three dome lights are provided for cabin lighting (Figure 2-5). Control of cabin lights is from the upper console by a control marked CABIN DOME LTS (Figure 2-6) with intensity control and a light color selector switch. The intensity control has marked positions OFF and BRT, and the light level control may be adjusted to any position between the two extremes. The light color selector switch has marked positions WHITE, OFF, and RED. To place the switch from OFF to WHITE, the switch must first be pulled out to clear a detent. This prevents accidentally placing the switch to WHITE. On helicopters equipped with NVG compatible lighting, cabin dome light operation and control is same as without NVG compatible lighting, except the light colors are white and blue. Dimming control for the cabin dome lights is from a control on the left side of the pilots seat (Figure 2-22), marked CABIN DOME LT, with marked positions OFF and BRT. Power to operate the cabin dome light system is provided from the No. 1 ac primary bus through a circuit breaker marked LIGHTS CABIN DOME.

2-201. Maintenance Light.

A portable 20 watt floodlight, in the cabin at the crew chief station (Figure 2-5), is used by the crew for maintenance work. The light has a 20-foot cord, allowing its use within the cabin and around the main transmission. A switch on the rear end of the light with marked positions, DIM, OFF, and BRIGHT, controls the light intensity. Another maintenance light receptacle, in the aft tailcone, allows the light to be used around the tail section. Power to operate the light is from the battery utility bus through a circuit breaker marked LIGHT UTIL CKPT. The maintenance light is stowed in a bag at the back of the pilot's seat. Power to operate the maintenance lights is provided from the battery utility bus through a circuit breaker, marked UTIL LTS CKPT. Make sure the maintenance and cockpit utility lights are OFF when not in use.

2-202. Exterior Lights.

2-203. Searchlight.

UH On helicopters not equipped with NVG lighting, the searchlight (Figure 2-1) is mounted on the right bottom of the nose section, and is controlled from either collective pitch stick; however, the pilot can override the copilot. The copilot's SRCH LT switch is operational only when the pilot's switch is OFF. The 450 watt light can be moved forward through a 120° arc from the stow position. It can also be turned 360° in either a right or left direction on its axis. The light is operated by a switch labeled SRCH LT ON, OFF and STOW (Figure 2-11). Directional control of the light is provided through the four-position searchlight control switch, labeled EXT (extend), RET (retract), L (left), and R (right). When the SRCH LT switch is placed ON, the lamp will go on, arming the control switch. Placing the control switch to EXT causes the light beam to move forward at a rate of about 12° per second. If the switch is placed to STOW the light will retract at a rate of about 30° per second to the stowed position in the searchlight well. Refer to Chapter 5 for extend/retract limitations. When the light is fully retracted, power is automatically removed. NV On helicopters with NVG lighting, an infrared filter can be installed on the controllable searchlight to enhance viewing objects outside the helicopter when wearing the night vision goggles. With the IR filter installed, maximum wattage lamp to be used is 250 watt. An OUTPUT switch on the searchlight dimmer under the pilot's seat, is placed at NORM when dimming feature on searchlight is desired. When in BYPASS position, the searchlight cannot be dimmed. The IR filter shall not be used with a 450 watt lamp installed. The dimming feature of the controllable searchlight provides a variable light level from 250 to 0 watts to the pilot and copilot through a switch on each collective grip marked PUSH ON - OFF, BRT DIM to control power to the light and the DIM/BRT mode selector. When the light is on, the BRT DIM switch may be moved to select the desired light level. When the wanted level is reached, the switch is released to the center position. The selected level will be maintained until additional DIM or BRT is selected. Power to light and control the searchlight is provided from the dc essential bus through circuit breakers, marked LIGHTS, CONTR PWR and SRCH CONTR. The IR filter may be removed for unaided night flight.

2-204. Landing Light.

One 600-watt landing light is mounted on the left side beneath the nose section and is controlled from both collective pitch stick grips (Figure 2-11). The light can be extended 107° from the stowed position. A dual function switch is used to operate the light. The LDG LT PUSH ON-PUSH OFF switch controls lighting and EXT, RET controls light position. When the light is ON (LDG LT ON advisory light should be on) and the switch is at EXT detent, the light can be positioned at any point between stowed and fully extended, or it will continue to extend until reaching its limit and power is removed. When the switch is held at RET the light retracts to the stowed position. When the light reaches its stowed position, power is automatically removed from the motor. The LDG LT PUSH ON/OFF switch must be pushed OFF (LDG LT ON advisory light should go off). Refer to Chapter 5 for extend/retract limitations. During extension, the travel speed is about 12° per second, and during retract, about 30° per second. Power to light and control the landing light is supplied from the No. 1 dc primary bus through circuit breakers, marked LIGHTS, RETR LDG, CONT and PWR.

2-205. Anti Collision Lights.

WARNING

White strobe lights may cause a safety hazard on the ground where other flight crews and ground personnel may be affected by the brilliance and pulse of the light. In such cases the white light should not be on until the aircraft is ready for take off.

This light system contains four strobes in two separate units, one beneath the aft fuselage and one on top of the aft pylon section. The lights are controlled by two switches on the upper console (Figure 2-6) labeled ANTI COLLISION LIGHTS UPPER, BOTH, LOWER and DAY, OFF, NIGHT. The system consists of a dual power supply and two interchangeable day/night anti-collision lights. The dual supply system provides separate outputs for the aft fuselage light and the pylon mounted light. Each anti-collision light assembly contains two lamps, the upper lamp within a red lens for night operation and the lower within a clear lens for day operation. Proper operation is selected by placing the switch to DAY or NIGHT. The desired strobe(s) is selected by placing the switch to UPPER, LOWER or BOTH. If at BOTH, the lower fuselage and the aft pylon lights will alternately flash 30 to 40 flashes per minute. If the selector switch is placed to UPPER or LOWER, that light will flash at 60 to 80 flashes per minute. To discontinue operation of the anticollision light(s), the DAY-NIGHT switch is placed to OFF. Power to operate the anticollision light system is provided from the No. 2 ac primary bus through a circuit breaker, marked LIGHTS, ANTI COLL.

2-206. Position Lights.

Position lights (Figure 2-1) are outboard of the left and right landing gear support and top tail pylon. The lights are red on the left, green on the right, and white on the tail. Control of the position lights is through the upper console panel containing two switches, marked POSITION LIGHTS, DIM, OFF, BRT, and STEADY, FLASH. When the intensity switch is placed to DIM or BRT, all three lights go on at once. If the STEADY-FLASH switch is placed to FLASH, the three lights will flash. The STEADY position causes the lights to remain on continuously. Power to operate the position lights is provided by No. 2 dc primary bus through a circuit breaker, marked POS LTS. On helicopters with NVG compatible lighting, infrared position lights are installed within close proximity of the standard position lights. NVG operation is selected through a toggle switch on the upper console (Figure 2-6) marked NAV LTS, with switch positions NORM and IR. Position lights are to be selected through a switch marked POSITION LIGHTS, DIM, OFF, or BRT, and mode of operation through a switch marked STEADY or FLASH. Power for control on the IR lights is from the No. 2 dc primary bus through a circuit breaker marked IR LTS.

2-207. Formation Lights.

These lights (Figure 2-1) are on top of the main pylon cowling, tail drive shaft cover, and horizontal stabilator. The system consists of four green electroluminescent lights. The lights are controlled by a single rotary selector switch, marked FORMATION LTS, with marked positions OFF and 1 through 5. Position 5 is the brightest. On helicopters with NVG compatible lighting, operation of the formation lights are the same as without NVG compatible lighting. When NVG operations are required, IR lights may be used to enhance viewing outside the helicopter. IR lights are selected through a toggle switch on the upper console (Figure 2-6) marked, NAV LTS, NORM, and IR. This switch shares operation with the IR position lights when operating in a NVG environment. Dimming of the IR lights is done with the FORMATION LT control, as used with the electroluminescent formation lights. Selection of position 1 through 4 causes the IR formation lights to illuminate at the same intensity. Position 5 causes the lights to illuminate brighter. Power to operate the formation lights is provided from the No. 2 ac primary bus through two circuit breakers, marked LIGHTS, FORM LV and HV.

Section XIV FLIGHT INSTRUMENTS

2-208. Pitot-Static System.

Two electrically-heated pitot tubes with static ports are aft and above the pilot's and copilot's cockpit doors. The right pitot tube is connected to the pilot's instruments and the left pitot tube is connected to the copilot's instruments. Tubing connects the pitot tube static pressure ports to the airspeed indicators, the vertical velocity indicators, and the altimeters. In addition to standard instrumentation, airspeed data is sensed for operation of stabilator, flight path stabilization, pitch bias actuator and command instrument system. Refer to Section IX for pitot tube heater system.

2-209. Attitude Indicating System.

Helicopter pitch and roll attitudes are sensed by the pilot's and copilot's vertical displacement gyroscopes, that apply attitude signals to the vertical situation indicators (VSI) for visual display (Figure 2-8). Signals are applied through the VERT GYRO select switches to the remote indicator on the vertical situation indicators. Helicopter pitch and roll attitudes are shown on the pilot's and copilot's vertical situation indicators. The indicator face contains a fixed bar, representing the helicopter, a movable sphere with a white horizon line dividing the two colors, white above and black below, a fixed bank angle scale and a bank index on the moving sphere. Relative position of the fixed bar (helicopter) and the horizon line indicates the helicopter's attitude referenced to the earth horizon. A ROLL trim knob on the lower left of the VSI permits adjustment of the roll index about 14° ± 6° right and left from zero. A pitch trim knob on the lower right of the VSI permits adjustment of the indicator sphere 14° ± 6° for dive and 7° ± 3° for climb from zero index. If a power failure or unbalance occurs in the pilot's or copilot's vertical displacement gyroscope, a gyroscope power failure flag will appear, indicating ATT, warning the pilot or copilot that pitch and roll attitude signals are not being sent to his indicator. To restore attitude information to the indicator, the pilot or copilot pressed his VERT GYRO select switch on the MODE SEL panel so that ALT appears in the switch window. This causes the ATT flag on the indicator to disappear, and pitch and roll signals are supplied from the operating gyro, restoring attitude information display. Refer to Chapter 3 for description of VERT GYRO select switch.

2-210. Turn Rate Indicating System.

A 4-minute turn rate (turn and slip) indicator is at the bottom center of each VSI (Figure 2-8). The pilot's and copilot's indicators operate independent of each other through TURN RATE switches on the MODE SEL panels. Each system consists of a rate gyro, a turn slip indicator and a select switch. The VSI contains a moving turn rate needle and a fixed turn rate scale for indicating rate and direction of turn. During straight flight the needle is positioned at the center of the scale. When the helicopter turns, the rate-of-turn signal from the rate gyroscope deflects the needle in the proper direction to indicate the turn. Amount of deflection is proportional to the rate-of-turn. A one-needle width deflection represents a turn of 1.5° per second. The VSI also contains a slip indicator that shows uncoordinated turns. If a power failure or unbalance occurs in the pilot's or copilot's rate gyroscope, the associated VSI signal will be lost. To restore rate-of-turn information to the indicator, the pilot or copilot will press the TURN RATE switch on his MODE SEL panel so that ALT appears in the switch window. This applies alternate rate gyroscope signals from the operating GYRO scope to the indicator. Power to operate the pilot's turn rate system is provided from the dc essential bus through a circuit breaker, marked PILOT TURN RATE. The copilot's system is powered from the No. 1 dc primary bus through a circuit breaker, marked copilot TURN RATE GYRO. Refer to Chapter 3 for a description of the TURN RATE select switch.

2-211. Airspeed Indicator.

Two airspeed indicators (Figure 2-8), are installed on the instrument panel, one each for the pilot and copilot. The indicators are differential pressure instruments, measuring the difference between impact pressure and static pressure. System error is noted on two placards below the instrument panel on each side of the lower console. Instrument range markings and limitations are contained in Chapter 5, Section II, System Limits.

2-212. Altimeter/Encoder AAU-32A.

Two altimeters are installed on the instrument panel (Figures 2-8 and 2-23). The altimeter encoder functions as a barometric altimeter for the pilot and a barometric altitude sensor for the AN/APX-100 transponder in mode C. The copilot's functions only as a barometric altimeter. The system is equipped with a continuously operating vibrator to improve altitude measuring accuracy. The altimeter's operating range is from −1000 feet to 50,000 feet. The face of the instrument has a marked scale from zero to nine in 50-foot units. The operating indicators and controls are a 100-foot pointer, 100-foot drum, 1,000-foot drum, 10,000-foot drum, barometric pressure set knob, barometric pressure scale window and warning flag. The warning flag is only used in conjunction with the encoder. A counter window next to the sweep hand contains the three digital drums that rotate to indicate the altitude of the helicopter. Another window in the upper left section of the instrument face indicates the normal code operation. When the system fails to transmit signals to the transponder, a flag marked CODE OFF will appear in the window. A window on the lower right section of the instrument face indicates barometric pressure setting. The barometric pressure set knob is on the lower left corner of the indicator bezel. Power to operate the encoder system is provided by the No. 2 ac primary bus through a circuit breaker, marked PILOT ALTM.

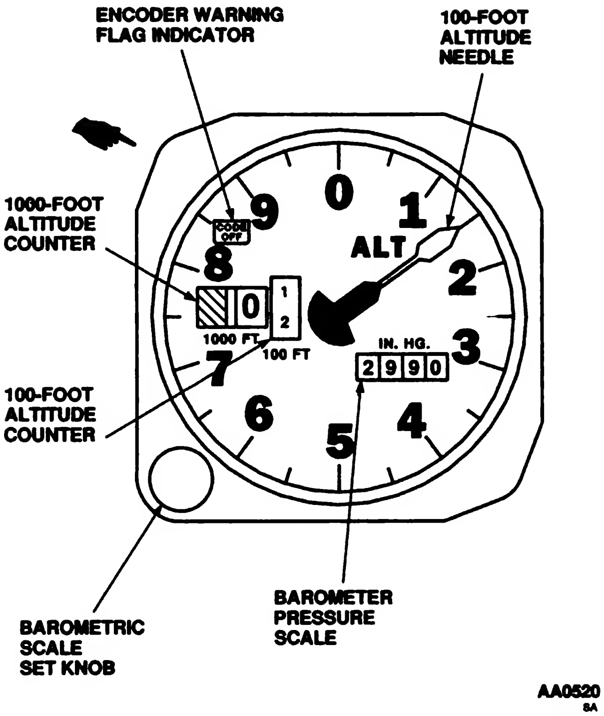


Figure 2-23. Altimeter Encoder AAU-32A

2-213. Vertical Speed Indicator.

Two indicators are installed, one each in front of the pilot and copilot (Figure 2-8), to indicate rate of climb of descent.

2-214. Standby Magnetic Compass.

A magnetic compass is installed above the instrument panel on the right center windshield frame (Figure 2-4). The compass is used as a standby instrument for heading references. A compass correction card with deviation errors is installed on only the right side of the upper console.

2-215. Free-Air Temperature (FAT) Indicator.

The free-air temperature indicator is a direct reading instrument marked FREE AIR, and reads in degrees Celsius. One FAT indicator is installed through the center windshield on helicopters without center windshield anti-ice system. On helicopters with center windshield anti-ice system, two indicators are installed through the overhead windows (Figure 2-4).

2-216. Clock.

Two clocks (Figure 2-8) are installed on the instrument panel. The elapsed time knob is on the upper right corner of the clock. The clock is wound and set with a knob on the lower left corner.

2-217. Master Warning System.

Two master caution lights (Figures 2-8 and 2-22) one each side for the pilot and copilot, marked MASTER CAUTION PRESS TO RESET, are on the master warning panel. They light whenever a caution light goes on. These lights alert the pilots and direct attention to the caution/advisory panel. The master caution lights should be reset at once to provide a similar indication if a second condition or malfunction occurs while the first is still present. The master caution light can be reset from either pilot position. Four red warning lights, also on the master warning panel, require immediate action if they go on. The markings are #1 ENG OUT, #2 ENG OUT, FIRE, and LOW ROTOR RPM. The LOW ROTOR RPM warning light will flash at a rate of three to five flashes per second if rotor rpm drops below 95% RPM R. In addition, if % RPM R drops below 95% or Ng drops below 55%, a low steady tone is provided. The low rotor rpm tone is inhibited on the ground through the left landing gear weight-on-wheels switch. The engine Ng steady tone is not inhibited. The ENG OUT warning lights and tone will go on at 55% Ng SPEED and below. Refer to paragraph 2-33 for description of the FIRE warning lights. Power for the master caution lights is provided from the No. 1 dc primary bus through a circuit breaker, marked LIGHTS CAUT/ADVSY.

2-218. Caution/Advisory Light System.

The caution/advisory panel, (Figures 2-8 and 2-23) is on the left of center of the instrument panel. The caution section (upper two-thirds) of the panel, indicates certain malfunctions or unsafe conditions with amber lights. The advisory section (lower one-third) of the panel shows certain non-critical conditions with green lights. Each light has its own operating circuit and will remain on as long as the condition that caused it to light up exists. The caution and advisory lights are powered by the No. 1 dc primary bus through a circuit breaker, marked LIGHTS CAUTION/ADVSY on the copilot's circuit breaker panel. Refer to major systems for a complete description of caution-advisory panel capsules. Refer to Table 2-1 for a brief description of each fault.

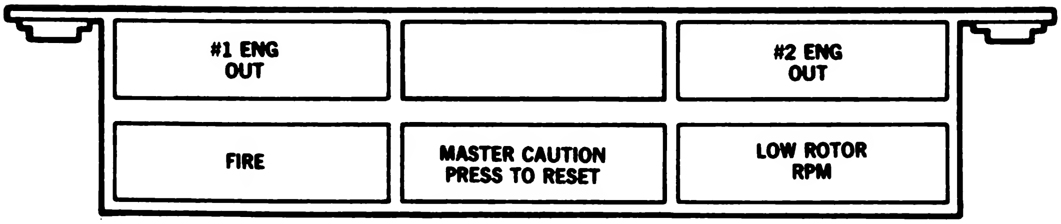


Figure 2-24. Master Warning Panel

2-219. Caution/Advisory BRT/DIM - TEST Switch.

Testing of the caution/advisory lights is done through a momentary spring-loaded to center switch marked BRT/DIM and TEST, on the lower left of the caution/advisory panel (Figure 2-25). Placing the switch to TEST simultaneously checks all lights on the caution/advisory and the master warning panels and #1 and #2 FUEL LOW caution lights and LOW ROTOR RPM warning lights will flash. Placing the BRT/DIM-TEST switch to BRT/DIM causes the caution/advisory lights and master warning lights to change intensity. When the lights are dim and power is removed, the light intensity will return to bright when power is reapplied. The TEST switch position receives power from the No. 1 dc primary bus through a circuit breaker, marked LIGHTS CAUT/ADVSY. The BRT/DIM switch position receives power from the dc essential bus through a circuit breaker, marked CAUT/ADVSY PNL, on the No. 1 circuit breaker panel. On helicopters equipped with NVG compatible lighting, dimming of the cockpit indicator lights operates with the CAUTION panel dimming system.

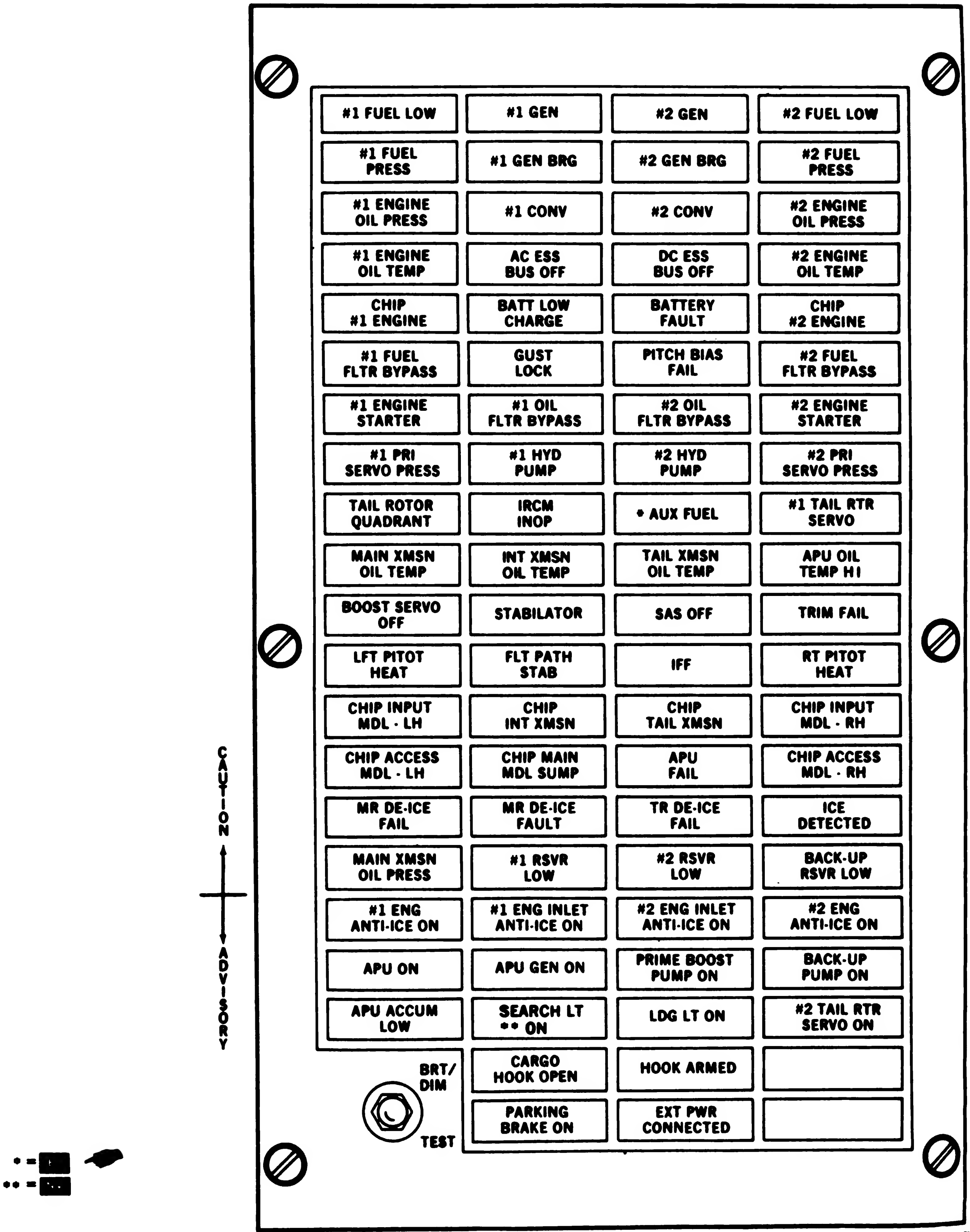


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Figure 2-25. Caution/Advisory Panel (Sheet 1 of 2) UH

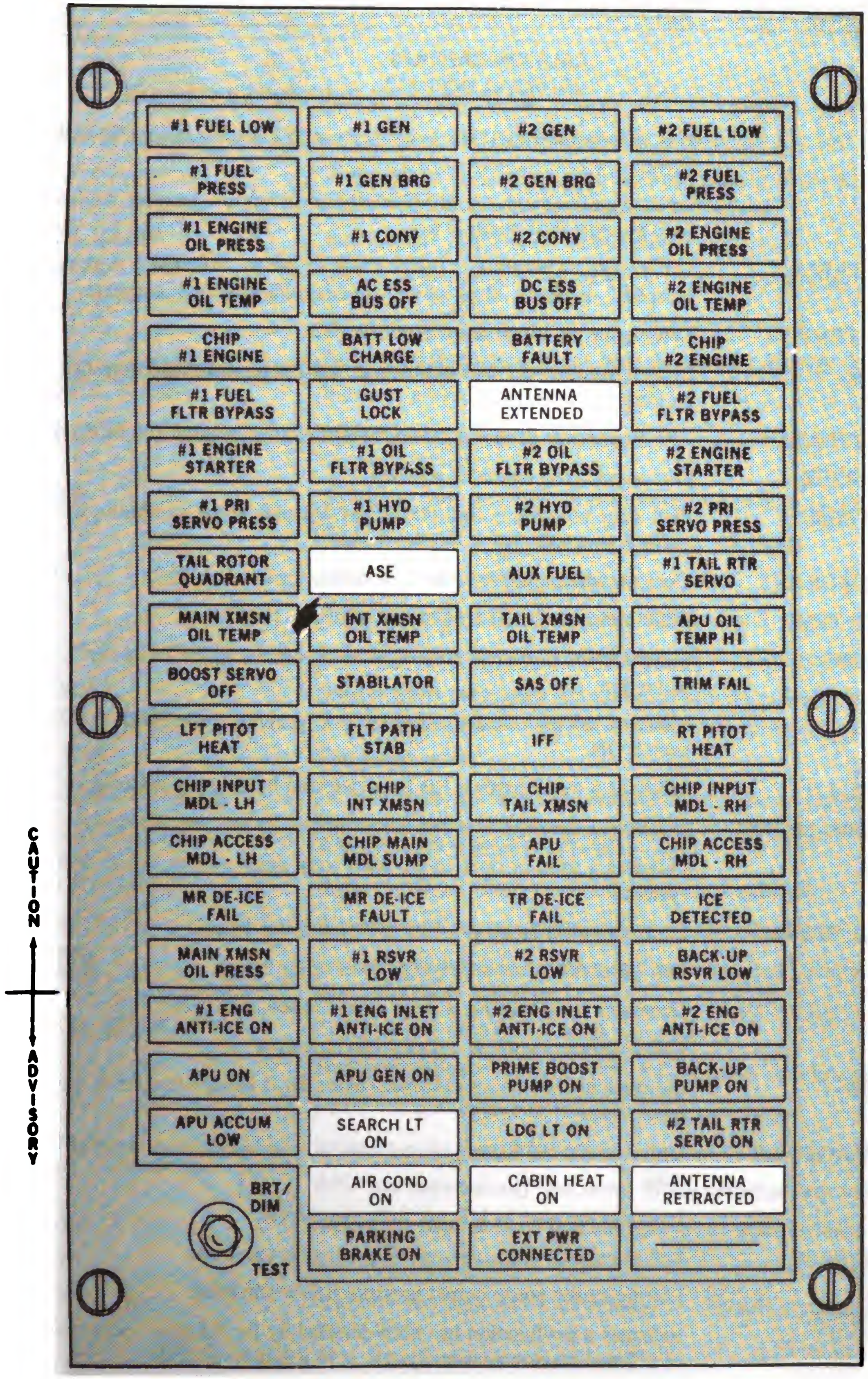

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Figure 2-25. Caution/Advisory Panel (Sheet 2 of 2) EH

Table 2-1. Caution/Advisory and Warning Lights Lighting Parameters (Sheet 1 of 4)

CAUTION CAPSULES

LEGEND	ILLUMINATING PARAMETER OR FAULT
#1 FUEL LOW	Flashes when left fuel tank level is about 172 pounds remaining at normal cruise flight.
#1 FUEL PRESS	Left engine fuel pressure between engine-driven low-pressure fuel pump and high-pressure fuel pump is low.
#1 ENGINE OIL PRESS	Left engine oil pressure is below about 25 psi on helicopters without modified faceplate, or below 20 psi on helicopters with modified faceplate.
#1 ENGINE OIL TEMP	Left engine oil temperature is above 150°C.
CHIP #1 ENGINE	Left engine chip detector in scavenge oil system has metal chip or particles buildup.
#1 FUEL FLTR BYPASS	Left engine fuel filter has excessive pressure differential across filter.
#1 ENGINE STARTER	Left engine start circuit is actuated.
#1 PRI SERVO PRESS	First stage pressure is shut off, or has dropped below minimum, or servo pilot valve is jammed.
TAIL ROTOR QUADRANT	Goes on when a tail rotor cable is broken or disconnected.
MAIN XMSN OIL TEMP	Main transmission oil temperature is above 120°C.
BOOST SERVO OFF	Indicates loss of second stage hydraulic pressure to the boost servo, or a boost servo jam.
LFT PITOT HEAT	Indicates left pitot heater element is not receiving power with PITOT HEAT switch ON.
CHIP INPUT MDL-LH	Indicates a metal particle has been detected by the chip detector.
CHIP ACCESS MDL-LH	Indicates a metal particle has been detected by the chip detector.
MR DE-ICE FAIL	Indicates a short or open in the main rotor deice system, which will disable the system.
MAIN XMSN OIL PRESS	Main transmission oil pressure is below about 14 psi.
#1 GEN	Left generator is not supplying power to the buses.
#1 GEN BRG	Generator main bearing is worn or has failed.
#1 CONV	Left converter (ac to dc current) has no output.
AC ESS BUS OFF	Indicates that no power (115 vac, phase B) is being supplied to the ac essential bus.
BATT LOW CHARGE	Indicates that the battery charge state is at or below about 40% of full charge state.
GUST LOCK	Indicates the gust lock is not fully disengaged.
#1 OIL FLTR BYPASS	Left engine oil filter pressure differential is excessive.
#1 HYD PUMP	Left hydraulic pump output pressure below minimum.
IRCM INOP	Indicates a malfunction has been detected by the infrared countermeasure system or infrared countermeasure system is in a cooldown cycle.

Table 2-1. Caution/Advisory and Warning Lights Lighting Parameters (Sheet 2 of 4)

CAUTION CAPSULES

LEGEND	ILLUMINATING PARAMETER OR FAULT
ASE EH	Indicates the ALQ-156 system is being jammed or the ALQ-136, ALQ-144, ALQ-156, or ALQ-162 system is degraded.
INT XMSN OIL TEMP	Intermediate gear box oil temperature is excessive.
STABILATOR	Stabilator system is turned on but is in the manual mode.
FLT-PATH STAB	Indicates that FPS is inoperative in one or more axis.
CHIP INT XMSN	Indicates a metal particle has been detected by the chip detector.
CHIP MAIN MDL SUMP	Indicates a metal particle has been detected by the chip detector.
MR DE-ICE FAULT	Indicates partial failure of the blade deice system. Uneven shedding of ice can be expected.
#1 RSVR LOW	Hydraulic fluid level has dropped below about 60% of full capacity.
#2 GEN	Right generator is not supplying power to the buses.
#2 GEN BRG	Generator main bearing is worn or has failed.
#2 CONV	Right converter (ac to dc current) has no output.
DC ESS BUS OFF	Indicates that no power is being supplied to the dc essential bus.
BATTERY FAULT	Indicates that the battery has exceeded safe operating temperature (overtemperature), or a battery cell dissimilarity exists.
PITCH BIAS FAIL	(No longer used)
ANTENNA EXTENDED EH	ECM antenna not fully retracted and at least one of these conditions exist: Helicopter is below radar altimeter LO bus setting, or power is lost, or AN/APN-209 is turned off or is removed.
#2 OIL FLTR BYPASS	Right engine oil filter pressure differential is excessive.
#2 HYD PUMP	Right hydraulic pump output pressure below minimum.
AUX FUEL EH	Indicates one or more auxiliary fuel tanks are empty and/or a degraded mode of system operation.
TAIL XMSN OIL TEMP	Tail gear box oil temperature is excessive.
SAS OFF	Hydraulic pressure supplied to the SAS actuator is below minimum.
IFF	Mode 4 is not capable of responding to interrogation.
CHIP TAIL XMSN	Indicates a metal particle has been detected by the chip detector.
APU FAIL	APU was automatically shut down by the electrical sequence unit.
TR DE-ICE FAIL	Indicates a short or open in a tail rotor blade deice element.
#2 RSVR LOW	Hydraulic fluid level has dropped below about 60% of full capacity.
#2 FUEL LOW	Flashes when right fuel level is about 172 pounds remaining at normal cruise flight.

Table 2-1. Caution/Advisory and Warning Lights Lighting Parameters (Sheet 3 of 4)

CAUTION CAPSULES

LEGEND	ILLUMINATING PARAMETER OR FAULT
#2 FUEL PRESS	Right engine fuel pressure between engine-driven low-pressure fuel pump and high-pressure fuel pump is low.
#2 ENGINE OIL PRESS	Right engine oil pressure is below 25 psi on helicopters without modified faceplate, or below 20 psi on helicopters with modified faceplate.
#2 ENGINE OIL TEMP	Right engine oil temperature is above 150°C.
CHIP #2 ENGINE	Right engine chip detector in scavenge oil system has metal chip or particle buildup.
#2 FUEL FLTR BYPASS	Right engine fuel filter has excessive pressure differential across filter.
#2 ENGINE STARTER	Right engine start circuit is activated.
#2 PRI SERVO PRESS	Second stage pressure is shut off, or has dropped below minimum, or servo pilot valve is jammed.
#1 TAIL RTR SERVO	Pressure to the first stage tail rotor servo is below minimum, or servo pilot valve is jammed.
APU OIL TEMP HI	APU oil temperature is above the maximum.
TRIM FAIL	Indicates that yaw, roll, or pitch trim actuators are not responding accurately to computer signals.
RT PITOT HEAT	Indicates right pitot heat element is not receiving power with PITOT HEAT switch ON.
CHIP INPUT MDL-RH	Indicates a metal particle has been detected by the chip detector.
CHIP ACCESS MDL-RH	Indicates a metal particle has been detected by the chip detector.
ICE DETECTED	Indicates that ice has been detected.
BACK-UP RSVR LOW	Hydraulic fluid level has dropped below about 60% of full capacity.

ADVISORY CAPSULES

LEGEND	ILLUMINATING PARAMETER OR FAULT
#1 ENG ANTI-ICE ON	Indicates that No. 1 engine anti-ice/start bleed valve is open.
APU ON	APU is operative.
APU ACCUM LOW	APU accumulator pressure is low.
#1 ENG INLET ANTI-ICE ON	Indicates that No. 1 engine inlet anti-icing air temperature is 93°C or above.
APU GEN ON	APU generator output is accepted and being supplied to the helicopter.
SEARCH LT ON NV EH	Either pilot or copilot has selected SRCH LT switch is on and power is applied to searchlight relay.
CARGO HOOK OPEN	Indicates that cargo hook load beam is not latched.
AIR COND ON EH	Power is applied to air conditioner compressor.
PARKING BRAKE ON	Indicates that PARKING BRAKE handle is pulled.

Table 2-1. Caution/Advisory and Warning Lights Lighting Parameters (Sheet 4 of 4)

ADVISORY CAPSULES

LEGEND	ILLUMINATING PARAMETER OR FAULT
#2 ENG INLET ANTI-ICE ON	Indicates that No. 2 engine inlet anti-icing air temperature is 93°C or above.
PRIME BOOST PUMP ON	Prime boost pump switch is at PRIME or BOOST.
LDG LT ON	Either pilot or copilot has selected LDG LT ON.
HOOK ARMED	The cargo hook release system is armed.
CABIN HEAT ON EH	Aux heater system is operating.
EXT PWR CONNECTED	Indicates that external power plug is connected to helicopter's EXT POWER connector.
#2 ENG ANTI-ICE ON	Indicates that No. 2 engine inlet anti-ice/start bleed valve is open.
BACKUP PUMP ON	Backup pump pressure is being supplied.
#2 TAIL RTR SERVO ON	Pressure to 2nd stage tail rotor servo is above minimum.
ANTENNA RETRACTED EH	ECM antenna fully retracted.

MASTER WARNING PANEL

#1 ENG OUT	No. 1 engine N_g SPEED is below 55%.
FIRE	Indicates a fire detector has actuated a fire warning circuit.
MASTER CAUTION PRESS TO RESET	Indicates a caution light on the caution panel has been actuated by failed system.
#2 ENG OUT	No. 2 engine N_g SPEED is below 55%.
LOW ROTOR RPM	Rotor speed is below about 95% RPM R.

Section XV SERVICING, PARKING, AND MOORING

2-220. Servicing.

Servicing information is given by systems or components. Points used in frequent servicing and replenishment of fuel, oil and hydraulic fluid are shown in Figure 2-26. Fuel and lubricant specifications and capacitites are in Table 2-2. Table 2-3 contains a listing of acceptable commercial fuel.

2-221. Service Platforms and Fairings.

Service platforms are a part of the engine cowlings, providing access to the engines. Each service platform is about 46 inches long and 18 inches wide. It is capable of supporting a static weight of 600 pounds on any area without yielding. The platform is made of composite metal and fiberglass with a honeycomb core. The engine cowling is opened by releasing a latch on the side and pulling outward on a locking handle. The cowling is opened outward and down, providing a standing area at the lower section. When closed, the cowling lock prevents opening in flight.

2-222. Fuel System Servicing.

a. Both tanks (Figure 2-26) may be serviced simultaneously through pressure refueling or closed circuit refueling. They may be serviced individually by gravity refueling through refueling ports on the left and right sides of the helicopter.

CAUTION

The two range extension tanks must be serviced with a equal amount of fuel in each to prevent going over helicopter CG limits.

b. Both range extension tanks are serviced individually by gravity refueling through the refueling ports.

c. Servicing of the external extended range tanks can be done only by gravity refueling through refueling ports on the forward top of each tank. ES

2-223. Fuel Types.

Fuels are classified in Table 2-3.

2-224. Use of Fuels

Mixing of fuels in fuel tanks. When changing from one type of authorized fuel to another, for example JP-4 to JP-5, it is not necessary to drain the helicopter fuel system before adding the new fuel. Fuels having the same NATO code number are interchangeable. Jet fuels conforming to ASTM D-1655 specification may be used when MIL-T-5624 fuels are not available. This usually occurs during cross-country flights where helicopters using NATO F-44 (JP-5) are refueled with NATO F-40 (JP-4) or Commercial ASTM Type B fuels. Whenever this condition occurs, the operating characteristics may change in that lower operating temperature: slower acceleration, easier starting, and shorter range may be experienced. The reverse is true when changing from F-40 (JP-4) fuel to F-44 (JP-5) or Commercial ASTM Type A-1 fuels.

2-225. Gravity Refueling.

a. Ground helicopter to fuel truck or other suitable ground.

b. Plug hose nozzle ground into the helicopter grounding jack, marked GROUND HERE, above refueling ports.

c. Removal fuel filler caps and refuel. Refer to Table 2-2 for fuel quantities.

2-226. Pressure Refueling.

a. Ground helicopter to fuel truck or other suitable ground.

b. Ground fuel dispenser nozzle to the helicopter grounding point marked GROUND HERE, above refueling ports.

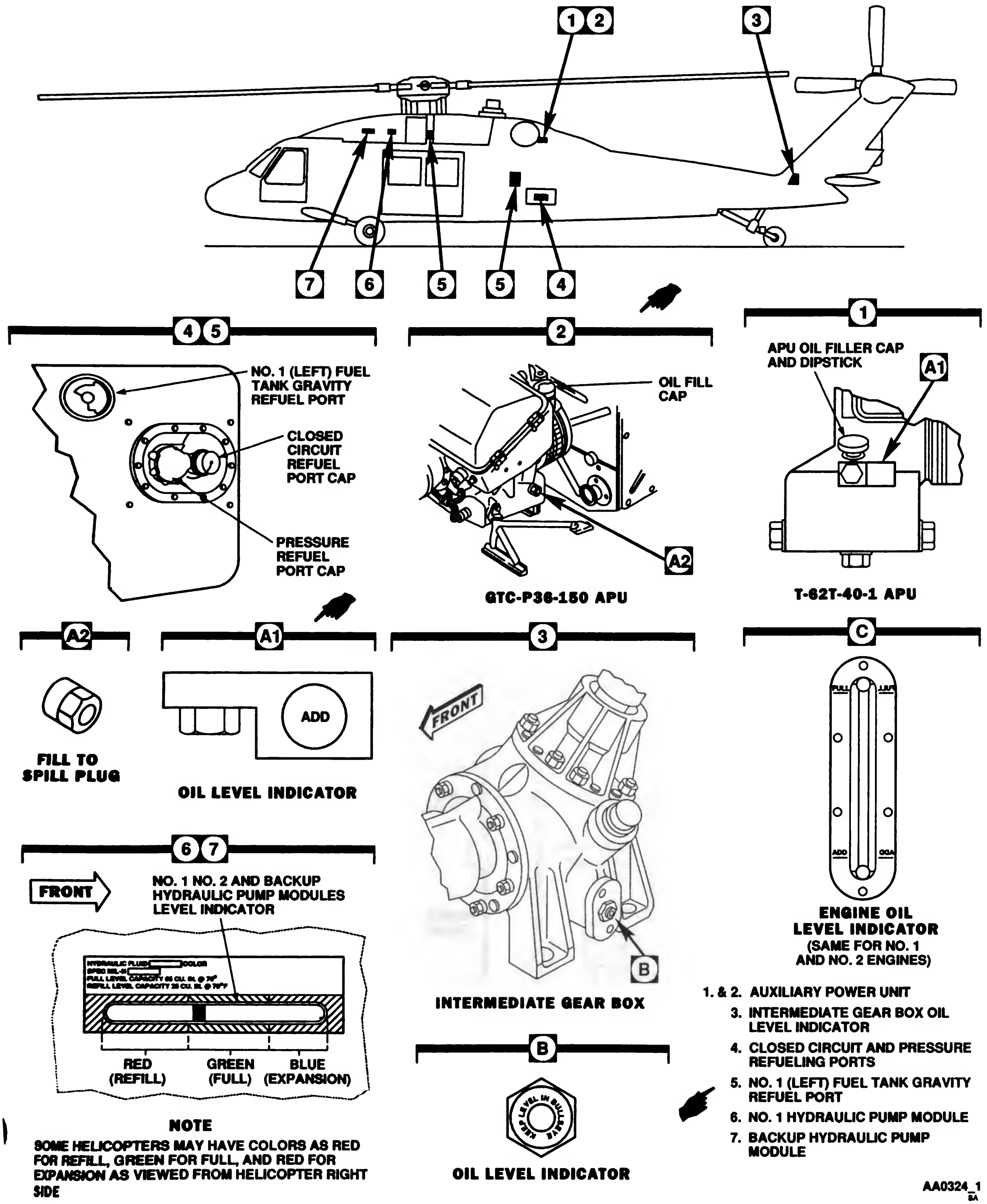
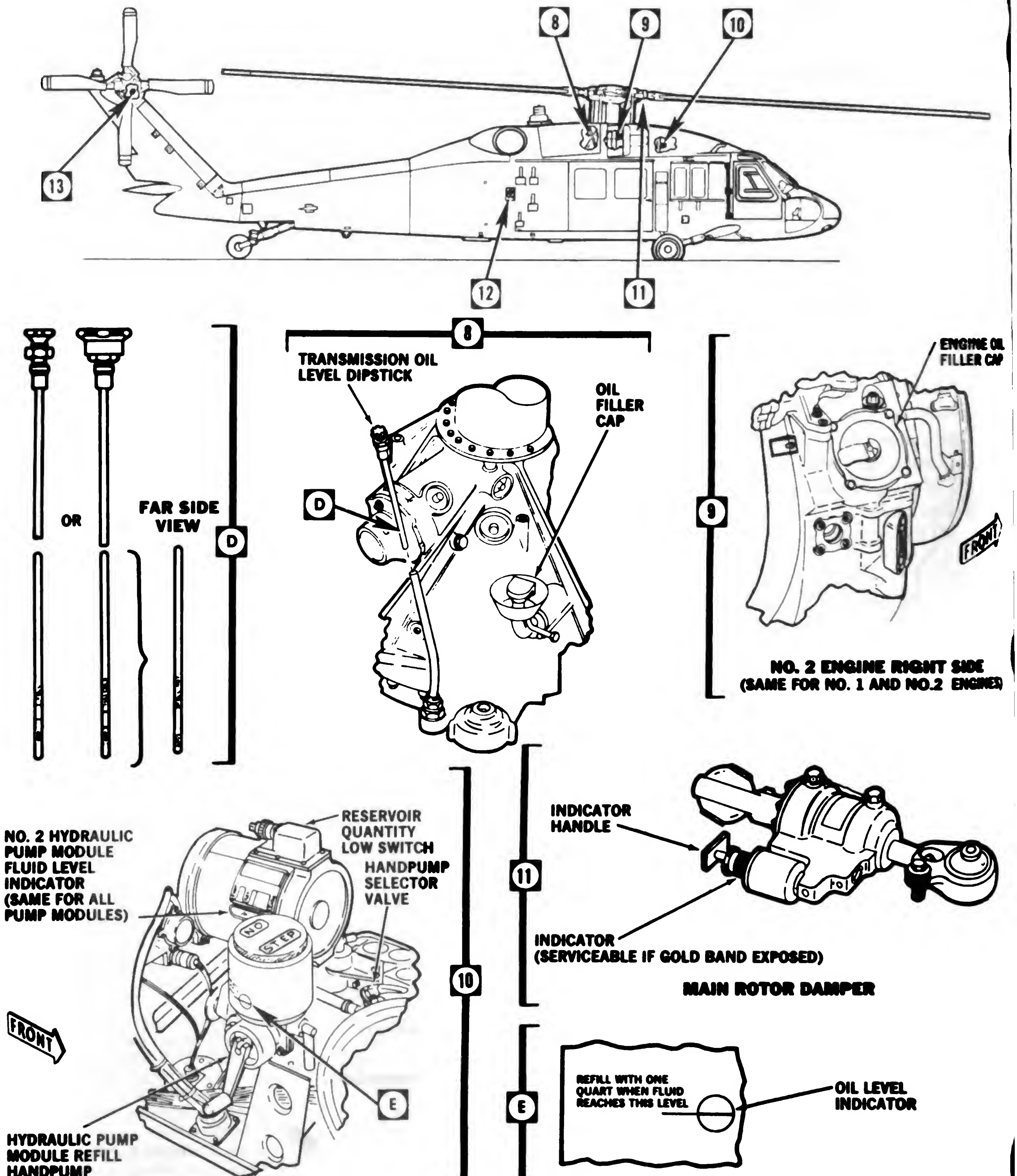


Figure 2-26. Servicing Diagram (Sheet 1 of 3)



8. MAIN TRANSMISSION OIL FILLER PORT AND DIP STICK
9. NO. 2 ENGINE OIL FILLER PORT AND SIGHT GAGE
10. NO. 2 HYDRAULIC PUMP MODULE AND PUMP MODULE REFILL HANDPUMP
11. MAIN ROTOR DAMPER CHARGE INDICATOR
12. NO. 2 (RIGHT) FUEL TANK GRAVITY REFUEL PORT
13. TAIL ROTOR GEAR BOX OIL LEVEL SIGHT GAGE

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Figure 2-26. Servicing Diagram (Sheet 2 of 3)

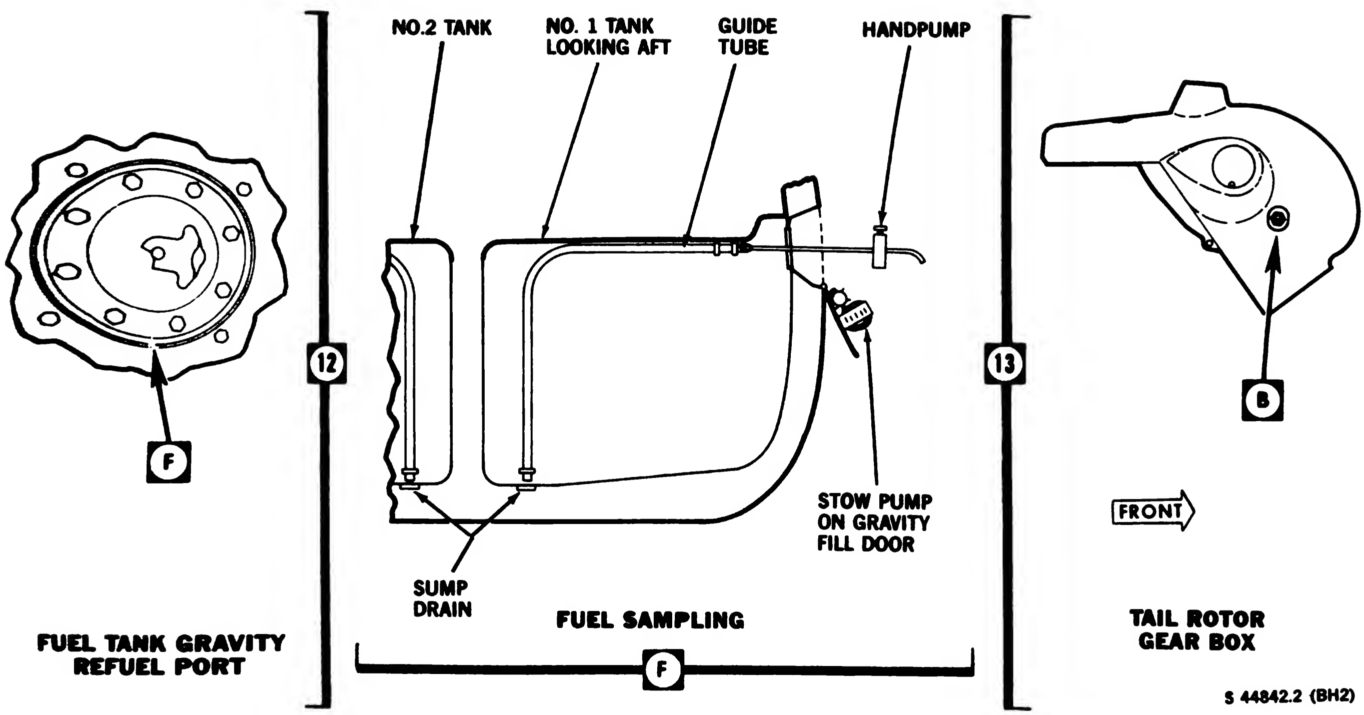


Figure 2-26. Servicing Diagram (Sheet 3 of 3)

Table 2-2. Fuel and Lubricants, Specifications, and Capacities (Sheet 1 of 2)

SYSTEM	SPECIFICATION	CAPACITY
Fuel	Primary: Grade JP-4 (NATO Code F-40) (Note 6) Alternate: Grade JP-5 (NATO Code F-44) (Notes 1 and 6) Grade JP-8 (NATO Code F-34) (Note 1)	Main Tanks usable U.S. Gallons of fuel are: 362 gravity, 361 pressure, and 358 closed circuit. Range Extension Tanks 780 usable U.S. Gallons. Extended Range Tanks Gravity Refueling: 230 U.S. Gallons.

WARNING

Lubricating oils MIL-L-23699 and MIL-L-7808 contain materials hazardous to health. They produce paralysis if swallowed. Long contact may irritate the skin. Wash hands thoroughly after handling. Oils may burn if exposed to heat or flames. Use only with proper ventilation.

SYSTEM	SPECIFICATION	CAPACITY
Engine oil	MIL-L-23699 (NATO Code 0-156) MIL-L-7808 (NATO Code 0-148) (Notes 2 and 3)	7 U.S. Quarts
Auxiliary power unit	MIL-L-23699 (NATO Code 0-156) MIL-L-7808 (NATO Code 0-148) (Notes 2 and 3)	3 U.S. Quarts (T-62T-40-1) 2 U.S. Quarts (GTC-P36-150)
Transmission oil	MIL-L-23699 (NATO Code 0-156) MIL-L-7808 (NATO Code 0-148) (Note 3)	7 U.S. Gallons
Intermediate gear box oil	MIL-L-23699 (NATO Code 0-156) MIL-L-7808 (NATO Code 0-148) (Note 3)	2.75 U.S. Pints
Tail gear box oil	MIL-L-23699 (NATO Code 0-156) MIL-L-7808 (NATO Code 0-148) (Note 3)	2.75 U.S. Pints
First stage hydraulic reservoir	MIL-H-83282 MIL-H-5606 (NATO Code H-515) (Note 4)	1 U.S. Quart
Second stage hydraulic reservoir	MIL-H-83282 MIL-H-5606 (NATO Code H-515) (Note 4)	1 U.S. Quart
Backup hydraulic reservoir	MIL-H-83282 MIL-H-5606 (NATO Code H-515) (Note 4)	1 U.S. Quart
Rescue Hoist	Mobil ATF DEXRON Type A (Note 5)	

Table 2-2. Fuel and Lubricants, Specifications, and Capacities (Sheet 2 of 2)

APPROVED COMMERCIAL OILS

NOTE

Commercial oils listed below are approved alternates for engines and gear boxes except as indicated.

Source	Primary or Standard Oil	Alternate Oil
U.S. Military Oil	MIL-L-23699	MIL-L-7808
NATO Code No.	0-156	0-148
COMMERCIAL OIL	TYPE II	TYPE I
Shell Oil Company	Aeroshell Turbine Oil 500	
Castrol Ltd. (Not qualified for use in gear boxes)	Castrol 205	Castrol 325
Exxon Co.	Exxon Turbo Oil 2380	Exxon Turbo Oil 2389
Mobil Oil Co.	Mobil Jet II	
Stauffer Chemical Co.	Stauffer Jet II	

NOTES

1. When starting in ambient temperatures below −34°C (−29°F), do not use JP-5 or JP-8.
2. When starting in ambient temperatures of −34°C (−29°F) or below, lubricating oil MIL-L-7808 must be used. It is not advisable to mix MIL-L-23699 oil with MIL-L-7808 oil.
3. If the type oil being used is not available, another authorized type oil may be added. When one type oil is mixed with another, it is not necessary to drain the system and refill with one type oil. No mixing is allowed for cold temperature operation.
4. For operation below −34°C (−29°F), MIL-H-5606 (NATO Code H-515) shall be used. Mixing MIL-H-5606 with MIL-H-83282 degrades fire-resistant qualities of MIL-H-83282.
5. Below −40°C (−40°F) Shell DONAXT-1 must be used.
6. Fuel settling time for jet (JP) fuel is 1 hour per foot depth of fuel. Allow the fuel to settle for the prescribed period before any samples are taken (about 4 hours for proper settling).

Table 2-3. Approved Fuels (Sheet 1 of 2)

Source	Primary or Standard Fuel	Alternate Fuels	
U.S. Military Fuel	JP-4	JP-5	JP-8
NATO Code No.	F-40	F-44	F-34
COMMERCIAL FUEL (ASTM-D-1655)	JET B	JET A	JET A-1
American Oil Co.	American JP-4	American Type A	
Atlantic Richfield Richfield Div	Arcojet B	Arcojet A Richfield A	Arcojet A-1 Richfield A-1
B.P. Trading	B.P.A.T.G		B.P.A.T.K.
Caltex Petroleum Corp.	Caltex Jet B		Caltex Jet A-1
City Service Co.		CITCO A	
Continental Oil Co.	Conoco JP-4	Conoco Jet-50	Conoco Jet-60
Exxon Co. U.S.A.	Exxon Turbo Fuel B	Exxon A	Exxon A-1
Gulf Oil	Gulf Jet B	Gulf Jet A	Gulf Jet A-1
Mobil Oil	Mobil Jet B	Mobil Jet A	Mobil Jet A-1
Phillips Petroleum	Philjet JP-4	Philjet A-50	
Shell Oil	Aeroshell JP-4	Aeroshell 640	Aeroshell 650
Sinclair		Superjet A	Superjet A-1
Standard Oil Co.		Jet A Kerosene	Jet A-1 Kerosene
Chevron	Chevron B	Chevron A-50	Chevron A-1
Texaco	Texaco Avjet B	Avjet A	Avjet A-1
Union Oil	Union JP-4	76 Turbine Fuel	
INTERNATIONAL FUEL	NATO F-40	NATO F-44	NATO F-34
Belgium	BA-PF-2B		
Canada	3GP-22F	3-6P-24c	

Table 2-3. Approved Fuels (Sheet 2 of 2)

Source	Primary or Standard Fuel	Alternate Fuels
INTERNATIONAL FUEL	NATO F-40	NATO F-44
Denmark	JP-4 MIL-T-5624	
France	Air 3407A	
Germany (West)	VTL-9130-006	UTL-9130-007 UTL-9130-010
Greece	JP-4 MIL-T-5624	
Italy	AA-M-C-1421	AMC-143
Netherland	JP-4 MIL-T-5624	D. Eng RD 2493
Norway	JP-4 MIL-T-5624	
Portugal	JP-4 MIL-T-5624	
Turkey	JP-4 MIL-T-5624	
United Kingdom (Britain)	D. Eng RD 2454	D. Eng RD 2498

NOTES

Commercial fuels are commonly made to conform to American Society for Testing and Materials (ASTM) Specification D 1655. The ASTM fuel specification does not contain anti-icing additives unless specified. Icing inhibitor conforming to MIL-L-27686 (Commerical name PRIST) shall be added to commercial and NATO fuels, not containing an icing inhibitor, during refueling operations, regardless of ambient temperatures. Adding PRIST during refueling operation shall be done using accepted commercial mixing procedures. The additive provides anti-icing protection and also functions as a biocide to kill microbial growths in helicopter fuel systems.

c. Connect fuel dispenser nozzle to pressure refueling adapter.

CAUTION

Damage to the fuel system could result if refueling hose pressure exceeds 55 psi during pressure refueling or 15 psi during closed circuit refueling.

NOTE

The system is designed to restrict fuel flow to 300 gpm during pressure refueling at a nozzle pressure of 55 psi and 110 gpm at a nozzle pressure of 15 psi during closed circuit refueling.

d. Start fuel flow from fuel dispenser and refuel helicopter.

CAUTION

If fuel is observed flowing from vent, discontinue refueling and make an entry on DA Form 2408-13.

e. Once fuel has reached the desired level, remove the fuel dispenser nozzle from the refueling adapter and cap pressure fueling adapter.

2-227. Fuel Sampling System.

Fuel sampling is done with a thumb-operated handpump (Figure 2-26) containing 5 feet of plastic tubing. The tubing is placed in a guide tube inside the fuel tank and is directed to the bottom of the tank. The handpump is stroked and fuel is drawn from the tank, with contaminants at the bottom. When sampling is completed, the tubing is emptied, rolled, and stowed with the pump on the gravity refueling door. Fuel sampling of the range extension fuel tanks is done in the same manner. An alternate method of draining the fuel is from the sump drains.

2-228. External Air Source/Electrical Requirements.

Refer to Chapter 5 for limitations.

2-229. Engine Oil System Servicing.

CAUTION

The helicopter must be level to get accurate oil tank readings. When the helicopter is parked on a slope, the downslope engine will read higher oil level than actual, and the upslope engine will read lower.

The engine oil tank (Figure 2-26) is within the main frame. When the oil level reaches the ADD

Figure 2-27. Deleted

mark, oil should be added to bring the level to the full mark on the sight gage. Wait at least 10 minutes after engine shutdown before checking engine oil level. Before adding oil, determine whether system contains MIL-L-7808 oil or MIL-L-23699 oil. If flights of over 6 hours are made, engine oil level must be at the full line of sight glass before flight.

2-230. APU Oil System Servicing.

The APU oil supply is in the APU gear box asembly. The sump filler/oil dipstick port (T-62T-40-1) or cap and fill to spill plug (GTC-P36-150) (Figure 2-26), are on the left side of the gear box housing.

2-231. Handpump Reservoir Servicing.

CAUTION

Do not allow reservoir level to fall below refill line.

Servicing of the refill handpump is done when fluid level decreases to the refill line on the fluid level sight gage, on the side of the pump tank. When fluid level decreases to the refill line, 1 quart of hydraulic fluid can be poured into the reservoir after removing the refill cap. Handpump reservoir level should be replenished only in 1 quart units.

2-232. Hydraulic Systems Servicing.

Reservoirs (Figure 2-26) for the hydraulic systems are on the hydraulic pump modules. Fluid level sight gages are visible on the side of each pump. All hydraulic pump reservoir capacities are 1 U.S. quart to the blue (red on some pumps) mark. When the indicator reaches the red area (refill) point, 2/3 of a pint is required to return the indicator to the green mark. The fluid level indication is the 1/8 inch wide gold band at the outboard edge of the level piston. To refill the reservoirs, the fluid is supplied from the manual handpump. After flight, fluid in hydraulic systems will be hot. Piston movement of up to 3/8 inch into the blue (red on some pumps) (overfill) zone is acceptable. When piston is beyond this limit, bleed off enough fluid to bring piston back to 3/8 inch above fill limit. To replenish the pump reservoir fluid, do the following:

a. Unscrew handpump lid and pour in clean hydraulic fluid, MIL-H-83282, until pump is full. Make sure you can always see oil in pump reservoir window while servicing, so not to pump air into pump module's reservoir. Keep filling.

b. Make sure pump cover is clean, then screw lid on tight.

c. Turn selector valve to desired reservoir to be filled. OUT 1 is left pump module, OUT 2 is right pump module, and OUT 3 is backup pump module.

d. While holding selector valve handle down, crank pump handle on handpump clockwise and fill desired hydraulic pump module until forward end of piston in reservoir window is at forward end of green decal on reservoir housing. At the same time, push in and turn bleed valve, and bleed air from pump module. Release button when air-free oil shows.

e. Check that reservoirs stay full (forward end of piston at forward end of green decal), with fluid at ambient temperature 1 hour after flight.

f. Make sure area remains clean during procedure.

g. Stow selector valve handle in OUT 4 (capped off) position.

h. Turn on electrical power.

i. Check caution panel for #1 RSVR LOW, #2 RSVR LOW, or BACK-UP PUMP RSVR LOW lights are off.

2-233. Rescue Hoist Lubrication System Servicing.

Servicing of the rescue hoist lubrication system consists of replacing automatic transmission fluid in the boom head and the gear box (Figure 4-15) until oil level sight gages indicate full.

2-234. Main Transmission Oil System Servicing.

The transmission oil supply is in the sump case with the filler port and dipstick gauge (Figure 2-26), on the right rear of the main module. When filling is required, oil is poured through the filler tube on the main module case, and oil level is checked by a dipstick, marked FULL and ADD, or FULL COLD and ADD on one side of the dipstick and FULL HOT and ADD on the other side. A valid check of oil level may be made as follows:

NOTE

Remove the dipstick, clean and reinsert to obtain correct reading.

a. Single scale dipstick is for checking cold oil levels. Wait at least 2 hours after shutdown to check oil. If oil level must be checked when hot (immediately to 1/2 hour after shutdown), oil level will read about 1/2 inch low (halfway between full and add mark or 1/2 inch below add mark).

b. Dual scale dipstick is for checking cold or hot oil levels. Use appropriate scale when checking oil level. Read hot side of dipstick when checking hot oil (immediately to 1/2 hour after shutdown), or cold side of dipstick when checking cold oil (at least 2 hours after shutdown).

2-235. Tail and Intermediate Gear Box Servicing.

The intermediate gear box oil level sight gage (Figure 2-26) is on the left side of the gear box. The tail gear box oil level sight gauge is on the right side.

2-236. Parking.

The methods used to secure the helicopter for temporary periods of time will vary with the local commands. The minimum requirements for parking are: gust lock engaged and wheel brakes set, tailwheel locked, and wheels properly chocked. Engine inlet covers, exhaust covers, and pitot covers should be installed. When required, the ignition system and the doors and window should be locked.

2-237. Protective Covers and Plugs.

The covers and plugs (Figure 2-28) protect vital areas from grit, snow, and water. The protected areas are avionics compartment air inlet, engine air inlet/accessory bay, engine and APU exhausts, pitot tubes, IRCM transmitter and APU air inlet and main transmission oil cooler exhaust. Covers and plugs should be installed whenever the helicopter is to be on the ground for an extended period of time. Each cover may be installed independently of the others.

2-238. Mooring.

Mooring fittings are installed at four points on the helicopter (Figure 2-28). Two fittings are at the front of the fuselage, one above each main landing gear strut, and two at the rear, one attached to each side of the aft transition section. These fittings are used to tie down the helicopter when parked, and wind conditions require it.

2-239. Mooring Instructions.

Refer to TM 1-1520-250-23-1 for mooring instructions.

2-240. Main Rotor Tiedown.

Tiedown of the main rotor should be done when the helicopter will be parked for a period of time or when actual or projected wind conditions are 45 knots and above. To tiedown main rotor blades, do this:

a. Turn rotor head and position a blade over centerline of helicopter. Install tiedown fitting into receiver while pulling down on lock release cable. Release cable when fitting is installed in blade receiver.

b. Uncoil tiedown rope.

c. Repeat steps a. and b. for each remaining blade.

d. Turn blade to about 45° angle to centerline of helicopter and engage gust lock.

CAUTION

Do not deflect main rotor blade tips more than 6 inches below normal droop position when attaching tiedowns. Do not tie down below normal droop position.

e. Attach tiedown ropes to helicopter as shown in Figure 2-28. To release tiedown fitting, pull down on lock release cable and remove fitting from blade.

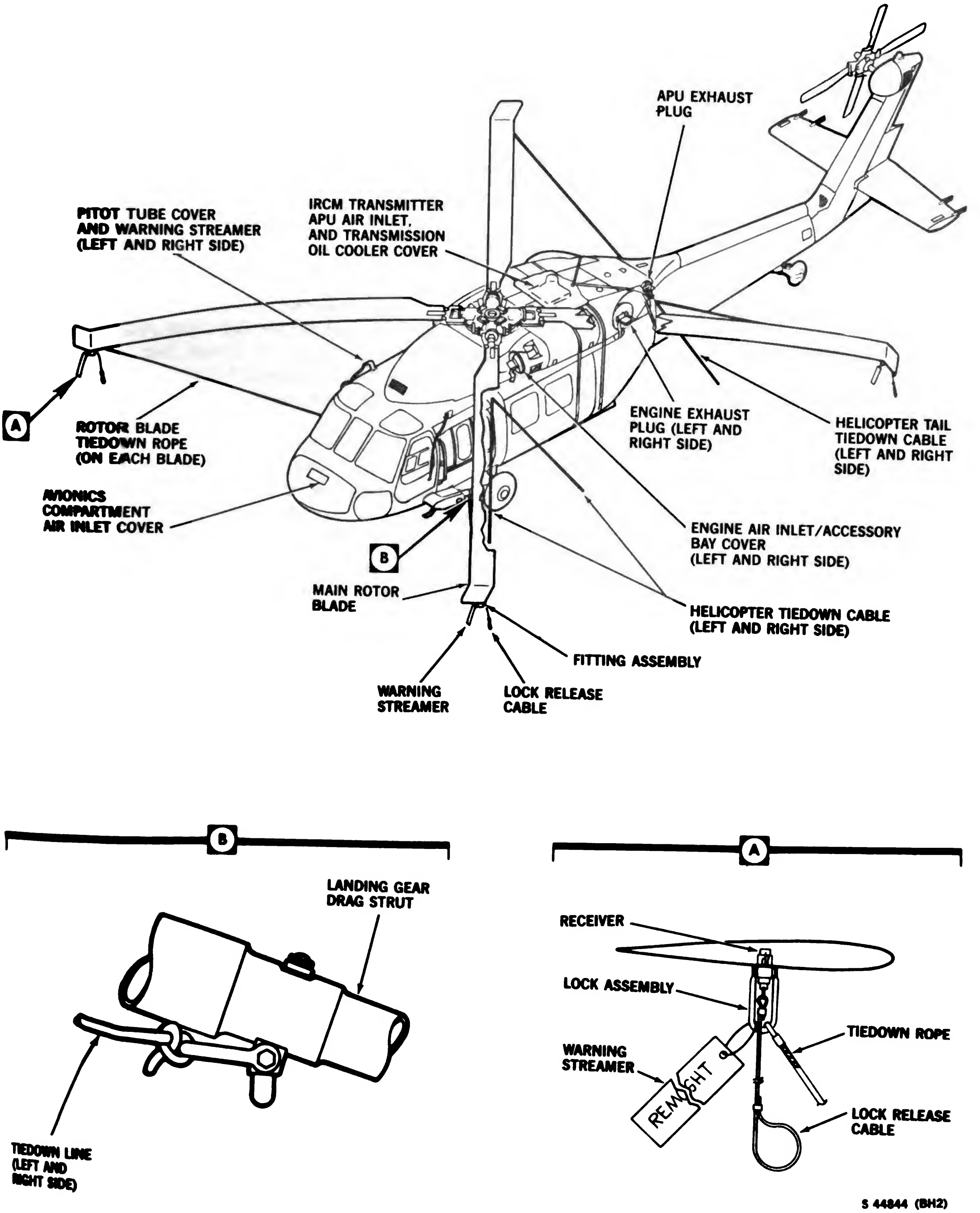


Figure 2-28. Mooring

CHAPTER 3

AVIONICS

Section I GENERAL

3-1. Description.

The avionic subsystems consist of the communications equipment providing VHF-AM, VHF-FM, and UHF-AM communications. The navigation equipment includes, LF-ADF, VOR, ILS, marker beacon, Doppler [illegible] , or Integrated Inertial Navigation System [illegible]. VHF-FM homing is provided through the No. 1 VHF-FM communication radio. Transponder equipment consists of an IFF receiver-transmitter with inputs from barometric altimeter for altitude fixing. Absolute height is provided by a radar altimeter. Each antenna will be described with its major end item, and locations as shown in Figure 3-1.

3-2. Avionics Equipment Gonfiguration.

Equipment configuration is as shown in Table 3-1.

3-3. Avionics Power Supply.

Primary power to operate the avionic systems is provided from the No. 1 and No. 2 dc primary buses and the essential dc bus, and No. 1 and No. 2 ac primary buses (Figures 2-18 electrical system diagrams). When operating any of the avionics equipment, helicopter generator output must be available or external ac power connected. Function selector switches should be at OFF before applying helicopter power.

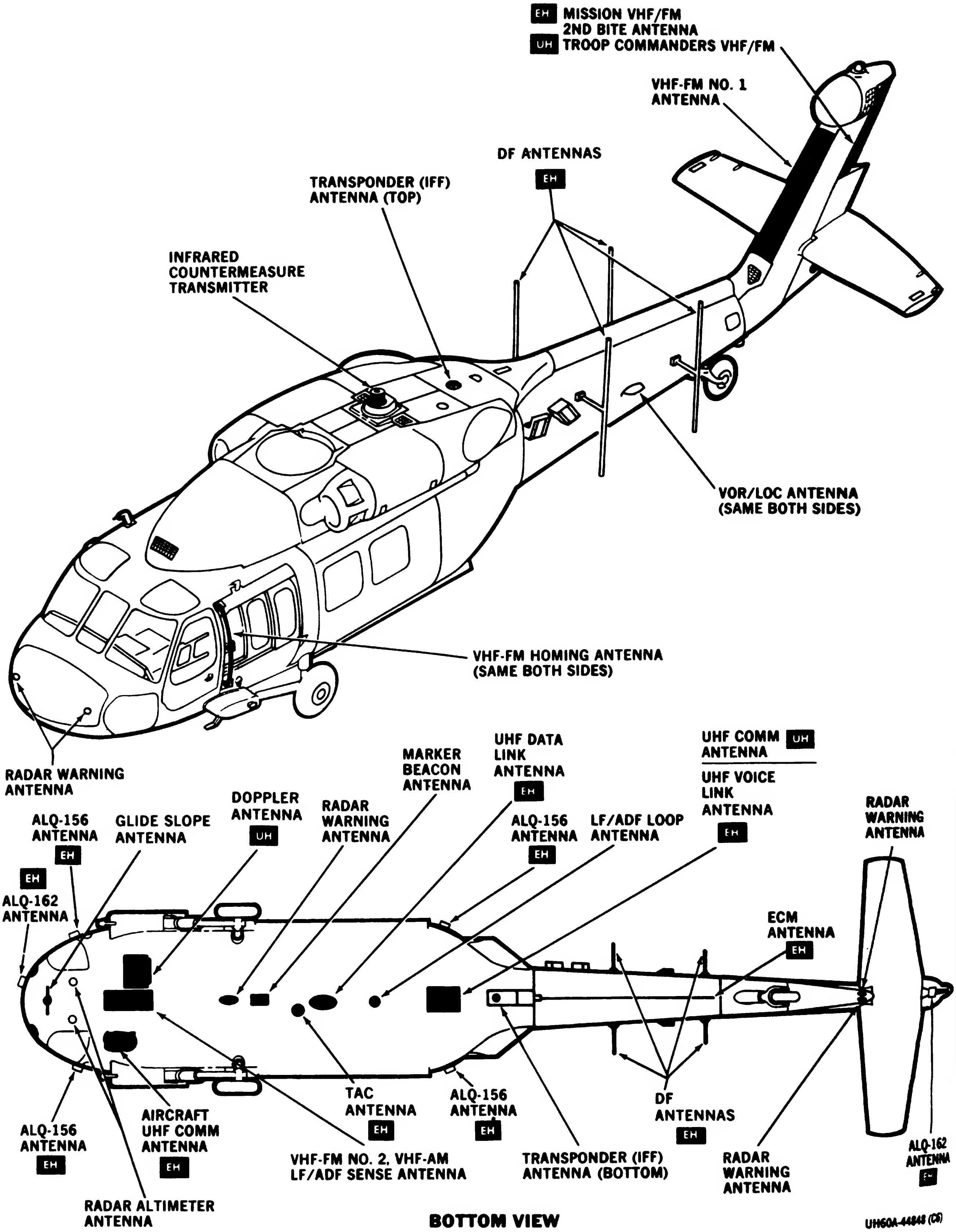


Figure 3-1. Antenna Arrangement

Table 3-1. Communication/navigation equipment (Sheet 1 of 2)

FACILITY	NOMEN-CLATURE	USE	RANGE	CONTROL LOCATION	REMARKS
Intercommunication	Interphone control C-6533/ARC	Intercommunication between crewmembers and control of navigation and communication radio.	Stations within helicopter	Cockpit lower console, crewchief/gunner's stations, and troop commander's station at center of cabin overhead with handset	
FM communications (If installed) UH	Radio set AN/ARC-114A VHF-FM No. 1	Two-way voice communications; FM and continuous-wave homing frequency range 30 through 75.95 MHz	*Line of sight	Lower console	FM NO. 1 transmitter may be used only in helicopters serial No. 79-23273 and subsequent and those helicopters modified by MOD 99-122 and 99-122-1.
FM communications (If installed) UH	Radio Set AN/ARC-114A VHF-FM No. 2	Same as No. 1 VHF-FM, except no homing is provided		Lower console	
VHF communications (If installed) UH	Radio Set AN/ARC-115A VHF-AM	Two-way voice communications in the frequency range of 116.000 through 149.975 MHz	*Line of sight	Lower console	Radio Set AN/ARC-115 may be installed on some helicopters
VHF AM and FM communications (If installed)	Radio Set AN/ARC-186(V) VHF-AM/FM	Two-way voice communications in the freq range 30.0 through 87.979 and 116.0 through 151.975. 108.0 through 115.975 receive only.		Lower console UH ECM operator's station EH	VHF-FM No. 2 Provisional.
UHF communications	Radio-Transmitter Radio, RT-1167/ARC-164(V) UHF AM	Two-way voice communications in the frequency range of 225 to 399.95 MHz	*Line of sight	Lower console UH DF operator's station EH	
Tunable diplexer EH	TD-1336/A	Allows narrow band use of guard channel		Beneath seat of copilot	

Table 3-1. Communication/navigation equipment (Sheet 2 of 2)

FACILITY	NOMEN-CLATURE	USE	RANGE	CONTROL LOCATION	REMARKS
Voice security system	TSEC/KY-28 C-8157/ARC	Secure communications	Not applicable	Lower console	
Voice security system	TSEC/KY-58	Secure communications	Not applicable	Lower console	
Automatic direction finding	Direction Finder Set AN/ARN-89	Radio range and broadcast reception; automatic direction finding and homing in the frequency range of 100 to 3000 kHz	*50 to 100 miles range signals.	Lower console	
VOR/LOC/GS/MB receiving set	Radio Receiving Set AN/ARN-123(V)	VHF navigational aid, VHF audio reception in the frequency range of 108 to 117.95 MHz and marker beacon receiver operating at 75 MHz	*Line of sight	Lower console	
Doppler navigation set JH	Doppler Navigation Set AN/ASN-128	Provides present position or destination navigation information in latitude and longitude (degrees and minutes) or Universal Transverse Mercator (UTM) coordinates		Lower console	
Integrated Inertial Navigation System (IINS) EH	AN/ASN-132(V)	Navigational Aid		Lower console	
Magnetic heading indications	Gyro Magnetic Compass AN/ASN-43	Navigational Aid		Lower console	
Identification friend or foe	Transponder Set AN/APX-100(V)	Transmits a specially coded reply to a ground-based IFF radar Interrogator system	*Line of sight	Lower console	
Absolute altimeter	Radar Altimeter AN/APN-209	Measures absolute altitude	0 to 1500 feet	Instrument panel	

Table 3-1. Communication/navigation equipment (Sheet 2A of 2)

FACILITY	NOMEN-CLATURE	USE	RANGE	CONTROL LOCATION	REMARKS
Missile warning radar EH	AN/ALQ-156(V)2 Countermeasures Set	Detects missiles and counters the threat by activating launch of a flare cartridge from M-130 Dispenser Set.		Instrument panel	
Radar jammer EH	AN/ALQ-162(V)2 Countermeasures Set	Detects and validates fire control radar signals. Warns crew with audible tone and AN/APR-39 display. Counters threat by transmitting modulated received signal. Warning/jamming parameters are programmable.		Lower console	

NOTES

*Range of transmission of reception depends upon many variables including weather conditions, time of day, operating frequency, power of transmitter and altitude of the helicopter.

Section II COMMUNICATIONS

3-4. Intercommunication System C-6533( )/ARC.

Five intercommunication system (ICS) controls provide interior intercommunication capability between crew members and with the troop commander's position. They also provide a means by which the pilot and copilot may select and control associated radio equipment for voice transmission and reception. Additional audio circuits may also be selected for constant monitoring. When the communication control is operated in conjunction with equipment listed in Table 3-1, it is used to select associated radio equipment for voice operations. The operator may select any one of four transmitters (Figure 3-2), and/or any or all of four receivers to monitor. Four direct-wired audio circuits allow continuous monitoring. Hands-free intercommunication is provided by a hot mike feature. An exterior jack is to the front and below each gunner's window. When the walkaround cord is connected to it, the crewchief can communicate with the interior of the helicopter or with the other exterior jack through the crewchief/gunner's control panels. A placard installed on the instrument panel and above each troop-cargo compartment ICS station control panel indicates which receiver is selected when a selector switch is placed ON. Power for the intercommunication system is provided from the dc essential bus through circuit breakers, marked ICS PILOT COPILOT.

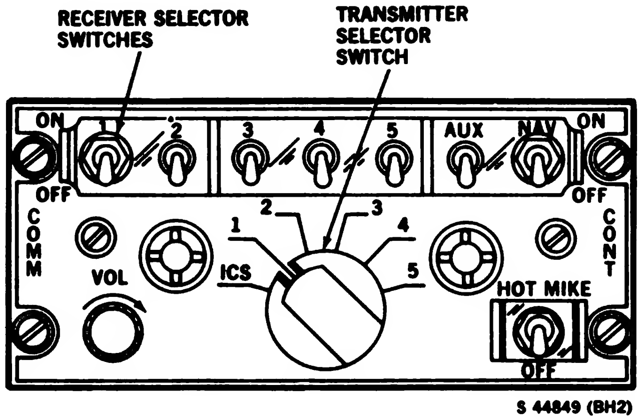


Figure 3-2. Intercommunication Control Panel C-6533/ARC

3-5. Controls and Functions.

Controls for the intercom/radios are on the front panel of the unit (Figure 3-2). The function of each control is as follows:

CONTROL/ INDICATOR	FUNCTION
Receiver Selector switches (ON)	
1	Connects FM 1 receiver to the headphone
2	Connect UHF receiver to the headphone
3	Connects VHF receiver to the headphone
4	Connects FM 2 receiver to the headphone
5	No connection (Spare)
AUX	Connects VOR/LOC/ audio to the headphone
NAV	Connects ADF/marker beacon audio to the headset
VOL control	Adjusts headphone volume level
Transmitter selector switch	
ICS	Enables intercom operation when keyed
1	Enables FM 1 transmission when keyed
2	Enables UHF transmission when keyed
3	Enables VHF transmission when keyed
4	Enables FM 2 transmission when keyed (provisions)

CONTROL/ INDICATOR	FUNCTION
5	No connection (Spare)
HOT MIKE switch	Enables intercom transmission without manual key

3-6. Intercommunication Keying System.

Keying of the ICS system is done by these controls:

a. Pilot or copilot station. An ICS or RADIO switch on the top of each cyclic stick, or by a switch on the floor at the pilot's left and the copilot's right foot (Figure 2-4).

b. Crewchief/Gunner and Left Gunner. A pushbutton at the end of the ICS cord or the exterior walkaround cord, and foot switches on each side of the helicopter at the crewchief/gunner's and left gunner's station.

c. Troop commander. A push switch on the handset at the troop commander's station

3-7. Modes of Operation.

3-8. Primary Operation Check.

There are several methods of intercommunication operation. In all cases, no operation action is required to receive intercom signals other than adjusting the VOL control for a comfortable level at the headset.

3-9. Intercommunication (All Stations).

a. Transmitter selector switch ICS for pilot and copilot when using foot switch, any position when using cyclic switch, ICS for crewchief/gunner, gunner, and troop commander.

b. Key switch - ICS switch on pilot's or copilot's cyclic, or foot switch at pilot's, copilot's or crewchief/ gunner, gunner positions, or push-to-talk button on crewchief/gunner's ICS cord, push-to-talk switch on troop commander handset press, speak into microphone and listen for sidetone, release to listen.

3-10. External Radio Communication.

All stations of the helicopter are capable of external radio communications.

3-11. Pilot and copilot.

a. Transmitter selector - Desired position, 1 through 4.

b. RADIO push-to-talk switch on cyclic stick, or foot-operated push-to-talk switch - press; speak into microphone while holding switch; release to listen.

3-12. Crewchief/gunner.

a. Transmitter selector - Desired position, 1 through 4.

b. Push-to-talk switch on headset-microphone cord, or foot-operated push-to-talk switch - Press, speak into microphone while holding switch, release to listen.

3-13. Troop commander.

a. Transmitter selector - Desired position 1 through 4.

b. Transmitter key switch on handset - Press, speak into microphone while holding switch, release to listen.

3-14. Receiver selection.

a. Receiver selector switch(es) - ON as desired.

b. Adjust volume to a comfortable listening level.

3-15. Radio Set AN/ARC-114A(VHF-FM) (If installed).

WARNING

Installation of FM No. 1 is prohibited in helicopters prior to Serial No. 79-23273 that do not have MOD 99, 122-1 except in those helicopters that have 122-A applied.

Radio Sets AN/ARC-114A (Figure 3-3) is an airborne, very high frequency (VHF), frequency-modulated (FM), radio receiving-transmitting set that is compatible with the narrow band series of ground tactical radios. The radio set contains a multichannel, electronically tunable main receiver and transmitter, a fixed-tuned guard receiver, and has a homing capability. The main receiver and transmitter operate on any one of 920 channels in the 30.00- to 75.95-MHz frequency range. The guard receiver is fixed tuned in the 40.0 to 42.0-MHz frequency range. The radio set, when operated in conjunction with TSEC KY 28 equipment, is used for receiving and transmitting clear-voice or X-mode communications. An additional capability for retransmission of clear voice communication allows use of the radio set as a relay link. During retransmission, when the one radio receives a signal, it sends a keying signal to the second radio and the first radio's received audio modulates the second radio's transmitter. Use of the homing capability of the No. 1 FM radio set provides a steering output to the VSI course deviation pointer for steering indications. No. 1 VHF-FM receives power from the dc essential bus through a circuit breaker marked No. 1 VHF-FM. When installed, No. 2 VHF-FM receives power from the No. 1 dc primary bus through a circuit breaker marked No. 2 VHF-FM.

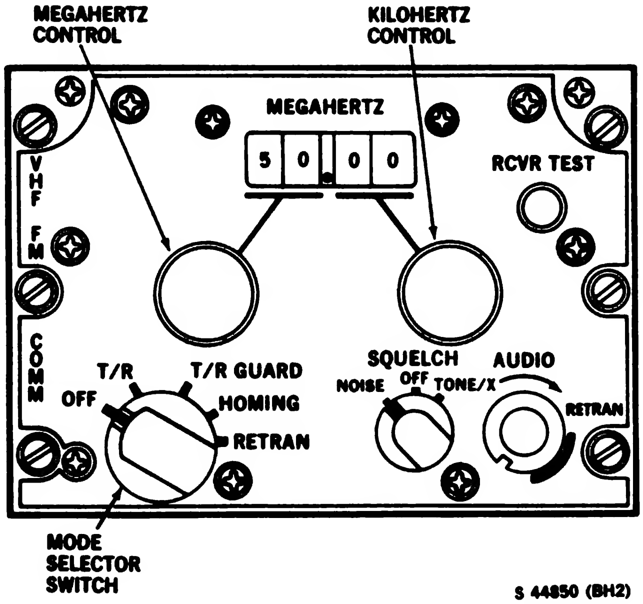


Figure 3-3. FM Control AN/ARC-114A

3-16. Antennas.

The VHF/FM antenna arrangements (Figure 3-1) are: The FM No. 1 communication antenna is within the leading edge pylon drive shaft cover. FM No. 2 communication antenna is under the nose section and is shared with operation of other radio sets. The FM homing antennas, one on each side of the fuselage, are used with the FM No. 1 radio set. The troop commander's antenna is on the upper trailing edge of the tail pylon. Refer to Chapter 4, Section I for use of troop commander's antenna.

3-17. Controls and Functions.

Controls for the AN/ARC-114A transceiver are on the front panel of the unit (Figure 3-3). The function of each control is as follows:

CONTROL	FUNCTION
MEGAHERTZ indicator	Indicates frequency to which main receiver/ transmitter is tuned. (Guard receiver is fixed tuned.)
1 Megahertz control	Tunes main receiver/ transmitter in 10-MHz and 1-MHz steps as indicated by first two digits of MEGAHERTZ indicator. (Guard receiver is fixed tuned.)
Kilohertz control	Tunes main receiver/ transmitter in 100-kHz and 50-kHz steps as indicated by last two digits of MEGAHERTZ indicator. (Guard receiver is fixed tuned.)
RCVR TEST pushbutton	When pressed, injects a signal into main receiver to audibly indicate proper main receiver performance.

CONTROL	FUNCTION
SQUELCH switch	
OFF	Disables squelch
NOISE	Activates noise squelch
TONE/X	Activates tone squelch for secure voice mode.
Mode selector switch	Turns set on or off and determines operating mode of radio set:
OFF	Removes power from radio set.
T/R	Provides for radio set operation as a transceiver on main channels indicated on MEGAHERTZ indicator.
T/R GUARD	Same as T/R above plus reception on guard channel. T/R GUARD mode is used when it is desired to monitor a preset frequency within 40.00 to 42.00 MHz band, usually 40.50 MHz, and also operate main transmitter/receiver as a communications unit.
HOMING	Provides for radio set operation in homing mode. May also be operated as a transceiver on main channels indicated on MEGAHERTZ indicator.
RETRAN	Provides for retransmit operation when used to relay a signal from another source. May also be operated as a transceiver on main channels indicated on MEGAHERTZ indicator.
AUDIO control	Adjusts radio set volume. Control is set to white RETRAN segment for proper audio output during retransmission operation.

3-18. Operation.

3-19. Mode of Operation.

a. Depending on the settings of the operating controls, the radio set can be used for these modes of operation:

(1) Two-way voice, normal (T/R).

(2) Two-way voice, secure voice, when T SEC/KY-28 is installed. Refer to paragraph 3-61.

(3) Constant monitoring of guard channel without losing main receiver use (T/R GUARD).

(4) Homing.

(5) Retransmit (RETRAN).

3-20. Starting procedure.

The radio set is capable of operating in any of the four modes indicated by the mode selector switch (Figure 3-3).

3-21. Transmit/Receive (T/R) Mode.

a. Mode selector - T/R or T/R GUARD.

b. Frequency - Select.

c. ICS transmitter selector - Position 1 (FM No. 1), or position 4 (FM No. 2).

d. Radio push-to-talk switch - Press to talk; release to listen.

3-22. T/R GUARD Mode.

a. Mode selector - T/R GUARD.

b. Frequency - Select.

c. ICS transmitter selector - Position 1 (FM No. 1), or position 4 (FM No. 2).

d. Radio push-to-talk switch - Press to talk; release to listen.

NOTE

If reception on selected frequency is interfering with guard reception, detune set(s) by selecting an open frequency. This condition permits only the priority guard channel to be monitored.

3-23. Homing Mode (FM NO. 1 only).

a. Frequency - Select.

b. Mode selector switch - HOMING.

c. MODE SEL - FM HOME.

d. CIS MODE SEL - NAV.

e. Observe homing indications on vertical situation indicator (VSI) (Figure 3-13). These are:

(1) FM navigation (NAV) flag will move from view, and will come into view if the received signal is too weak.

(2) A steering (course deviation) pointer moves either left or right about 5° to indicate any deviation from the course to the transmitting station.

(3) Station passage will be indicated by course deviation change and CIS MODE SEL NAV switch light going out and HDG switch light going on.

3-24. RETRAN (Retransmission) Mode.

Retransmission permits the helicopter to be used as an airborne relay (Figure 3-7).

a. Mode selector - RETRAN.

b. AUDIO Control - Set to RETRAN.

c. Frequency(s) - Select.

d. RADIO RETRANSMISSION selector switch - Set to radios used.

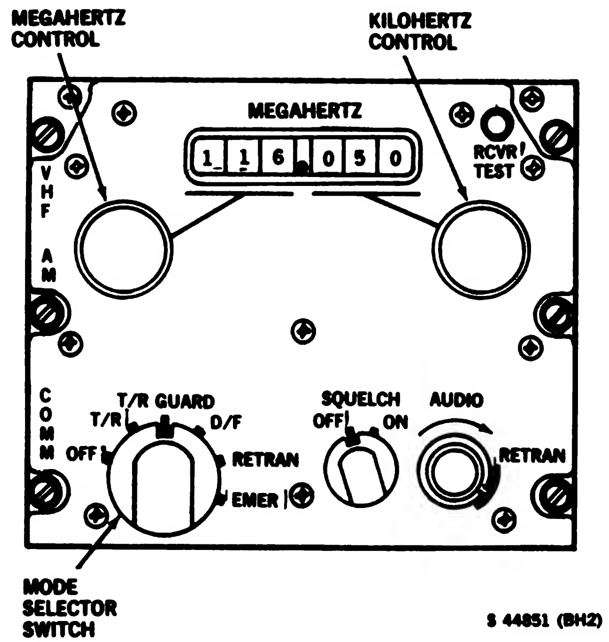


Figure 3-4. VHF Control AN/ARC-115A

e. Establish communication between each relay radio in helicopter and its counterpart radio at terminal station by using appropriate ICS TRANS selector. If audio monitoring is desired, adjust AUDIO control for a suitable output. AN/ARC-114A and AN/ARC-115A radios have a predetermined mark on AUDIO control for retransmission audio level.

3-25. Stopping Procedure.

Mode selector - OFF.

3-26. Radio Set AN/ARC-115A (VHF-AM) (If installed).

NOTE

Radio Set AN/ARC-115 may be installed on some helicopters. Appearance and operation is the same as the Radio Set AN/ARC-115A, except, the mode selector switch does not have an EMER position, and the SQUELCH operation is not controlled from the cockpit.

The radio set AN/ARC-115A (Figure 3-4) is a lightweight multichannel airborne radio communication set, which provides transmission, reception, and retransmission of amplitude modulated (am) radio communications. The radio set contains a multichannel, tunable main receiver and transmitter which operates on any one of 1,360 discrete channels, each spaced 25 kHz within the frequency range of 116.000 through 149.975 MHz. The fixed guard channel receiver operates in the 119.000 through 124.000 MHz frequency range, with the preset crystal control normally at 121.500 MHz, the guard (emergency) frequency. Power to operate the AN/ARC-115A is from the No. 2 dc primary bus through a circuit breaker, marked VHF AM, refer to TM 11-5821-260-12.

3-27. Antenna.

The VHF/AM antenna is under the nose section (Figure 3-1). The antenna operation is shared with FM No. 2, and ADF sense.

3-28. Controls and Functions.

Controls for the AN/ARC-115A are on the front panel of the unit (Figure 3-4). The function of each controls is as follows:

CONTROL	FUNCTION
MEGAHERTZ indicator	Indicates frequency to which the main transmitter/receiver is tuned (Guard receiver is fixed tuned).
1 Megahertz control	Tunes the main transmitter/receiver in 1 MHz steps as indicated by the first three digits of the MEGAHERTZ indicator.
Kilohertz control	Tunes the main transmitter/receiver in 25-kHz steps as indicated by the last three digits of the MEGAHERTZ indicator.
RCVR TEST pushbutton	When pressed, injects a noise signal into the main receiver to audibly indicate proper receiver performance.
SQUELCH ON-OFF switch	Enables and disables squelch of main receiver.
AUDIO-RETRAN (Volume Control)	Adjusts radio set volume. Control is set to white RETRAN segment for proper audio output during retransmission operation.
Mode selector switch	Turns set on or off and determines operating mode of radio set.
OFF	Turns power off.
T/R	Provides for radio set operation as a transceiver on main channels as indicated on MEGACYCLE indicator.
T/R GUARD	Same as T/R above plus reception on guard channel.
D/F	D/F mode is not used in this installation.
RETRAN	Provides for retransmit operation when used to relay a signal from another source. May also be operated as a transceiver on main channel indicated on MEGACYCLE indicator.
EMER	Disables multichannel receiver and enables transmit and receive on guard (EMER) frequency. Blocks out frequency selected on MEGAHERTZ indicator.

3-29. Modes of Operation.

a. Depending on the settings of the operating controls, the radio set can be used for these modes of operation.

(1) Two-way voice, normal (T/R).

(2) Two-way voice, secure voice, when T-SEC/KY-28 is installed.

(3) Constant monitoring of guard channel (121.5 MHz), without losing main receiver use (T/R GUARD).

(4) Retransmit (RETRAN).

(5) Guard receive and transmit only (EMER).

3-30. Starting Procedure.

Before starting radio set, check settings of controls that pertain to communications equipment. With dc power applied, radio set is turned on with mode selector (Figure 3-4) in any position other than OFF or EMER.

3-31. Operation.

3-32. Transmit/Receive (T/R) Mode.

a. Mode Selector - T/R or T/R GUARD.

b. Frequency - Select.

c. ICS transmitter selector - Position 3.

d. Radio push-to-talk switch - Press to talk; release to listen.

3-33. Transmit/Receive Plus GUARD (T/R GUARD) Mode.

The T/R GUARD mode of operation is used when it is desired to monitor a frequency within the 119.000 to 124.000 MHz band, usually 121.500 MHz distress frequency. Transmission on this frequency should be limited to emergency use only. When emergency conditions occur, the main transceiver must be tuned to the distress frequency, or function switch placed to EMER.

a. Mode selector - T/R GUARD.

b. Frequency - Select.

NOTE

If reception on the selected frequency is interfering with guard reception, detune the set by selecting an open frequency, or place the mode switch to EMER.

c. ICS transmitter selector - Position No. 3.

d. Radio push-to-talk switch - Press to talk; release to listen.

3-34. Retransmit (RETRAN) Mode.

a. Mode selector - RETRANS.

b. AUDIO control - Set to RETRANS.

c. Frequency - Select.

d. RADIO RETRANSMISSION selector switch - Set to radios to be used.

e. Establish communication between each relay radio in helicopter and its counterpart radio at terminal station by using appropriate ICS TRANS selector.

3-35. Emergency (EMER) Operation.

a. Mode selector - EMER.

b. ICS transmitter selector - Position 3.

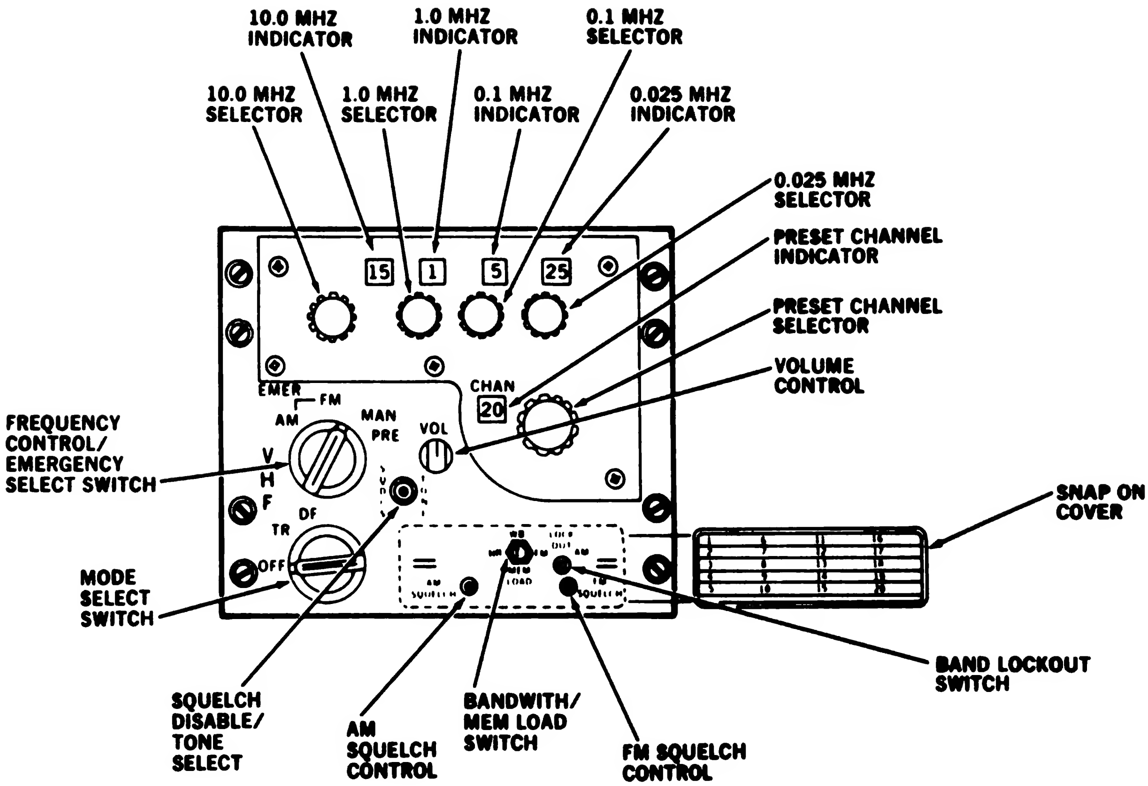
c. Radio push-to-talk switch - Press to talk; release to listen.

3-36. Stopping Procedure.

Mode Selector - OFF.

3-37. Radio Set AN/ARC-186(V).

The radio set AN/ARC-186(V) (Figure 3-5) is a lightweight multichannel airborne radio communications set, which provides transmission, reception, and retransmission of amplitude modulated (AM), frequency modulated (FM) radio communications, and FM directional finding (homing) with installation of other associated equipment. AM reception only is provided on frequencies between 108.000 and 115.975 MHz. Installation of the AN/ARC-186(V) in the UH-60A helicopter is a VHF-AM and/or VHF-FM installation(s). The transceiver has a tunable main receiver and transmitter which operates on any one of 1,469 AM discrete channels, each spaced 25 kHz apart within the frequency range of 116.000 through 151.975 MHz, or 30.000 through 87.975 MHz FM, providing 2,319 channels. FM homing operations within the 30 through 87.975 MHz band. The fixed guard channels are between 116.000 and 151.975 MHz AM (usually 121.500 MHz), and between 30.000 and 87.975 MHz FM (usually 40.500 MHz). The guard frequencies are



(PANEL-MOUNTED TRANSCEIVER)

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Figure 3-5. VHF Control AN/ARC-186(V) (Sheet 1 of 2)

preset and only require selection by the frequency/ emergency select switch. Frequencies can be preset for 20 channels. VHF-AM installations cannot be used to transmit VHF-FM signals. If an AM frequency is selected on an FM only installation, an audible tone would be heard, warning the pilot of an out-of-band frequency selection. The same is true in the case of selection of an FM frequency on an AM installation. Keying the microphone for voice transmission when in DF (homing) mode will disable the homing function while the mic is keyed. In DF mode audio reception is distorted. When using secured speech and EMER FM or AM is selected, secure speech function will be disabled to enable normal voice communications. Power to operate the AN/ARC-186(V) radio is provided from the No. 2 dc primary bus through a circuit breaker,

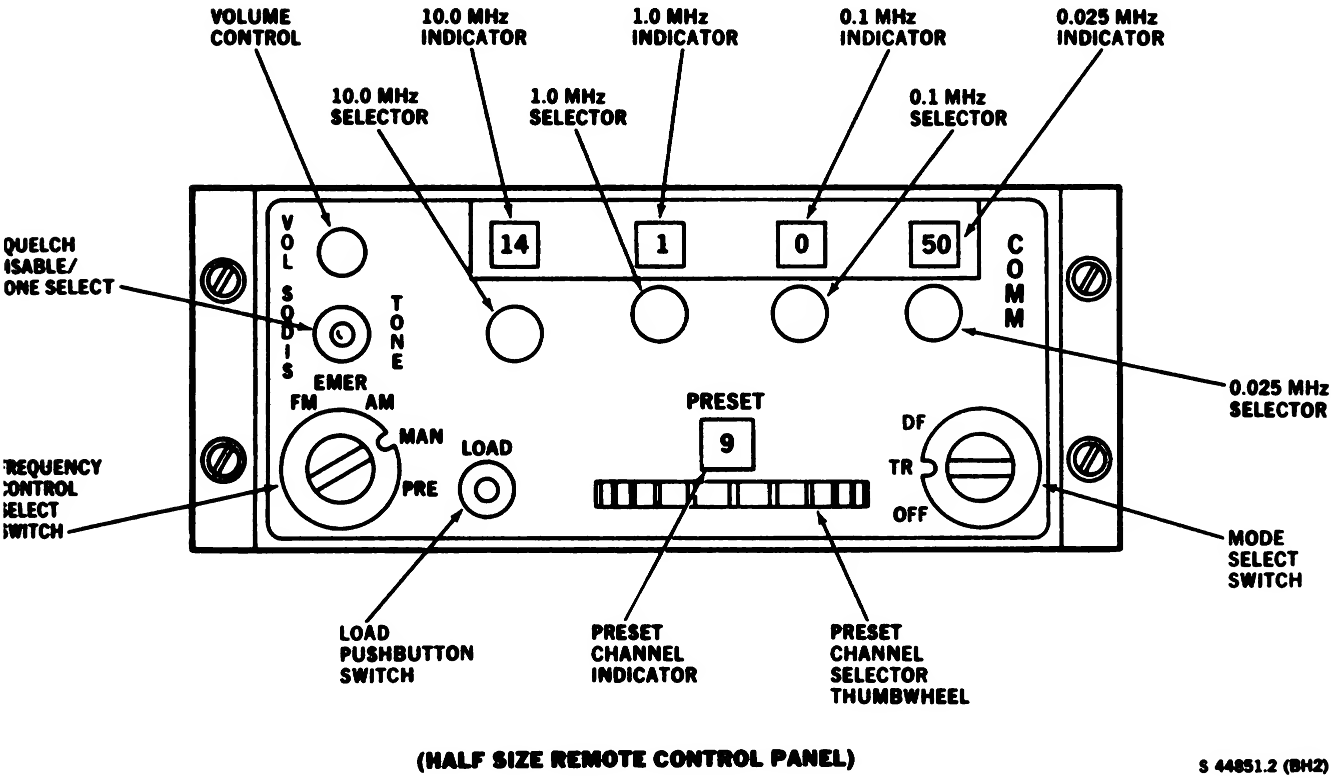


Figure 3-5. VHF Control AN/ARC-186(V) (Sheet 2 of 2)

marked VHF-AM for the AM radio, and from the No. 1 and No. 2 dc primary buses, respectively, through circuit breakers marked No. 1 VHF-FM and No. 2 VHF-FM for the No. 1 and No. 2 VHF-FM radios.

3-38. Antennas.

The VHF-AM antenna is under the nose section (Figure 3-1). The antenna operation is shared with FM No. 2 and ADF sense. The No. 1 VHF-FM communication antenna is within the leading edge fairing of the tail pylon drive shaft cover. The two FM homing antennas used with the No. 1 VHF-FM radio are on each side of the helicopter fuselage, just behind the cockpit doors.

3-39. Controls and Functions.

Controls for the AN/ARC-186(V) are on the front panel of the unit (Figure 3-5). The function of each control is as follows:

CONTROL	FUNCTION
0.025 MHz selector	Rotary switch. Selects rt frequency in 0.025 MHz steps. Clockwise rotation increases frequency.
0.1 MHz selector	Rotary switch. Selects rf frequency in 0.1 MHz steps. Clockwise rotation increases frequency.
1.0 MHz selector	Rotary switch. Selects rt frequency in 1.0 MHz steps. Clockwise rotation increases frequency.
10 MHz selector	Rotary switch. Selects rt frequency in 10 MHz steps from 30 to 150 MHz. Clockwise rotation increases frequency.

CONTROL	FUNCTION
Preset channel selector	Selects preset channel from 1 to 20. Clockwise rotation increases channel number selected.
Volume control	Potentiometer. Clockwise rotation increases volume.
Squelch disable/tone select	Three-position switch. Center position enables squelch, SQ DIS position disables squelch, momentary TONE position transmits tone of approximately 1000 Hz.
Frequency control/ emergency select switch	Four-position rotary switch. PRE position enables preset channel selection, MAN position enables manual frequency selection, EMER AM or FM selects a prestored guard channel (FM not used in helicopters with panel-mounted transceiver). **NOTE** Selecting EMER-AM or FM automatically disables the secure speech function and enables normal voice communication.
Mode select switch	Three-position rotary switch. OFF position disables receiver/ transmitter, TR position enables transmit/receive modes. DF position enables FM homing.
Bandwidth/MEM LOAD (On helicopters with panel-mounted transceiver). On helicopters with half-size remote control panel, the memory switch is labeled LOAD. Bandwidth switch is inaccessible.	Three-position switch NB (NARROW) position enables narrow-band selectivity WB (WIDE) enables wideband selectivity in the FM band, momentary MEM LOAD position allows manually selected frequency to go into selected preset channel memory.
AM squelch control (On helicopters with panel-mounted transceiver). (Use of control is a maintenance function).	Screwdriver adjustable potentiometer. Squelch overridden at maximum counterclockwise position, clockwise rotation increases input signal required to open the squelch.
FM squelch control (On helicopters with panel-mounted transceiver). (Use of control is a maintenance function).	Screwdriver adjustable potentiometer. Squelch overridden at maximum counterclockwise position, clockwise rotation increases input signal required to open the squelch.
Band Lockout switch (On helicopters with panel-mounted transceiver). (Use of control is a maintenance function).	Screwdriver settable three-position switch. Center position enables both AM and FM bands, AM position locks out AM band, FM position locks out FM band. (Band lockout is indicated by a warning tone.)

3-40. Modes of Operation.

Depending on the settings of the operation controls, the radio set can be used for these modes of operation:

a. Two-way voice, normal (TR).

b. Constant monitoring of guard channel 121.5 MHz only.

c. Guard receive and transmit only (EMER).

3-41. Starting Procedure.

Before starting radio set, check settings of controls that pertain to communication equipment. With dc power applied, radio set is turned on with mode selector (Figure 3-5) in any position other than OFF or EMER.

3-42. Operational Check.

Select mode and communicate with or direction to the ground station on selected frequencies in low, middle, and high range of applicable frequency band. Check the action of the volume control and note that the selected frequencies are heard loud and clear. Check that adequate sidetone is audible during all transmissions.

a. Communications mode check.

(1) Mode select switch - TR.

(2) Select out-of-band frequency to check warning. (On helicopters with panel-mounted transceivers.)

(3) Select frequency of station to be used for check, MAN or PRE as desired.

(4) Communicate with check station.

NOTE

Transmitting with the AN/ARC-186 FM#2 radio may cause the LF-ADF (AN/ARN-89) bearing pointer to deflect and lose audio when tuned to a station 400 KC or below. Releasing the transmitter key allows the LF-ADF receiver to return to the normal audio and bearing indication.

Transmitting with the AN/ARC-186 VHF/AM radio on frequencies from 120 MHz and above, may cause the LF-ADF (AN/ARN-89) bearing pointer to deflect and lose audio when tuned to a station below 1500 KHz. Releasing the transmitter key allows the LF-ADF receiver to return to the normal audio and bearing indication.

b. DF mode check.

(1) Select frequency of station to be used for homing.

(2) Mode select switch - DF.

(3) Frequency control select switch - MAN or PRE as desired.

(4) Check for homing indication.

c. Squelch disable/tone check.

(1) Select SQ DIS - Check for noise.

(2) Select momentary TONE, check for tone of about 1000 Hz.

d. Preset channel load.

(1) Mode select switch - TR.

(2) Frequency control select switch - MAN.

(3) Set MHz frequency for desired channel and rotate PRESET channel to number to be used with that frequency using channel selector thumbwheel.

(4) LOAD button - Press and release.

(5) Repeat steps (3) through (4) for other preset channels.

3-43. Operation.

3-44. TR Mode AM or FM As Applicable.

a. Set OFF-TR-DF switch to TR.

b. Set frequency control select switch to MAN or PRE.

c. Rotate four MHz selectors to desired frequency or set PRESET channel number as desired.

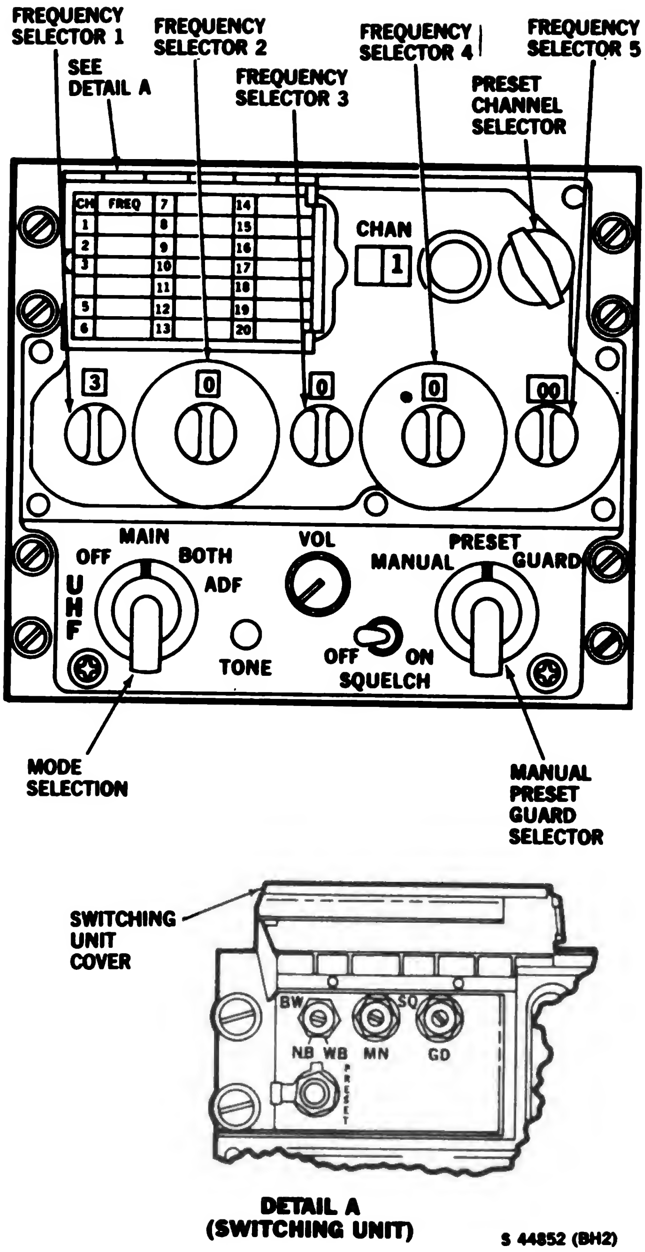


Figure 3-6. UHF Control, AN/ARC-164(V)

3-45. Emergency Mode AM or FM As Applicable.

a. Mode select switch - TR or DF.

b. Frequency mode selector switch - EMER AM or FM as applicable.

3-46. DF (Homing) Mode.

a. Mode select switch - DF.

b. Frequency control select switch - MAN or PRE.

3-47. Retransmission Mode.

Do a retransmission check as follows:

NOTE

Do not disable squelch when retransmit switches are in retransmit position. Squelch level is used to key transmitter for retransmission.

a. Establish two base stations at unrelated frequencies.

b. Set appropriate receiver-transmitter to desired retransmit frequency.

c. Place RADIO TRANSMISSION selector switch to radios to be used.

d. Establish communication between base stations through aircraft radios.

e. Note that selected frequencies are heard loud and clear and that received audio is present and clear at each crew station.

3-48. Stopping Procedure.

Mode Selector OFF.

3-49. Receiver-Transmitter Radio, RT-1167/ARC-164(V).

Receiver-Transmitter Radio, RT-1167/ARC-164(V) (Figure 3-6) is an airborne, ultra-high frequency (UHF), amplitude-modulated (am), radio transmitting-receiving (transceiver) set. It contains a multichannel, electronically tunable main transmitter and receiver, and a fixed-tuned guard receiver. The main transceiver operates on any one of 7,000 channels, spaced in 0.025 MHz units in the 225.000 to 399.750 HMz UHF military band. The guard receiver is tunable in the 238.000 to 248.000 MHz frequency range with crystal replacement and realignment. (Usually 243.000 MHz.) The radio set is primarily used for voice communications. An additional capability for retransmission allows use of the radio set as a relay link. Power to operate the ARC-164(V) radio is from the dc essential bus, through a circuit breaker, marked UHF-AM.

3-50. Antenna.

The UHF-AM antenna is under the fuselage transition section (Figure 3-1) or EH under the fuselage below the copilot's seat (Figure 3-1). The antenna provides a path for both the radiated and received UHF comm signals. The EH-60 AN/ALQ-151(V) mission package has two UHF-AM radios that utilize the existing fuselage transition section conformal antenna for the voice link and adds the data link antenna under the fuselage where the cargo hook would normally be installed.

3-50.1. Tunable Diplexer. EH

The tunable diplexer (TD-1336/A) is connected between the antenna and the output of the ARC-164(V). When properly tuned, the diplexer acts as a bridge network isolating signals of similar frequency

which share the same antenna. It allows the guard channel in the ARC-164(V) guard receiver to be monitored while other frequencies in the main transmitter-receiver are being used.

3-51. Controls and Functions.

Controls for ARC-164(V) are on the front panel of the unit (Figure 3-6). The function of each control is as follows:

CONTROL	FUNCTION
Manual frequency selector switch 1	Selects 100's digit of frequency (either 2 or 3) in MHz.
Manual frequency selector switch 2	Selects 10's digit of frequency (0 through 9) in MHz.
Manual frequency selector switch 3	Selects units digit of frequency (0 through 9) in MHz.
Manual frequency selector switch 4	Selects tenths digit of frequency (0 through 9) in MHz.
Manual frequency selector switch 5	Selects hundredths and thousandths digits of frequency (00, 25, 50, or 75) in MHz.
Preset channel selector switch	Selects one of 20 preset channels.
MANUAL-PRESET-GUARD selector	Selects method of frequency selection:
MANUAL	Any one of 7,000 frequencies is manually selected using the five frequency selector switches.
PRESET	Frequency is selected using the preset channel selector switch for selecting any one of 20 preset channels as indicated on the CHAN indicator.
GUARD	The main receiver and transmitter are automatically tuned to the guard frequency and the guard receiver is disabled. Blocks out frequencies set either manually or preset.
SQUELCH ON-OFF switch	Turns squelch of main receiver on or off.
VOL control	Adjusts volume.
TONE switch	Enables transmission and headset monitoring of a 1,020-Hz tone on selected frequency for maintenance check only.
Mode selector switch	Selects operating mode function:
OFF	Turns power off.
MAIN	Enables main receiver and transmitter.
BOTH	Enables main receiver, transmitter, and guard receiver.
ADF	Not used in this installation.
BW switch (NB-WB)	Selects wideband or narrow-band selectivity of main receiver.

CONTROL	FUNCTION
SQ-MN control	Adjusts threshold level of squelch for main receiver.
SQ-GD control	Adjusts threshold level of squelch for guard receiver.
PRESET switch	Stores selected frequency in selected preset channel.

3-52. Modes of Operation.

a. Depending on the settings of the operating controls, the radio set can be used for these modes of operation:

(1) Two-way voice, normal.

(2) Two-way voice, and secure voice when TSEC/KY-28 is installed. (Refer to paragraphs 3-61 through 3-64.)

(3) Transmission of 1.020 Hz TONE signal.

(4) Constant monitoring of guard channel without losing main receiver use.

(5) Retransmit.

b. The radio set has three different methods of frequency selection as determined by the position of the MANUAL-PRESET-GUARD switch. An explanation of these three positions is given in paragraph 3-51.

c. To use the radio set for any particular mode of operation, do this:

(1) Mode Selector - MAIN or BOTH.

(2) Frequency Selector - MANUAL, PRESET or GUARD.

d. A procedure for presetting the 20 preset channel numbers to the desired frequencies is given in paragraph 3-57.

3-53. Operation.

The radio set can operate in any of the three modes, MAIN, BOTH and GUARD.

3-54. Transmit/Receive (MAIN) Mode.

a. Function Selector Switch - MAIN.

b. MANUAL-PRESET-GUARD selector MANUAL.

c. Megahertz controls - desired frequency.

d. ICS transmitter selector - Position 2.

e. Establish communication by keying transmitter and speaking into microphone. Release to listen and adjust audio output for a comfortable level.

3-55. Guard Channel Constant Monitoring.

The guard channel monitoring (Figure 3-6) mode of operation is used when it is desired to monitor a frequency within the 238.000 to 248.000 MHz band, usually 243.000 MHz. Transmission on this frequency should be limited to emergency use only. When conditions require transmissions on the emergency frequency, the MANUAL-PRESET-GUARD selector switch must be at GUARD, or the main receiver must be tuned to the emergency frequency.

NOTE

If reception on the selected frequency is interfering with guard reception, detune the set by selecting an open frequency, or place the MANUAL-PRESET-GUARD switch to GUARD.

3-56. Two-Way Voice, Secure Voice.

Controls for the secure speech mode are on TSEC/KY-28. After doing the required procedures on the KY-28 to the radio set, operation in the secure speech two-way voice mode is described in paragraph 3-63.

3-57. Preset Channel Selector Memory Storage.

Set 20 preset channel numbers to desired frequencies as follows (Figure 3-6):

a. Place MANUAL-PRESET-GUARD switch to PRESET.

b. Use manual frequency selector switches to select frequency to be placed in memory.

c. Turn preset channel selector switch to desired channel number.

d. Press and release PRESET switch.

e. Using a soft lead (erasable) pencil, record frequency selected for channel number used on card on front panel.

3-58. Retransmit.

Retransmission permits the helicopter to be used as an airborne relay link. To operate as a relay unit, additional installed equipment must be used (Figure 3-8).

a. Frequency - Select.

b. RADIO TRANSMISSION selector switch - Set to radio sets to be used.

c. Establish communication between each relay radio in helicopter and its counterpart radio link terminal station by using appropriate ICS TRANS selector.

3-59. Guard (Emergency) Operation.

a. MANUAL-PRESET-GUARD switch to GUARD.

b. ICS transmitter selector - Position 2.

c. Radio push-to-talk switch on cyclic stick or foot-operated push-to-talk switch - Press to talk.

3-60. Stopping Procedure.

Mode Selector - OFF.

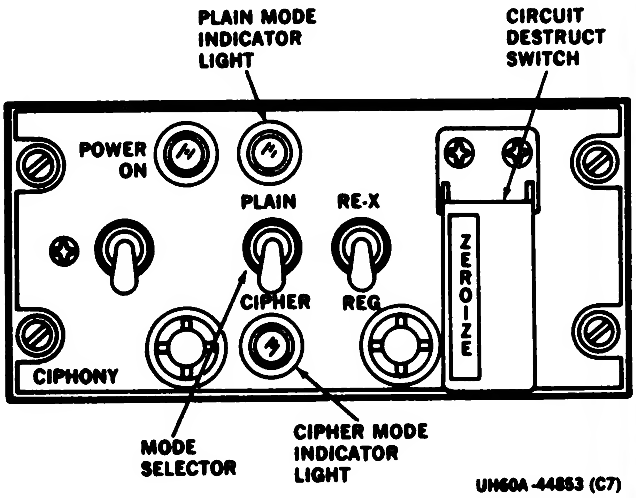


Figure 3-7. Voice Security System Control C-8157/ARC

3-61. Voice Security System TSEC/KY-28.

Three TSEC/KY-28s (Figure 3-7) are used as auxiliary equipment to provide voice security (ciphony) mode. Control indicator C-8157/ARC is used by the pilot and copilot to control TSEC/KY-28 for FM-1, FM-2 and UHF-AM. The control has four switches and three indicator lamps. Power to operate the TSEC/KY-28 for the NO. 1 and NO. 2 AN/ARC-114A systems is provided from the dc essential bus through a circuit breaker, marked No. 1 FM COMM SCTY SET, and No. 1 dc primary bus through a circuit breaker, marked No. 2 FM COMM SCTY SET respectively. Power to operate the AN/ARC-164(V) TSEC/KY-28 is provided from the dc essential bus through a circuit breaker, marked COMM SCTY SET UHF. Each Control C-8157/ARC is located adjacent to the radio set it supports. Two operating modes are available when the TSEC/KY-28 is installed in the helicopter; PLAIN mode for clear voice radio transmission or reception, and CIPHER mode for secure voice radio transmission or reception.

NOTE

When the TSEC/KY-28s are installed in the helicopter, the TSEC/KY-28 for the intended use radio set must be ON before radio communication, plain or ciphered, is possible. Non-secure radios will not be keyed when using any secure radio or the intercom for classified communications.

3-62. Controls and Functions.

Controls for the TSEC/KY-28 are on the front panel of the C-8157/ARC (Figure 3-7). The function of each control is as follows:

CONTROL	FUNCTION
POWER ON	Turns set on and off. Switch must be on (up) for operation in either plain or cipher mode.
POWER ON light (amber)	Lights when POWER ON switch is placed on (up).
PLAIN-CIPHER switch	At PLAIN, permits normal communications on associated equipment. At CIPHER, permits secure voice communications on associated equipment.
Plain mode indicator light (red)	Lights when PLAIN-CIPHER switch is at PLAIN.
Cipher mode indicator light (green)	Lights when PLAIN-CIPHER switch is at CIPHER.

CONTROL	FUNCTION
RE-X, REG switch	RE-X, Not used in this installation. At REG, permits normal or secure communications.
ZEROIZE switch (two-position locking toggle, under spring-loaded cover).	Normally in off (down) position. Placed in on (up) position during emergency situations to zero any code setting and make associated TSEC/KY-28 equipment unusable.

NOTE

Do not place ZEROIZE switch on (up) unless a crash or capture is imminent.

3-63. Operation.

a. Preliminary operation.

(1) CIPHONY POWER switch - On.

(2) Apply power to associated transmitter/receiver.

(3) When power is initially applied, this automatic alarm procedure is initiated.

(a) A constant tone is heard in headset, and after about 2 seconds, this tone will change to an interrupted tone.

(b) To clear interrupted tone, press and release push-to-talk switch. Interrupted tone will no longer be heard, and circuit will be in a standby condition ready for either transmission or reception. No radio communications will be passed if interrupted tone is still heard after pressing and releasing push-to-talk switch.

(4) RE-X REG switch - Set for REG.

b. Plain Mode.

(1) CIPHONY POWER switch - ON.

(2) PLAIN-CIPHER switch - PLAIN, PLAIN mode indicator light (red) should be on.

(3) RE-X, REG switch - REG.

(4) ICS transmitter selector - Select desired position.

(5) Radio push-to-talk switch on cyclic stick or foot-operated push-to-talk - Press to talk; release to listen.

c. Cipher Mode.

(1) CIPHONY POWER switch - On.

(2) PLAIN-CIPHER switch - CIPHER. Cipher mode light (green) should be on.

(3) RE-X, REG switch - REG.

(4) ICS transmitter selector - Select desired position.

(5) To transmit, press radio press-to-talk switch. DO NOT TALK. A short beep will be heard. This indicates receiving station is now capable of receiving your message. Begin transmitting.

NOTE

Only one TSEC/KY-28 can be used on a given frequency at any one time. Always listen before attempting transmission to make certain that no one else is transmitting.

(6) When transmission is completed, release press-to-talk switch. This will return equipment to standby.

(7) To receive, it is necessary for another station to send you a signal first. Upon receipt of a signal, the cipher equipment will be switched automatically to the receive condition which will be indicated by a short "beep" heard in the headset. Reception will then be possible. Upon loss of the signal, the cipher equipment will be automatically returned to standby.

3-64. Stopping Procedure.

CIPHER/PLAIN switch - PLAIN.

3-64.1. Voice Security Equipment TSEC/KY-58.

a. Description. A complete description of the TSEC/KY-58 can be found in TM 11-5810-262-OP. This voice security equipment is used with the FM Radio to provide secure two-way communication. The equipment is controlled by the Remote Control Unit (RCU) (Z-AHP) mounted in the lower console. The POWER switch must be in the ON position, regardless of the mode of operation, whenever the equipment is installed.

b. Controls and Functions. Figure 3-7.1

c. Operating Procedures.

(1) Secure Voice Procedures.

NOTE

To talk in secure voice, the KY-58 must be "loaded" with any number of desired variables.

(a) MODE switch - OP.

(b) FILL switch - Set to the storage register which contains the crypto-net variable (CNV) you desire.

(c) POWER switch - ON.

(d) PLAIN, C/RAD switch - C/RAD1.

(e) DELAY switch - Down unless the signal is to be retransmitted.

NOTE

At this time a crypto alarm, and background noise, in the aircraft audio intercom system should be heard.

To clear alarm:

(f) PTT (push-to-transmit) switch - Press and release.

NOTE

When operating in either secure or clear (plain) voice operations the VOLUME must be adjusted on the aircraft radio and intercom equipment to a comfortable operating level.

(2) Clear Voice Procedures:

(a) POWER switch - ON.

(b) PLAIN C/RAD1 switch - PLAIN.

(3) Zeroing Procedures.

NOTE

Instructions should originate from the Net Controller or Commander as to when to zeroize the equipment.

(a) POWER switch - ON.

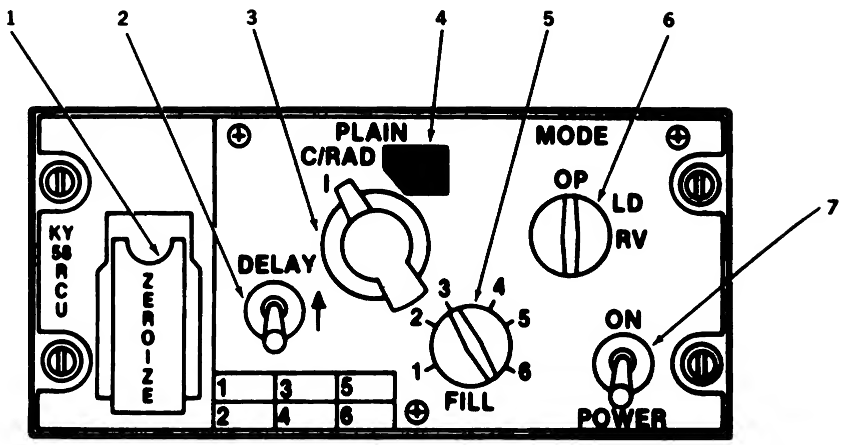
(b) Spring-loaded ZEROIZE switch - Activate and release. This will zeroize all positions (1-6). The equipment is now zeroized and secure voice communications are no longer possible.

(4) Automatic Remote Keying Procedures.

NOTE

Automatic Remote Keying (AK) causes an "old" crypto-net variable (CNV) to be replaced by a "new" CNV. Net Controller simply transmits the "new" CNV to your KY-58.

(a) The Net Controller will use a secure voice channel, with directions to stand by for an AK transmission. Calls should not be made during this standby action.



REMOTE CONTROL UNIT (RCU) (Z-AHP)

CONTROL	FUNCTION
1. ZEROIZE SWITCH TWO-POSITION MOMENTARY TOGGLE UNDER SPRING LOADED COVER	ZEROIZES THE KY-58; CLEARS ALL ENCODING IN THE SYSTEM.
2. DELAY SWITCH TWO-POSITION TOGGLE	UP WHEN SIGNAL IS TO BE RETRANSMITTED.
3. PLAIN-C/RAD SWITCH ROTARY TWO-POSITION SELECTOR SWITCH	IN THE PLAIN POSITION, PERMITS NORMAL (UNCIPHERED) COMMUNICATIONS ON THE ASSOCIATED FM RADIO SET. IN THE C/RAD POSITION, PERMITS CIPHERED COMMUNICATIONS ON THE ASSCIATED RADIO SET.
4. C/RAD2 SWITCH STOP	LOCATION OF STOP FOR C/RAD2 ON FRONT PANEL.
5. FILL SWITCH SIX POSITION ROTARY SWITCH	PERMITS PILOT TO SELECT ONE OF 6 STORAGE REGISTERS FOR FILLING.
6. MODE SWITCH THREE POSITION ROTARY	IN THE OP POSITION KY-58 NORMAL OPERATING, IN THE LD POSITION FOR FILLING. IN THE RV POSITION KY-58 IN RECEIVE-VARIABLE, FILLED FROM ANOTHER EXTERNAL SOURCE.
7. POWER ON SWITCH TWO POSITION TOGGLE	CONNECTS POWER TO THE ASSOCIATED TSEC/KY-58 CIPHER EQUIPMENT IN THE ON (FORWARD) POSITION, AND DISCONNECTS POWER FROM THE EQUIPMENT IN THE OFF (AFT) POSITION. TURNS ON POWER TO TSEC/KY-58.

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Figure 3-7.1. Voice Security Equipment

(b) Several beeps should now be heard in your headset. This means that the "old" CNV is being replaced by a "new" CNV.

(c) Using this "new" CNV, the Net Controller will ask you for a "radio check."

(d) After the "radio check" is completed, the Net Controller Instructions will be to resume normal communications. No action should be taken until the net controller requests a "radio check."

(5) Manual Remote Keying Procedures.

(a) The Net Controller will make contact on a secure voice channel with instructions to stand by for a new crypto-net variable (CNV) by a Manual Remote Keying (MK) action. Upon instructions from the Net Controller:

1 Set the Z-AHP FILL switch to position 6. Notify the Net Controller by radio, and stand by.

2 When notified by the Net Controller, set the Z-AHP MODE switch to RV (receive variable). Notify the Net Controller, and stand by.

3 When notified by the Net Controller, set the Z-AHP FILL switch to any storage position selected to receive the new CNV (May be unused or may contain the variable being replaced). Notify the Net Controller, and stand by.

NOTE

When performing Step 3, the storage position (1 through 6) selected to receive the new CNV may be unused, or it may contain the variable which is being replaced.

(b) Upon instructions from the Net Controller:

1 Listen for a beep on your headset.

2 Wait two seconds

3 Set the RCU MODE switch to OP

4 Confirm

(c) If the MK operation was successful, the Net Controller will now contact you via the new CNV.

(d) If the MK operation was not successful, the Net Controller will contact you via clear voice (plain) transmission; with instructions to set your Z-AHP FILL selector switch to position 6, and stand by while the MK operation is repeated.

(6) It is important to be familiar with certain KY-58 audio tones. Some tones indicate normal operation, while other indicate equipment malfunction. These tones are:

(a) Continuous beeping, with background noise, is cryptoalarm. This occurs when power is first applied to the KY-58, or when he KY-58 is zeroized. This beeping is part of normal KY-58 operation. To clear this tone, press and release the PTT button on the Z-AHQ (after the Z-AHQ LOCAL switch has been pressed). Also the PTT can be pressed in the cockpit.

(b) Background noise indicates that the KY-58 is working properly. This noise should occur at TURN ON of the KY-58, and also when the KY-58 is generating a cryptovariable. If the background noise is not heard at TURN ON, the equipment must be checked out by maintenance personnel.

(c) Continuous tone, could indicate a "parity alarm." This will occur whenever an empty storage register is selected while holding the PTT button in. This tone can mean any of three conditions:

1 Selection of any empty storage register.

2 A "bad" cryptovariable is present.

3 Equipment failure has occurred. To clear this tone, follow the "Loading Procedures" in TM 11-5810-282-OP. If this tone continues, have the equipment checked out by maintenance personnel.

(d) Continuous tone could also indicate a cryptoalarm. If this tone occurs at any time other than in (c) above, equipment failure may have occurred. To clear this tone, repeat the "Loading Procedures" in TM 11-5810-262-OP. If this tone continues, have the equipment checked out by maintenance personnel.

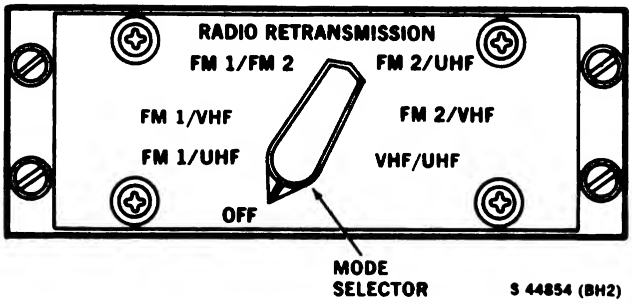

Figure 3-8. Retransmission Control Panel

(e) Single beep, when RCU is not in TD (Time Delay), can indicate any of the three normal conditions:

1 Each time the PTT button is pressed when the KY-58 is in C (cipher) and a filled storage register is selected, this tone will be heard. Normal use (speaking) of the KY-58 is possible.

2 When the KY-58 has successfully received a cryptovariable, this tone indicates that a "good" cryptovariable is present in the selected register.

3 When you begin to receive a ciphered message this tone indicates that the cryptovariable has passed the "parity" check, and that it is a good variable.

(f) A single beep, when the RCU is in TD (Time Delay) occurring after the "preamble" is sent, indicates that you may begin speaking.

(g) A single beep, followed by a burst of noise after which exists a seemingly "dead" condition indicates that your receiver is on a different variable than the distant transmitter. If this tone occurs when in cipher text mode: Turn RCU FILL switch to the CNV and contact the transmitter in PLAIN text and agree to meet on a particular variable.

3-65. Radio Retransmission Control.

Control of retransmission is through a switch panel (Figure 3-8) on the lower console. The position of the switch determines which radio set pairs will be used when the corresponding FM and VHF radio function and VOL switches (not required for UHF) are placed to RETRAN. Operation of the retransmission control is included with the operating procedures of each radio set where applicable. The retransmission control is only a means of directing the audio output of a receiver to the audio input of a transmitter through switching.

Section III NAVIGATION

3-66. Direction Finder Set AN/ARN-89. (LF/ADF).

Direction Finder set AN/ARN-89 (Figure 3-9) is an airborne, low frequency (LF), automatic direction finder (ADF) radio, that provides an automatic or manual compass bearing on any radio signal within the frequency range of 100 to 3,000 kHz. The ADF can identify keyed or continuous wave (CW) stations. The ADF displays the bearing of the helicopter relative to a selected radio transmission on the horizontal situation indicator NO. 2 bearing pointer (Figure 3-24). When ADF is selected on the MODE SEL panel (Figure 3-25) three modes of operation permit the system to function: as a CW automatic direction finder, as a CW manual direction finder or as an amplitude-modulated (AM) broadcast receiver. Power to operate the Direction Finder AN/ARN-89 is provided by No. 1 dc primary bus through a circuit breaker, marked ADF, and the ac essential bus through a circuit breaker, marked 26V INST.

3-67. Antennas.

The ADF sense antenna is a part of the VHF/FM No. 2, VHF/AM, antenna (Figure 3-1) under the nose section of the helicopter. The ADF loop antenna is flush-mounted, under the center fuselage section.

3-68. Controls and Functions.

Controls for the LF/ADF receiver are on the front panel of the unit (Figure 3-9). The function of each control is as follows:

CONTROL	FUNCTION
Mode selector switch	
OFF	Turns power off.
COMP	Provides operation as an ADF.
ANT	Provides for operation as an AM receiver using sense antenna.
LOOP	Provides for receiver operation as a manual direction finder using loop only.

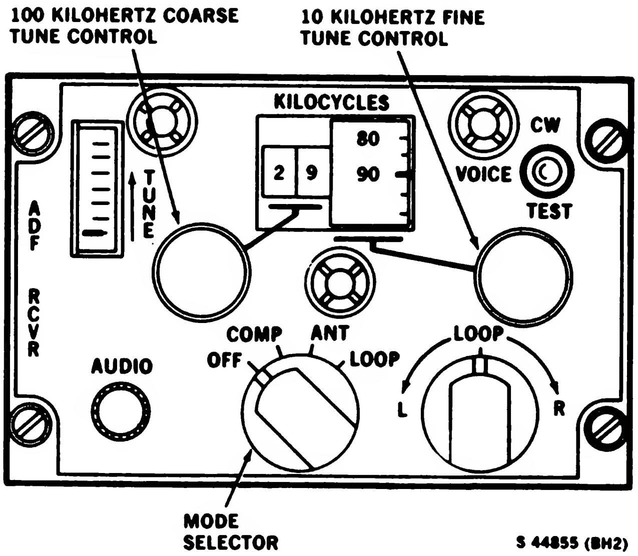

Figure 3-9. LF/ADF Control Panel C-7932/ARN-89

CONTROL	FUNCTION
LOOP L-R control switch	Provides manual left and right control of loop when operating mode selector in LOOP position. It is spring loaded to return to center.
AUDIO	Adjusts volume.
100 Kilohertz coarse-tune control knob	Tunes receiver in 100-kHz steps as indicated by first two digits of KILO-CYCLES indicator.
10 Kilohertz fine-tune control knob	Tunes receiver in 10 kHz steps as indicated by last two digits of KILO-CYCLES indicator.
CW, VOICE, TEST switch	
CW (COMP mode)	Enables tone oscillator to provide audible tone for tuning to CW station, when mode function switch is at COMP.
CW (ANT or LOOP mode)	Enables beat frequency oscillator to permit tuning to CW station, when mode function switch is at ANT or LOOP.
VOICE	Permits low frequency receiver to operate as a receiver with mode switch in any position.
TEST (COMP mode)	Provides slewing of loop through 180° to check operation of receiver in COMP mode. (Switch position is inoperative in LOOP and ANT mode.)
TUNE meter	Indicates relative signal strength while tuning receiver to a specific radio signal.
KILOCYCLES indicator	Indicates operating frequency to which receiver is tuned.

3-69. Operation.

3-70. Starting Procedure.

a. ICS NAV receiver selector - ON.

b. Mode selector - COMP, ANT, or LOOP.

c. Frequency - Select.

d. CW, VOICE, TEST switch - CW or VOICE as appropriate.

e. ICS NAV switch - ON.

f. Fine tune control - adjust for maximum upward indication on TUNE meter.

g. AUDIO control - adjust as desired.

3-71. ANT Mode Operation.

a. Mode selector - ANT.

b. ICS NAV switch - ON.

c. Monitor receiver by listening.

3-72. COMP Mode Operation.

a. Mode selector - COMP.

b. HSI/VSI MODE SEL BRG 2 switch - ADF.

c. The horizontal situation indicator No. 2 bearing pointer displays the magnetic bearing to the ground station from the helicopter, as read against the compass card, when ADF is selected on the MODE SEL BRG 2 switch.

d. ICS NAV switch - ON.

e. To test the ADF, when required:

(1) CW, VOICE, TEST switch - TEST. Check to see that No. 2 bearing pointer changes about 180°.

(2) CW, VOICE, TEST switch - release.

3-73. LOOP Mode Operation.

Manual direction finding uses the LOOP mode.

a. Mode selector switch - LOOP.

b. ICS NAV switch - ON.

c. Turn LOOP L-R switch to L (left) or R (right) to obtain an audio null and a TUNE indicator null. Watch HSI NO. 2 bearing pointer for a display of magnetic bearing to or from ground station as read against the compass card. In this mode of operation, two null positions 180° apart are possible.

3-74. Stopping Procedure.

Mode selector - OFF.

3-75. Radio Receiving Set AN/ARN-123(V) (VOR/ILS/MB).

Radio set AN/ARN 123(V) (Figure 3-10) is a very high frequency receiver that operates from 108.00 to 117.95 MHz. Course information is presented by the VSI course deviation pointer and the selectable No. 2

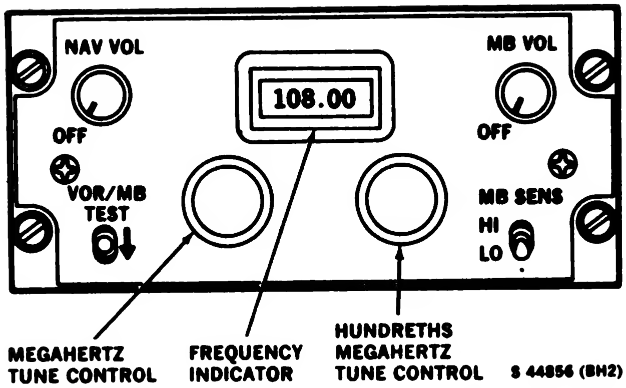

Figure 3-10. Radio Receiving Set AN/ARN-123(V)

bearing pointer on the horizontal situation indicator. The combination of the glide slope capability and the localizer capability makes up the instrument landing system (ILS). The marker beacon portion of the receiver visually indicates on the VSI MB advisory light, and aurally indicates on the headphones, of passage of the helicopter over a marker beacon transmitter. The receiving set may be used as a VOR receiver, or ILS receiver. The desired type of operation is selected by tuning the receiving set to the frequency corresponding to that operation. ILS operation is selected by tuning to the odd tenth MHz frequencies between 108.0 and 112.0 MHz. VOR operation is selected by tuning in .050 MHz units to the frequencies between 108.0 and 117.95 MHz, except the odd tenth MHz between 108.0 and 112.0 MHz, which are reserved for ILS operation. The three receiver sections do the intended functions independent of each other. Performance degradation within any one of the major sections will not affect the performance of the others. Power for the AN/ARN-123 is provided from the dc essential bus through a circuit breaker, marked VOR/ILS.

NOTE

Tuning to a localizer frequency will automatically tune to a glide slope frequency, when available.

3-76. Antenna.

The VOR/LOC antenna system (Figure 3-1), consists of two blade type collector elements, one on each side of the fuselage tail cone. The glide slope antenna is mounted under the avionics compartment in the nose. The antenna provides the glide slope receiver with a matched forward-looking receiving antenna. The marker beacon antenna is flush-mounted under the center section of the fuselage.

3-77. Controls and Functions.

The controls for the VOR/ILS/MB receivers are on the front panel of the unit. The function of each control is as follows:

CONTROL	FUNCTION
NAV VOL-OFF control	Turns VOR/ILS receiver on and off, adjusts volume.
MB VOL-OFF control	Turns marker beacon receiver on and off; adjusts volume.
Megahertz tune control	Tunes VOR/ILS receiver in MHz as indicated on frequency indicator.
Hundredths megahertz tune control	Tunes VOR/ILS receiver in hundredths MHz as indicated on frequency indicator.
VOR/MB TEST control	Activates VOR test circuit and MB receiver lamp self-test circuits.
MB SENS HI-LO control	For controlling MB sensitivity.
LO	Decreases receiver sensitivity by shortening time transmitted signal will be received.
HI	Increases receiver sensitivity by lengthening time transmitted signal will be received.

3-78. Operation.

3-79. Starting Procedure.

a. ICS AUX selector - ON.

b. NAV VOL OFF control - On.

c. Frequency - Select.

d. MODE SEL BRG 2 switch - VOR.

e. MODE SEL VOR/ILS switch - VOR.

3-80. VOR/Marker Beacon Test.

NOTE

If acceptable signal is not received, test will not be valid.

a. HSI CRS set .315 on COURSE set display, pilot and copilot.

b. VOR/MB TEST switch - Down and hold. The MB light on the VSI should go on.

c. HSI VOR/LOC course bar and VSI course deviation pointer - Centered ± 1 dot.

d. No. 2 bearing pointer - Should go to 310°-320° position.

e. To-from arrow should indicate - TO.

f. VOR/MB TEST switch - Release.

3-81. VOR Operation.

Course - Set.

3-82. ILS (LOC/GS) Operation.

ILS operation frequency - Set.

3-83. Marker Beacon (MB) Operation.

a. MB VOL OFF switch - ON.

b. MB SENS switch - as desired.

3-84. VOR Communications Receiving Operation.

Frequency - Set.

3-85. Stopping Procedure.

NAV VOL OFF switch - OFF.

3-86. Doppler Navigation Set AN/ASN-128.

The doppler navigation set, AN/ASN-128 in conjunction with the helicopter's heading and vertical reference systems, provides helicopter velocity, position, and steering information from ground level to 10,000 feet. To achieve best results with the set, pitch and roll angles should be limited to 30° pitch and 45° roll, and moderate maneuver rates should be employed. The Doppler navigation system is a completely self-contained navigation system and does not require any ground-based aids. The system provides world-wide navigation, with position readout available in both Universal Transverse Mercator (UTM) and Latitude and Longitude (LAT/LONG). Navigation and steering is done using LAT/LONG coordinates, and a bilateral UTM-LAT/LONG conversion routine is provided for UTM operation. Up to ten destinations may be entered in either format and not necessarily the same format. Present position data entry format is also optional and independent of destination format. Power to operate the AN/ASN-128 is provided from No. 1 dc primary bus through a circuit breaker marked DOPPLER, and from the ac essential bus through a circuit breaker, marked 26V DOPPLER, refer to TM 11-5841-281-12.

3-87. Antenna.

The Doppler antenna (Figure 3-1) consists of a combined antenna/radome and a receiver-transmitter housing below copilot's seat. The combination antenna/radome uses a printed-grid antenna.

3-88. Controls, Displays, and Function.

The control and displays for the Doppler are on the front panel (Figure 3-11). The function of each control is as follows:

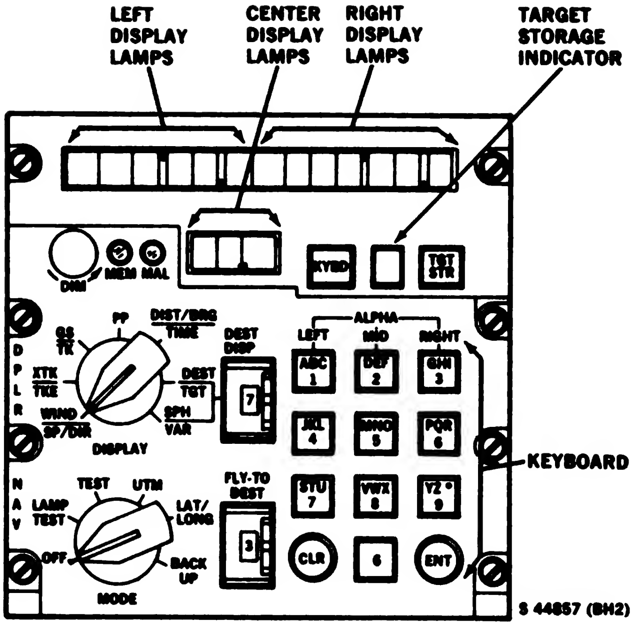

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Figure 3-11. Doppler Navigation Set AN/ASN-128

CONTROL/ INDICATOR	FUNCTION
MODE Selector	Selects Doppler Navigation Mode of operation.
OFF	Turns navigation set off.
LAMP TEST	Checks operation of all lamps.
TEST	Initiates built-in-test exercise for navigation set.
UTM	Selects Universal Transverse Mercator (UTM) navigational mode of operation.
LAT/LONG	Select latitude/longitude navigational mode of operation.

CONTROL/ INDICATOR	FUNCTION
BACKUP	Places navigation set in estimated mode of operation or estimated velocity mode of operation.
DISPLAY selector	Selects navigation data for display.
WIND SP/DIR	Not applicable.
XTK/TKE (Left Display)	Distance crosstrack (XTK) of initial course to destination in km and tenths of a km.
(Right Display)	Track angle error (TKE) in degrees displayed as right or left of bearing to destination.
GS-TK (Left Display)	Ground speed (GS) in km/hr.
(Right Display)	Track angle (TK) in degrees TRUE.
PP with switch set to UTM (Center Display)	Present position UTM zone.
(Left Display)	Present position UTM area square designator and easting in km to nearest ten meters.
(Right Display)	Present position UTM area northing in km to nearest ten meters.
PP with MODE switch set to LAT/LONG (Left Display)	Present position latitude in degrees, minutes and tenths of minutes.
(Right Display)	Present position longitude in degrees, minutes and tenths of minutes.
DIST/BRG-TIME (Center Display)	Time to destination selected by FLY TO DEST (in minutes and tenth of minutes).
(Left Display)	Distance to destination selected by FLY TO DEST (in km and tenths of a km).
(Right Display)	Bearing to destination selected by FLY TO DEST (in degrees TRUE).
DEST-TGT (Mode switch set to UTM) (Center Display)	UTM zone of destination selected by DEST DISP thumbwheel.
(Left Display)	UTM area and easting of destination set on DEST DISP thumbwheel.
(Right Display)	Northing of destination set on DEST DISP thumbwheel.
DEST-TGT (Mode switch set to LAT/LONG (Left Display)	Latitude (N 84° or S 80° max.) of destination set on DEST DISP thumbwheel.
(Right Display)	Longitude of destination set on DEST DISP thumbwheel.
SPH-VAR (Left Display)	Spheroid code of destination set on DEST DISP thumbwheel.
(Right Display)	Magnetic variation (in degrees and tenths of degrees) of destination set on DEST DISP thumbwheel.
MEM Indicator Lamp	Lights when radar portion of navigation set is in nontrack condition.

CONTROL/ INDICATOR	FUNCTION
MAL Indicator Lamp	Lights when navigation set malfunction is detected by built in self-test.
DIM Control	Controls light intensity of display characters.
Left, Right, and Center Display Lamps	Lights to provide data in alphanumeric and numeric characters, as determined by setting of DISPLAY switch, MODE switch, and operation of keyboard.
Target Storage Indicator	Displays destination number (memory location in which present position will be stored when TGT STR pushbutton is pressed.
TGT STR Pushbutton	Stores present position data when pressed.
KYBD Pushbutton	Used in conjunction with the keyboard to allow data to be displayed and subsequently entered into the computer when the ENT key is pressed.
DEST DISP Thumbwheel Switch	Destination display thumbwheel switch is used along with DEST-TGT and SPH-VAR position of DISPLAY switch to select destination whose coordinates or magnetic variation are to be displayed, or to be entered. Destinations are 0 through 9, P (Present Position) and H (Home).

CONTROL/ INDICATOR	FUNCTION
Keyboard	Used to set up data for entry into memory. When the DISPLAY switch is turned to the position in which new data is required and the KYBD pushbutton is pressed, data may be displayed on the appropriate left, right, and center display. To display a number, press the corresponding key or keys (1 through 0). To display a letter, first depress the key corresponding to the desired letter. Then depress a key in the left, middle or right column, corresponding to the position of the letter on the key. Example: To enter an L, first depress L, then 3, 6, or 9 in the right column.
FLY-TO-DEST Thumbwheel Switch	Selects the destination for which XTK/TKE and DIST/BRG/TIME are displayed when the DISPLAY switch is turned to either of these positions which steering information is desired. Destinations are 0 through 9, P (Present Position) and H (Home).
ENT key	Enters data set up on keyboard into memory when pressed.
CLR key	Clears last entered character when pressed once. When pressed twice, clears entire display panel under keyboard control.

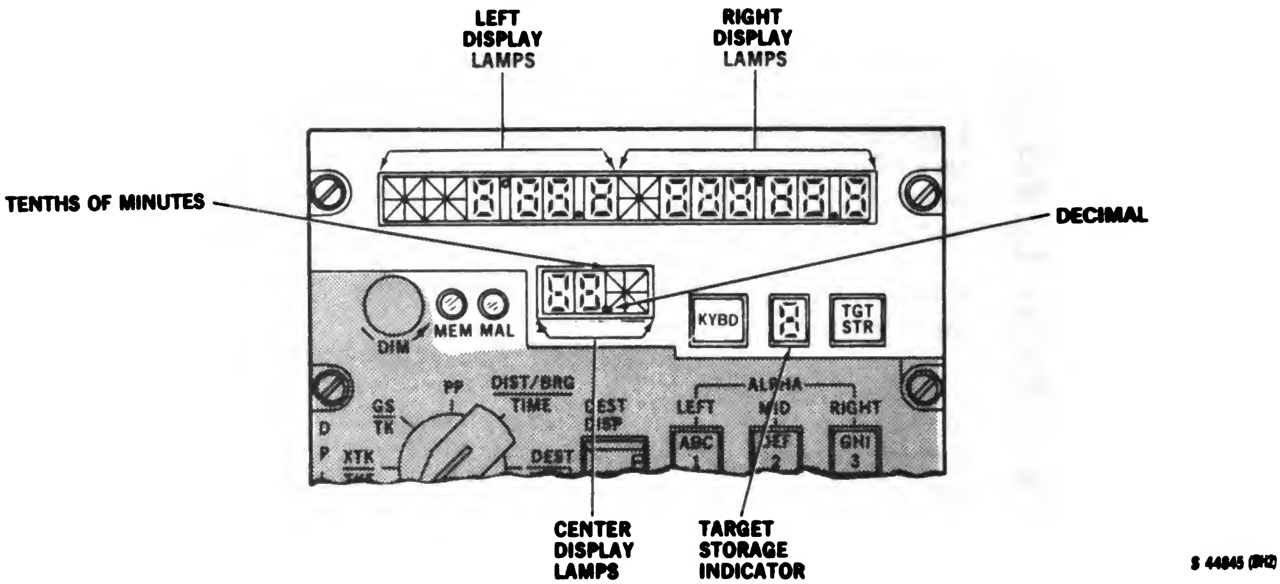


Figure 3-12. Doppler Lamp Test Mode Display

3-89. Modes of Operation.

The three basic modes of operation are: Navigate, test, and backup.

3-90. Test Mode.

The TEST mode contains two functions: LAMP TEST mode, in which all display segments are lit, and TEST mode, in which system operation is verified. In the LAMP TEST mode, system operation is identical to that of the navigate mode except that all lamp segments and the MEM and MAL indicator lamps are lighted to verify their operation (see Figure 3-12). In TEST mode, the system antenna no longer transmits or receives electromagnetic energy; instead, self-generated test signals are inserted into the electronics to verify operation. System operation automatically reverts into the backup mode during test mode. Self-test of the doppler set is done using built-in-test equipment (BITE), and all units connected and energized for normal operation. Self-test isolates failures to one of the three units. The computer-display unit (except for the keyboard and display) is on a continuous basis, and any failure is displayed by turn-on of the MAL indicator lamp on the computer-display unit. The signal data converter and receiver-transmitter-antenna are tested by turning the MODE switch to TEST. Failure of those components is displayed on the computer-display unit by turn-on of the MAL indicator lamp. Identification of the failed unit is indicated by a code on the display panel of the computer-display unit. Continuous monitoring of the signal data converter and receiver-transmitter-antenna is provided by the MEM indicator lamp. The MEM indicator lamp will light in normal operation when flying over smooth water. However, if the lamp remains on for over 10 minutes, over land or rough water, there is a malfunction in the doppler set. Then the operator should turn the MODE switch to TEST, to determine the nature of the malfunction. Keyboard operation is verified by observing the alphanumeric readout as the keyboard is used.

3-91. Navigate Mode.

In the navigate mode (UTM or LAT/LONG position of the MODE selector), power is applied to all system components, and all required outputs and functions are provided. Changes in present position are computed and added to initial position to determine the instantaneous latitude/longitude of the helicopter. Destination and present position coordinates can be entered and displayed in UTM and latitude/longitude. At the same time, distance, bearing and time-to-go to any one of ten preset destinations are computed and displayed as selected by the FLY-TO DEST thumbwheel.

3-92. Backup Mode.

In this mode, remembered velocity data are used for navigation. The operator can insert ground speed and track angle with the keyboard and the display in GS-TK position. This remembered velocity data can be manually updated through use of the keyboard and CDU DISPLAY switch in the GS-TK position. When GS-TK values are inserted under these conditions, navigation continues using only these values.

3-93. Operation.

3-94. Window Display and Keyboard Operation.

In all data displays except UTM coordinates, the two fields are the left and right display windows. In UTM coordinates displays, the first field of control is the center window and the second field is the combination of the left and right displays. When pressing the KYBD pushbutton, one or other of the fields described above is under control. If it is not desired to change the display in the panel section under control, the pilot can advance to the next field of the display panel by pressing the KYBD pushbutton again. The last character entered may be cleared by pressing the CLR key. That character may be a symbol or an alphanumeric character. However, if the CLR key is pressed twice in succession, all characters in the field under control will be cleared and that field will still remain under control.

3-95. Data Entry.

To enter a number, press the corresponding key. To enter a letter, first press the key corresponding to the desired letter. Then press a key in the left, middle, or right column corresponding to the position of the letter on the pushbutton.

Example: To enter an L, first press L, then either 3, 6, or 9 in the right column. The computer program is designed to reject unacceptable data (for example, a UTM area of WI does not exist, and will be rejected). If the operator attempts to insert unacceptable data, the display will be blank after ENT is pressed.

3-96. Starting Procedure.

a. MODE selector - LAMP TEST. All lights should be lit.

(1) Left, right, Center and Target storage indicator - Lit (Figure 3-12). All other lights should be on.

(2) Turn DIM control fully clockwise, then fully counterclockwise, and return to full clockwise; all segments of the display should alternately glow brightly, go off, and then glow brightly.

b. MODE selector - TEST. After about 15 seconds left display should display GO. Ignore the random display of alpha and numeric characters which occurs during the first 15 seconds. Also ignore test velocity and angle data displayed after the display has frozen. After about 15 seconds, one of the following five displays will be observed in the first two character positions in the left display:

NOTE

If the MAL lamp lights during any mode of operation except LAMP TEST, the computer-display unit MODE switch should be turned first to OFF, and then to TEST, to verify the failure. If the MAL lamp remains on after recycling to TEST, notify organizational maintenance personnel of the navigation set malfunction.

DISPLAY		REMARKS
LEFT	RIGHT	
GO	No display. Display blanks (normal).	If right display is blank, system is operating satisfactorily.
GO	P	If right display is P, then pitch or roll data is missing, or pitch exceeds 90°. In this case, pitch and roll in the computer are both set to zero and navigation continues in a degraded operation. Problem may be in the vertical gyroscope or helicopter cabling.

DISPLAY LEFT	DISPLAY RIGHT	REMARKS

NOTE

If the TEST mode display is MN or NG, the MODE switch should be recycled through OFF to verify that the failure is not a momentary one. If the TEST mode display is MN, the data entry may be made in the UTM or LAT/LONG mode, but any navigation must be carried on with the system in the BACKUP mode.

DISPLAY LEFT	DISPLAY RIGHT	REMARKS
BU	C, R, S, or H followed by a numeric code	A failure has occurred and the system has automatically switched to a BACKUP mode of operation as follows: 1. The operator has the option of turning the MODE switch to BACKUP and entering the best estimate of ground speed and track angle. 2. The operator has the option of turning the MODE switch to BACKUP and entering his best estimate of wind speed and direction and entering his best estimate of ground speed and track angle. The operator should update present position as soon as possible, because it is possible that significant navigation errors may have accumulated.
MN	C, R, S, or H followed by a numeric code	A failure has occurred and the BACKUP mode, used for manual navigation (MN), is the only means of valid navigation. The operator may use the computer as a dead reckoning device by entering ground speed and track data. The operator should update present position as soon as possible, because it is possible significant navigation errors may have accumulated.
MN	HO10000	No heading information to signal data converter.
	SO5000	No 26 vac to signal data converter.
NG	C, R, S, or H followed by a numeric code	A failure has occurred in the system and the operator should not use the system.
EN		The 9V battery has failed. All stored data must be reentered after battery replacement.
Blank	C with random numbers	Computer display unit failure.
Blank	R with random numbers	Receiver-transmitter-antenna failure.
Blank	S with random numbers	Signal data converter failure.
Random display	Random display	Signal data converter failure.

3-97. Entering UTM Data.

This initial data is inserted before navigating with the Doppler. Refer to paragraph 3-102.

a. Spheroid of operation, when using UTM coordinates.

b. UTM coordinates of present position - zone, area, easting (four significant digits) and northing (four significant digits; latitude/longitude coordinates may be used.

c. Variation of present position to the nearest one-tenth of a degree.

d. Coordinate of desired destination - 0 through 5 and H; (6 through 9 are normally used for target store locations; but may also be used for destinations). It is not necessary to enter all destinations in the same coordinate system.

NOTE

It is not necessary to enter destinations unless steering information is required, unless it is desired to update present position by overflying a destination, or unless a present position variation computation is desired (paragraph 3-92). If a present position variation running update is desired, destination variation must be entered. The operator may enter one or more destination variations to effect the variation update; it is not necessary for all destinations to have associated variations entered.

3-98. Entering Spheroid and/or Variation.

a. MODE selector - UTM, LAT/LONG or BACKUP.

b. DISPLAY selector - SPH-VAR.

c. DEST DISP thumbwheel - P, numeral, or H as desired.

d. KYBD pushbutton - Press. Observe display freezes and TGT STR indicator blanks. Press KYBD pushbutton again and observe left display blinks. If no spheroid data is to be entered, KYBD pushbutton - Press again, go to Step g.

e. Spheroid data - Entry. (Example: INØ). Press keys 3 (left window blanks), 3, 5, 5 and 0. Left display should indicate INØ. Refer to Table 3-2 for codes.

f. ENT pushbutton - Press if no variation data is to be entered.

g. KYBD pushbutton - Press, if variation data is to be entered, and note right display blanks. (If no variation data is to be entered, ENT key - Press.)

h. Variation data - Enter. (Example: E001.2, press keyboard keys 2 (right window blanks), 2, 0, 0, 1 and 2. Press ENT key, the entire display will blank and TGT STR number will reappear, display should indicate INØ E 001.2.)

3-99. Entering Present Position or Destination In UTM.

a. MODE selector - UTM.

b. DISPLAY selector - DEST-TGT.

c. DEST DISP thumbwheel - P, numerical, or H as desired.

Table 3-2. Spheroid Data Codes

SPHEROID	CODE	AREA COVERED
CLARK 1866	CL6	Use the listing on the DMA topographic maps for Spheroid Data Code of Area. For World Geodetic System. Modified Everest, Airy, and Modified Airy Spheroids Use INØ
CLARK 1880	CLØ	
INTERNATIONAL	INØ	
BESSEL	BEØ	
EVEREST	EVØ	
AUSTRALIAN NATIONAL	AUØ	

d. Present position and destination - Enter. (Example: Entry of zone 31T, area CF, easting 0958 and northing 3849.)

(1) KYBD pushbutton - Press. Observe that display freeze and TGT STR indicator blanks.

(2) KYBD button - Press. Observe that center display blanks.

(3) Key 3, 1, 7, and 8 - Press.

(4) KYBD button - Press. Observe left and right displays blank.

(5) Key 1, 3, 2, 3, 0, 9, 5, 8, 3, 8, 4, 9 - Press.

(6) ENT pushbutton - Press. Left, right, and center displays will momentarily blank and TGT STR number will appear. Displays should indicate 31T CF 09583849.

3-100. Entering Present Position or Destination Variation In LAT/LONG.

The variation of a destination must be entered after the associated destination coordinates are entered (since each time a destination is entered its associated variation is deleted). The order of entry for present position is irrelevant.

NOTE

If operation is to occur in a region with relatively constant variation, the operator enters variation only for present position, and the computer will use this value throughout the flight.

a. MODE selector - LAT/LONG.

b. DISPLAY selector - DEST-TGT.

c. DEST DISP thumbwheel - P, numerical or H as desired.

d. Present position or destination - Enter. (Example: Entry of N41° 10.1 minutes and E035° 50.2 minutes.) Press KYBD pushbutton. Observe that display freezes and TGT STR indicator blanks. Press KYBD pushbutton again and observe left display blanks. Press keys 5, 5, 4, 1, 1, 0 and 1. Press KYBD pushbutton (right display should clear), and keys 2, 2, 0, 3, 5, 5, 0 and 2.

e. ENT pushbutton - Press. Entire display will blank and TGT STR number will reappear. Display should indicate N 41° 10.1 E0 35° 50.2.

3-101. Ground Speed and Track.

a. MODE selector - BACK UP.

b. DISPLAY selector - GS-TK.

c. Ground speed and track - Enter. (Example: Enter 131 km/h and 024°. Press KYBD pushbutton, observe that left display freezes and TGT STR indicator blanks. Press KYBD pushbutton and observe that left display blanks. Press keys 1, 3, and 1. Left display indicates 131. Press KYBD pushbutton, control shifts to right display, and right display blanks. Press keys 0, 2 and 4.

d. ENT pushbutton - Press. The entire display will blank, and TGT STR number will reappear. Display should indicate 131 024°.

3-102. Initial Data Entry.

Initial data entry of variation in coordinates is normally done prior to takeoff. To make the initial data entry, do the following:

a. Present positon variation - Enter (paragraph 3-98).

b. DISPLAY selector - DEST-TGT.

c. DEST DISP thumbwheel - P. Do not press ENT key now.

d. ENT pushbutton - Press as helicopter is sitting over or overflies initial fix position.

e. FLY-TO DEST thumbwheel - Desired destination location.

3-103. Update of Present Position From Stored Destination.

The helicopter is flying to a destination set by the FLY-TO DEST thumbwheel. When the helicopter is over the destination, the computer updates the present position when the KYBD pushbutton is pressed, by using stored destination coordinates for the destination number shown in FLY-TO DEST window, and adding to them the distance traveled between the time the KYBD pushbutton was pressed and the ENT key was pressed.

a. DISPLAY selector - DIST/BRG-TIME.

b. KYBD pushbutton - Press, when helicopter is over the destination. Display freezes.

NOTE

If a present position update is not desired, as indicated by an appropriately small value of distance to go on overflying the destination, set the DISPLAY selector to some other position, this aborts the update mode.

c. ENT key - Press.

3-104. Update of Present Position from Landmark.

There are two methods for updating present position from a landmark. Method 1 is useful if the landmark comes up unexpectedly and the operator needs time to determine the coordinates. Method 2 is used when a landmark update is anticipated.

a. Method 1.

(1) DISPLAY selector - PP.

(2) KYBD pushbutton - Press as landmark is overflown. Present position display will freeze.

(3) Compare landmark coordinates with those on display.

(4) Landmark coordinates - Enter. If difference warrants an update.

(5) ENT key - Press if update is required.

(6) DISPLAY selector - Set to some other position to abort update.

b. Method 2.

(1) DISPLAY selector - DEST/TGT.

(2) DEST DISP thumbwheel - P. Present postion coordinate should be displayed.

(3) KYBD pushbutton - Press, observe that display freezes.

(4) Landmark coordinates - Manually enter via keyboard.

(5) ENT key - Press when overflying landmark.

(6) DISPLAY selector - Set to some other position to abort update.

3-105. Left-Right Steering Signals.

Flying shortest distance to destination from present position.

a. DISPLAY selector - XTK-TKE.

b. MODE SEL - DPLR.

c. Fly helicopter in direction of lateral deviation pointer on vertical situation indicator to center the pointer, or course deviation bar on HSI.

3-106. Target Store (TGT STR) operation.

Two methods may be used for target store operation. Method 1 is normally used when time is not available for preplanning a target store operation. Method 2 is used when time is available and it is desired to store a target in a specific DEST DISP position.

a. Method 1.

(1) TGT STR pushbutton - Press when flying over target.

(2) Present position is automatically stored and the destination location is that which was displayed in the target store indicator (position 6, 7, 8 or 9) immediately before pressing the TGT STR pushbutton.

b. Method 2.

(1) MODE selector - UMT or LAT/LONG, depending on coordinate format desired.

(2) DISPLAY selector - DEST-TGT.

(3) DEST DISP thumbwheel - P.

(4) KYBD pushbutton - Press when over flying potential target. Display should freeze.

NOTE

Do not press ENT key while DEST DISP thumbwheel is at P.

(5) If it is desired to store the target, turn DEST DISP thumbwheel to destination location desired and press ENT key.

(6) If it is not desired to store the target, place DISPLAY selector momentarily to another position.

3-107. Transferring Stored Target Coordinates From One Location to Another.

The following procedure allows the operator to transfer stored target coordinates from one thumbwheel location to another. For example, it is assumed that the pilot wants to put the coordinates of stored target 7 into location of destination 2.

NOTE

Throughout this procedure, range, time-to-go, bearing and left/right steering data are computed and displayed for the destination selected via the FLY-TO DEST thumbwheel.

a. DISPLAY selector - DEST-TGT.

b. DEST DISP thumbwheel - 7.

c. KYBD pushbutton - Press.

d. DEST DISP thumbwheel - 2.

e. ENT key - Press.

3-108. Transferring Variation From One Location to Another.

The procedure to transfer variation data to the same location where the associated stored target coordinates has been transferred is the same as in paragraph 3-107, Transferring Stored Target Coordinates From One Location To Another, except that the DISPLAY selector is placed at SPH-VAR.

3-109. Dead Reckoning Navigation.

As an alternate BACKUP mode, dead reckoning navigation can be done using ground speed and track angle estimates provided by the operator.

a. MODE selector - BACKUP.

b. DISPLAY selector - GS-TK.

c. Best estimate of ground speed and track angle - Enter via keyboard.

d. Set MODE selector to any other position to abort procedure.

3-110. Operation During and After Power Interruption.

During a dc power interruption inflight, or when all helicopter power is removed, the random access memory (RAM) (stored destination and present position) data is retained by power from an 8.4 volt dc dry cell battery. This makes it unnecessary to reenter any navigational data when power returns or before each flight. If the battery does not retain the stored destination data during power interruption, the display will indicate on EN when power returns. This indicates to the pilot that previously stored data has been lost, and that present position, spheroid/variation, and destinations must be entered. The computer, upon return of power, resets present position variation to E000.0°, destination and associated variations to a non-entered state, remembers wind to zero and spheroid to CL6. The following data must be entered following battery failure:

a. Enter spheroid.

b. Enter present position variation.

c. Enter present position.

d. Enter each destination and its associated variation.

3-111. Stopping Procedure.

MODE selector - OFF.

3-112. Integrated Inertial Navigation System (IINS) AN/ASN-132(V). EH

The IINS is a self-contained integrated navigation system capable of short and/or long-range missions which can be updated whenever TACAN navigational facilities exist or manually without TACAN data, and displays location of the helicopter on the control display unit (CDU). The IINS consists of the following equipment:

TYPE DESIGNATION	NAME	COMMON NAME
C-11097/ASN-132	Control Indicator	Control Display Unit
CV-3739/ASN-132	Converter, Signal Set	Signal Converter Unit (SDC)
AN/UYK-64(V)2	Data Processing Set	Navigation Processor Unit (NPU)
RT-1159/A	Receiver-Transmitter, Radio	TACAN RT
AN/ASN-141	Inertial Navigation Set	Inertial Navigation Unit (INU)
MT-4915/A	Mounting Base, Elect Equip	TACAN/SCU Mount

Auxiliary components of the IINS includes the SYSTEM SELECT Panel, INU Blower Assembly, INU Battery Assembly, and Data Bus Couplers. The IINS provides accurate indications of the helicopter navigation parameters including present position, velocity, altitude and heading information. The system employs a serial data bus for data interchange within the IINS and with external mission system computers. The IINS also interfaces with the helicopter flight instruments and altimeter encoder. The multiplex data bus system consisting of two buses (A and B), with only one bus active at any given time. The other bus is in a standby mode for redundancy purposes to provide a path for data flow between the Standard Inertial Navigation System (STD INS), Signal Converter Unit, Navigation Processor Unit, Control Display Unit, and the external mission systems. Data to and from the TACAN receiver-transmitter is first processed by the SCU before it is applied to the multiplex data bus.

3-113. Controls, Displays, and Function.

The IINS controls and displays (Figure 3-13) are contained on the CDU. The function of each control is as follows:

KEY	CONTROL OR INDICATOR	FUNCTION
1	Data display	Displays multiple flight parameters to the operator on seven data lines and a scratch pad line on the face of the cathode ray tube (CRT).
2	Line select keys	On both sides of data display lines 1, 3, 5, and 7 are pushbuttons (line select keys) which perform functions as defined by the legend adjacent to the key on the data display. If a line select key is active on a particular page, an arrow will appear in the character space closest to the key. Arrows will be oriented toward the legend, up, or toward the key (away from the legend). These orientations (with examples) are defined as follows: 1. → legend ← (TH 358.3 ←). If the arrow points toward the legend a numeric entry (entered into the scratch pad on line 8) is allowed by pressing the adjacent line select key.

KEY	CONTROL OR INDICATOR	FUNCTION
		2. ← legend → (MAG →). If the arrow points away from the legend, pressing the adjacent line select key will initiate the function described by the legend. For example, pressing the line select key adjacent to "MAG →" will change the display to MAG Heading (MH) and MAG VAR (MV).
		3. ↑ legend ↑ (↑ T/R). If the arrow points up, the legend indicates current mode status and pressing the adjacent line select key will change the mode. If no arrow appears next to a legend then that line select key performs no operation.
		4. Up or down pointing arrows on the sixth line of the data display allows operator to slew display one page up or down by pressing page slew toggle switch up or down.
3	Alphanumeric keys	Alphanumeric entries are made, by pressing one of the ten character keys on the keyboard and will appear first in the scratch pad (line 8). Each actuation of a key will cause a character to be displayed from left to right in the scratch pad. When using multiple letter keys (e.g., KLM/5), letters K, L, or M can be entered into the scratch pad by successive actuations of the KLM/5 key. The 0-9 and . keys shall enter the respective number of decimal point unless the keyboard is in the letter mode. When the LTR/USE key is pressed, LTR is annunciated to the right of the scratch pad, and the next keystroke will enter an alpha character. When the desired data appears in the scratch pad, it will be entered by pressing the line select key adjacent to the data being updated. When the line select key is pressed, the scratch pad contents will be checked for proper range and format. If the entry is valid, it will be transferred to the IINS, read back, and displayed adjacent to the line select key. Completion of this cycle will clear the scratch pad.
4	CLR key	Used for erasing scratch pad parameters before entry. First actuation clears the last number or letter entered, second actuation clears the entire entry.
5	BRT control	Controls brightness of the data display from full on to full off
6	0 key	Used to enter number 0 into the scratch pad
7	−/● key	Used to enter a minus symbol or decimal into the scratch pad. When pressed, ● will be entered into the scratch pad. When LTR/USE key is pressed, then −/● key is pressed, − will be entered into the scratch pad. To use the − in the scratch pad, the LTR/USE key must be pressed again.
8	LTR/USE key	When pressed, allows letters to be entered into the scratch pad. When pressed a second time, signals the CDU to use the character that was just entered, and deletes LTR entry mode.

KEY	CONTROL OR INDICATOR	FUNCTION
9	FACK key	When pressed, signals the system that an annunciated failure has been recognized by the operator, and causes the flashing annunciation to go to a steady annunciation.
10	Page select switch	Selects the type of information to be displayed. The following five categories of display pages can be selected: **NOTE** All CDU distance and speed displays in L/L mode are in nautical miles (NM). All distance and speed displays in UTM mode are in kilometers. 1. POS. Provides present position; universal transverse mercator (UTM) or latitude/longitude (L/L) selection; magnetic heading selection; magnetic variation; true or magnetic heading, ground track; and ground speed. 2. INS. Provides inertial alignment status; barometric pressure; altitude; data zeroize; and access to system data and unit tests. 3. DEST. Provides selected course entry; destination coordinates; UTM or L/L selection; range, bearing, and time to destination; cardinal heading/distance. 4. STR. Provides selected course; range, bearing and time to steerpoint; present position; UTM or L/L selection; cardinal heading/distance. 5. TCN. Provides both TACAN control and station data. The TACAN control page provides power control; mode selection; slant range and bearing to station; update enable; and access to station pages. The TACAN station pages provide station magnetic variation; coordinates, channel; slant range/bearing; and elevation.
11	Mode select switch	Selects eight different modes of operation for the IINS. The mode select switch selects the following IINS modes of operation: 1. OFF. Turns off the IINS (removes power from TACAN RT, STD INS, and CDU). 2. FAST. In this position the STD INS either performs a stored heading alignment or best available true heading (BATH) alignment. If a BATH alignment is performed, true or magnetic heading information must be entered not later than 1 minute after selecting the FAST mode. If magnetic heading information is not entered, system will assume a stored heading. After heading information is entered, present position may be entered if desired. FAST alignment is a degraded mode of operation and should not be used under normal conditions.

KEY	CONTROL OR INDICATOR	FUNCTION
		3. NORM. In this position the STD INS performs a gyrocompass alignment. Present coordinates must be entered not later than 2 minutes after selecting the NORM mode.
		4. NAV. This is the STD INS primary flight mode of operation. NAV is entered after satisfactory alignment conditions have been met.
		5. UPDT. In this position the NPU freezes present position data for a later manual position update by overflying a known position designated by a mark.
		6. ATTD. In this position the STD INS initiates an attitude reference mode of operation. Although navigation processing is discontinued, the STD INS continues to provide a stable reference frame for generation of roll, pitch, and inertial heading angles.
		7. CAL. In this position the STD INS performs an automatic calibration of the gyro biases.
		8. TEST. In this position the STD INS performs functional performance tests, fault detection, and fault localization checks.
12	DEST switch	Three position toggle switch used to increment/decrement selected destination. The number of the selected destination appears on line 1 of the data display. Up increases and down decreases the selected destination.
13	BIT indicator	Used to indicate the results of all internal CDU tests. White indicates a failure and black indicates test passed.
14	STR switch	Three position toggle switch used to increment/decrement selected steerpoint. The number of the selected steerpoint appears on line 1 of the data display. Up increases and down decreases the steerpoint number.
15	MRK key	Used to signal the STD INS to note the current position and use it for one of two of the following purposes:
		1. Store as a markpoint (destination A thru F) when the mode select switch is in the NAV position.
		2. Store present position relative to selected destination for possible updating when mode select switch is in the UPDT position.
16	Page slew switch	Three position toggle switch used to slew data display one page up or down by pressing page slew switch up or down.

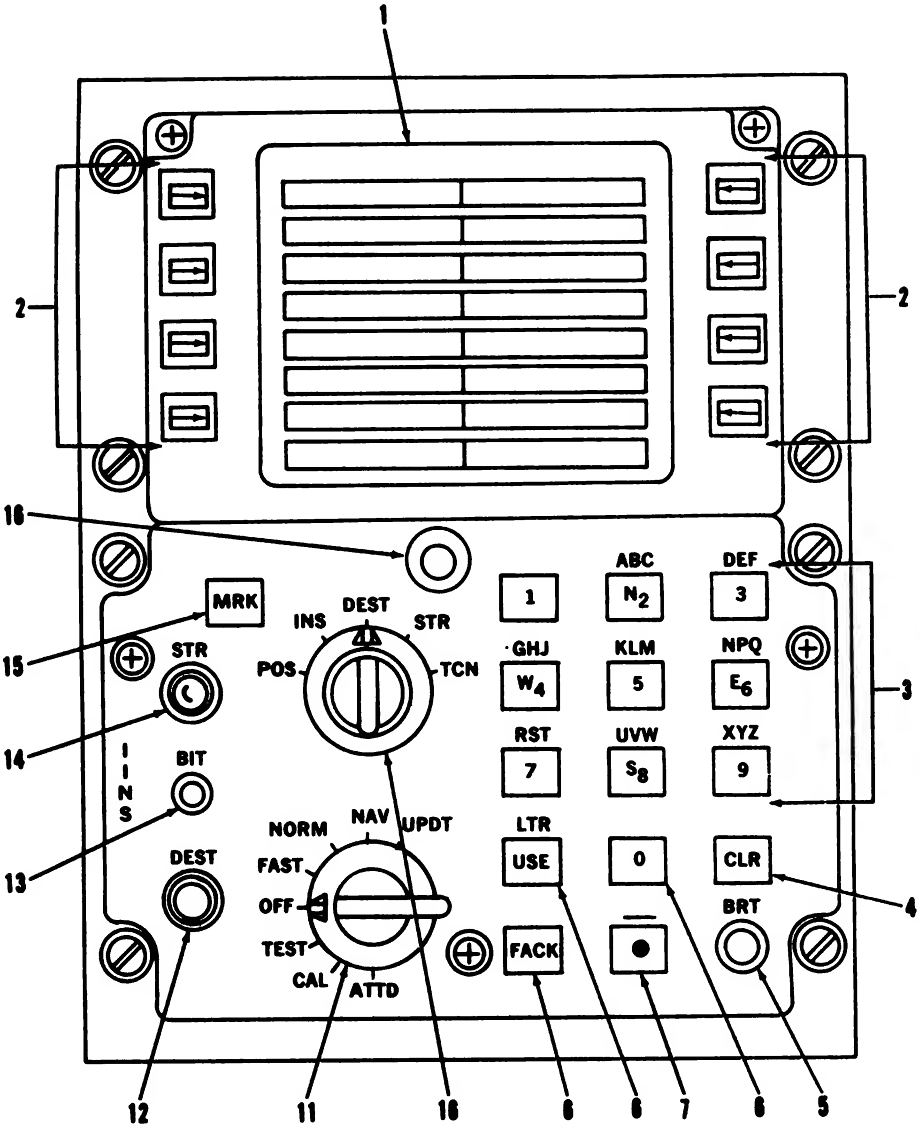


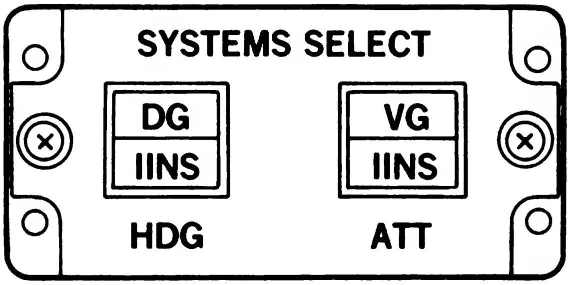
Figure 3-13. CDU Controls and Indicators EH

3-114. Signal Converter Unit, CV-3739/ASN-132. EH

The SCU performs data processing to convert the TACAN RT Aeronautical Radio Incorporated (ARINC) inputs and outputs to corresponding serial data formats for transmission over the multiplex data buses to the NPU and CDU. The SCU can communicate via one of the two multiplex data buses. Although the SCU communicates over only one multiplex data bus at a time, it can monitor both buses continuously to determine over which bus valid data communications are taking place. Redundant portions of the SCU circuitry are isolated to ensure that a failure of one bus does not degrade performance of the remaining bus.

3-115. TACAN Navigational Set Receiver-Transmitter, RT-1159/A. EH

The position error of an inertial navigation system increases with time, therefore, a position reference sensor is used to update the inertial data, and thereby bound the time-growing position error. The IINS derives position updates from the TACAN RT range and bearing measurements. The TACAN RT determines the relative bearing of the helicopter from a selected



S 99890 (BH2)

Figure 3-14. SYSTEM SELECT Panel EH

TACAN ground station and determines the distance of range of the station. The TACAN RT operates within 390 nautical miles of a TACAN ground station. Since the TACAN system operating limit is line of sight, the actual operating range is dependent on helicopter altitude. The TACAN system operates on a selected channel from 252 available channels. The 252 channels are equally divided into 126 x-channels and 126 y-channels with both x- and y-channels spaced at 1 MHz intervals. Upon being interrogated by the TACAN RT, the ground station beacon transmitts a signal. From the return signal, the TACAN RT computes bearing and distance values for updating the inertial system information. The TACAN RT outputs are processed by the SCU for compatibility with the multiplex data buses. The TACAN RT also produces and transmits distance information when interrogated in the air-to-air operation another TACAN equipped aircraft, however, this air-to-air mode precludes using the TACAN information to update the IINS.

3-116. SYSTEM SELECT Panel. EH

The SYSTEM SELECT panel (Figure 3-14) consists of two switch light indicators, located on the center lower edge of the instrument panel. It provides a switching capability for utilization of IINS through a relay assembly. The SYSTEM SELECT panel operates as follows:

HDG

DG: ASN-43 Directional Gyro output is displayed on the HSI's. ASN-43 interface with the VSI/HSI Mode Select System, the SAS/FPS flight computer, the civil navigation system, and the Command Instrument System (CIS).

IINS: IINS heading output is displayed on the HSI's. IINS interface with the above systems, replacing the ASN-43.

ATT

VG: CN-1314 Pilot or Copilot Vertical Displacement Gyro output is displayed on respective VSI's and used by the SAS/FPS computer as determined by the VSI/HSI Mode Selector VERT GYRO setting.

IINS: INU output is displayed on the VSI's and is used by the SAS/FPS computer depending on the VSI/HSI Mode Selector VERT GYRO setting.

NOTE

If the IINS is to be turned OFF during flight, the IINS should be deselected on the SYSTEM SELECT Panel prior to IINS turn OFF.

3-117. Pilot and Copilot VSI/HSI MODE SEL Panel. EH

The VSI/HSI MODE SEL Panel (Figure 3-15) modified for IINS, operates the same as the UH-60A. The IINS switch operation is as follows:

IINS

Selection of IINS will display IINS calculated range, bearing, and course deviation to the steerpoint on the associated HSI. Range is displayed as distance (KM), bearing by the #1 pointer, and deviation by the course deviation bar.

Selection of IINS disconnects the VOR (ARN-123) TO/FROM output to the HSI's and connects the SCU TO/FROM output to the HSI's.

To select IINS on the MODE SEL Panels, IINS must be selected on the SYSTEM SELECT Panel. Also the CDU must be on and in the NAV mode.

-118. Valid Entry Procedures. EH

The following paragraphs describe valid entry for-nats for data which may be entered on each of five nain pages. An inward pointing arrow indicates that lata can be entered on that line by pressing the adja-ent line select key.

a. POS (Position) Page. The position page pro-vides for entry of mag/true heading (BATH align-nent), present position (FAST/NORM alignment) and magnetic variation.

(1) Magnetic True Heading Entry. Magnetic heading and magnetic variation or true heading may be entered during the first 60 seconds of a FAST align-ment. Scratch pad entries may be up to four numeric digits including an optional decimal point. If no deci-mal point is entered, whole degrees are assumed. Leading zeros are optional.

(2) Latitude Entry. Key in N or S and then the numeric digits. The first two digits are degrees, third and fourth are minutes and fifth and sixth are seconds. A leading zero must be entered for any lati-tude less than 10 degrees. Entry examples:

PREVIOUS VALUE	SCRATCH PAD CONTENTS	ENTERED VALUE
S 6° 15 34	N263415	N 26° 34 15
N 33° 25 15	2634	N 26° 34 00
S 46° 13 00	S26	S 26° 00 00
S 46° 13 00	26	S 26° 00 00

(3) Longitude Entry. Key in E or W and then the numeric digits. A leading zero must be entered for a longitude less than 100 degrees and two leading zeros for a longitude less than 10 degrees.

PREVIOUS VALUE	SCRATCH PAD CONTENTS	ENTERED VALUE
E 176° 16 00	W1263415	W 126° 34 15
E 176° 16 00	12634	E 126° 34 00
W 135° 42 32	E126	E 126° 00 00
E 120° 16 24	126	E 126° 00 00

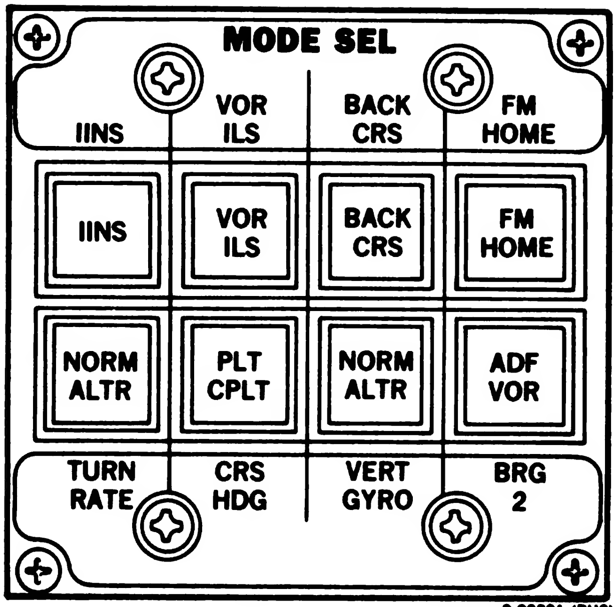


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Figure 3-15. HSI/VSI MODE SEL Panel EH

(4) Spheroid or Grid Zone Entry. Either spheroid or grid zone may be entered. Spheroid entries consist of numbers 0 through 10 and are an alpha dis-play as listed in Table 3-3. Grid zone entries consist of two numbers and alpha character. Entry examples.

PREVIOUS VALUE	SCRATCH PAD CONTENTS	ENTERED VALUE
16T INT	1	16T CL6
16T INT	18T	18T INT
16T INT	18T1	18T CL6

(5) Area/Eastings/Northings Entry. Scratch pad entries may be made for area, eastings and north-ings, just area, or just eastings and northings. Entries for area must consist of two alpha characters. Entries for eastings/northings must be 2, 4, 6, 8, or 10 digits. Digits will be evenly split between eastings and north-ings with trailing zeros inserted. Although entries may be made and sent to the INU to a resolution of 1 meter,

Table 3-3. Spheroid Data Codes EH

CODE	MODEL	ABBR
0	International	INT
1	Clark 1866	CL6
2	Clark 1880	CL0
3	Everest	EVR
4	Bessel	BSL
5	Australian National	AUS
6	Airy	ARY
7	Hough	HGH
8	South American	SAM
9	Modified Everest	MEV
10	WGS.72	WGS

the display will round to the nearest 10 meters. The following illustrates several examples:

PREVIOUS VALUE	SCRATCH PAD CONTENTS	ENTERED VALUE
AU 1234 5678	UV23456789	UV 2345 6789
AU 1234 5678	23456789	AU 2345 6789
AU 1234 5678	2345678	AU 2340 6780
AU 1234 5678	2367	AU 2300 6700
AU 1234 5678	26	AU 2000 6000
AU 1234 5678	UV	UV 1234 5678

(6) Magnetic Variation Entry. Scratch pad entries consist of an E/W and up to four numeric digits including decimal point. If no decimal point is entered, while degrees are assumed. The range of entries is 0.0° to E/W 180.0°. For entries greater than or equal to 100°, only whole degrees are displayed. The following gives some entry examples.

SCRATCH PAD CONTENTS	ENTERED VALUE
E2	E20
W10.9	W10.9
E.7	E0.7

b. INS (Inertial) Page. The INS Page provides miscellaneous control/display functions such as entry of altitude and baro pressure and provides access to INU and NPU memory.

(1) Manually Entered Altitude (MALT). Field altitude must be entered to the nearest 100 ft. MSL during alignment; however, manually entered altitude may be entered any time during the mission to override baro alt. The range of valid entries is from −1000 to +65,520 feet in increments of 100 feet. Entries shall delete MALT by causing an output of −65,520 feet over the baro.

SCRATCH PAD CONTENTS	ENTERED VALUE
2	2.0
10	10.0
10.5	10.5

(2) Barometric Pressure (BARO). Barometric pressure must be entered (0.01 in Hg) during alignment. The information is used by the NPU to initialize the scale factor of encoding altimeter data during alignment.

(3) DATA Page.

(a) Press the line select key adjacent to line 5 right (DATA).

(b) Line 7 of the DATA page provides the capability to enter and read the contents of various INU registers. Although the CDU will accept entered memory addresses with a range of 0 to 65,535 (decimal), the INU will not accept all of these as valid. If an illegal address is entered, the illegal address and the message "ENTRY REJECTED" will alternately appear in the scratch pad. Pressing the CLR key will clear the scratch pad. Register contents that are entered may be any six alphanumeric characters plus sign. Many of the INU registers are "read only". That is, their contents can be read but not altered. If an attempt is made to change the contents of one of these registers, "ENTRY REJECTED" will appear as described above.

c. DEST (Destination) Page. Two types of data may be entered on the Destination Page, destination coordinates, and course to destination.

(1) Destination Coordinates Entry. Destination coordinates may be entered during any phase of the mission. Either LAT/LONG or MGRS (UTM) coordinates may be entered. Coordinate selection is provided on line 7 (display right).

(a) Latitude entry described in paragraph 3-118.a.(2).

(b) Longitude entry described in paragraph 3-118.a.(3).

(c) Spheroid and zone entry described in paragraph 3-118.a.(4).

(d) Area/Eastings/Northings entries described in paragraph 3-118.a.(5).

(2) Course to Destination Entry. The desired true course to destination may be entered for each destination during any phase of the mission.

(a) Enter the true course in the scratch pad. Entries may be up to four numeric digits with an optional decimal point. If no decimal point is entered, whole degrees are assumed. Leading zeros are optional.

(b) Press line 1 right line select key. The true course to destination will be displayed on line 1 right.

(c) System will utilize any previous course data. If no data has been entered, the system will assume a true course of 000.0 degrees.

d. STR (Steer) Page. This page contains no enterable parameter.

e. TCN (TACAN) Pages. The TACAN pages consist of the TACAN control page and TACAN station pages.

(1) TACAN Control Page Data Entry. The only data entry on this page is channel number. Paragraph 3-120.f. describes the channel number entry.

(2) TACAN Station Page Entries. Parameter entries are station location magnetic variation channel and elevation.

(a) Latitude entry described in paragraph 3-118.a.(2).

(b) Longitude entry decribed in paragraph 3-118.a.(3).

(c) Spheroid and zone entry described in paragraph 3-118.a.(4).

(d) Area/Eastings/Northings entries described in paragraph 3-118.a.(5).

(e) Station Magnetics Variation entry described in paragraph 3-118.a.(6).

(3) Station Channel Entry. The TACAN Station Pages provide the capability to enter station channel for each of the 16 stations. A total of 252 channel are possible (126 "X" channels and 126 "Y" channels). Unless "Y" is entered, an "X" channel is assumed.

3-119. Starting Procedure (NORMAL ALIGNMENT). EH

a. Ensure that the following circuit breakers are in the ON position.

No. 1 AC PRI BUS Circuit Breaker Panel

INS
XFMR PWR
INU BATT PWR
26 VAC EQUIP PWR

No. 1 DC PRI BUS

CPLT ALTM
IINS

No. 2 AC PRI BUS Circuit Breaker Panel

TACAN

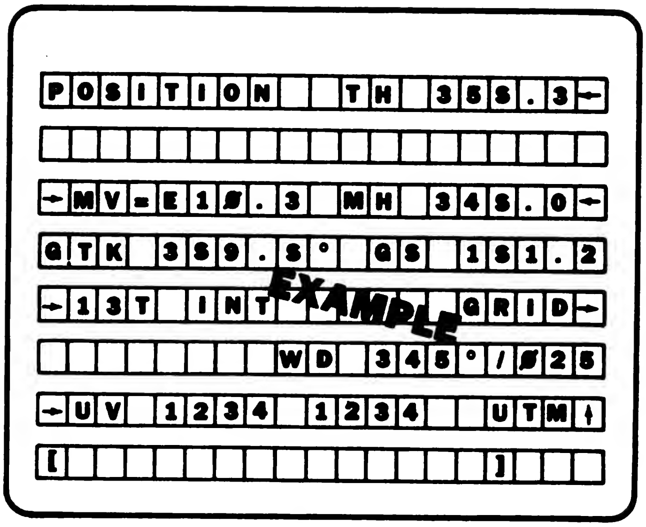
No. 2 DC PRI BUS

TACAN

NOTE

Present position must be entered during the first two minutes of NORM alignment. If present position is displayed, it must be reentered. A steady NAVRDY indicates INU attitude data and degraded NAV performance are available. After turn-on, flashing NAVRDY will be displayed on line 6 indicating full alignment.

b. To turn system on, set mode select switch to NORM. CDU display will remain blank for 30 seconds after turn-on. If the CDU does not light after 30 seconds, rotate the brightness control on the CDU clockwise to provide a comfortable intensity level.



NOTE

TO SELECT THIS PAGE, SET CDU PAGE SELECT SWITCH TO POS AND PRESS LINE 5 AND/OR LINE 7 RIGHT LINE SELECT KEYS AS REQUIRED.

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Figure 3-16. Position Page EH

(1) Check for annunciations on line 2 of the display. If any annunciation is flashing, return mode select switch to OFF.

CAUTION

Wait two minutes before returning Mode Select switch to NORM. Failure to do so will damage the INU.

(2) If mode select switch was turned off, rotate mode select switch to NORM. If an annunciation is still flashing, make an entry on DA Form 2408-13. Refer to paragraph 3-122 for an explanation of annunciations.

c. Set Page Selector switch to POS (Figure 3-16).

NOTE

If UTM Coordinates are selected, the COMPLETE UTM Coordinates must be entered for Present Position: GRID ZONE, SPHEROID, AREA, EASTINGS, and NORTHINGS.

d. Verify line 7 on right side display indicates desired COORDINATE SYSTEM (UTM or L/L). If not depress the line select key once to switch to the desired coordinate system.

(1) Enter GRID ZONE/SPHEROID or LATITUDE in scratch pad.

(2) Press Line Select key 5 left.

(3) Enter AREA, EASTINGS, NORTHINGS, or LONGITUDE in scratch pad.

(4) Press Line Select key 7 left.

NOTE

If INU computed MV is changed, updated MV will have to be manually entered as MV lines are crossed. If INU computed MV is utilized, automatic MV updating will be performed by the INU.

e. Verify line 3 on left side display indicates correct Magnetic Variation, MV.

(1) If incorrect, enter MV in scratch pad.

(2) Verify scratch pad entry is correct.

(3) Press Line Select key 3 left.

(4) Verify Line 3 Left displays: - > MV = XNN.N. (The "=" sign indicates that a manual MV was entered and automatic MV updating will not occur.)

f. Rotate Page Select switch to INS (Figure 3-17).

(1) Enter barometric pressure of present position in scratch pad.

(2) Press Line Select key 5 left.

(3) Enter altitude of present position in scratch pad (e.g., 156 ft is entered as 0.156 and displayed as 0.2).

(4) Press Line Select key 3 left.

g. Rotate Page Select switch to DEST.

(1) Press DEST toggle switch to select DEST desired page.

(2) Press Line Select key 7 right to display desired coordinate system (UTM or L/L).

(3) Enter grid zone and spheroid or latitude in scratch pad.

(4) Press Line Select key 5 left.

(5) Enter Area/Eastings/Northings or longitude in scratch pad.

(6) Press Line Select key 7 left.

(7) Press DEST toggle switch (Figure 3-13) to increment to the next page.

h. Rotate Page Select switch to TCN.

WARNING

Potential radiation hazard exists at the TACAN antenna when the TACAN is turned on. Make sure that no person is within 3 feet of antenna. When TACAN is first turned on and line 3 left of CDU displays anything other than REC, immediately press line select key 3 left until the display shows REC.

(1) Turn ON TACAN by pressing Line Select key 1 left.

(1.1) Press line 3 left until REC is displayed on the CRT.

(2) Press Page Slew toggle switch to display TACAN station zero page.

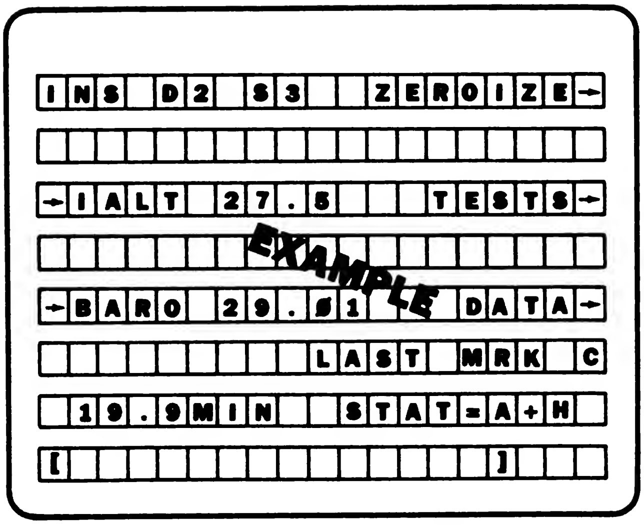
(a) Enter mag var in scratch pad.

(b) Press Line Select key 3 left.

(c) Enter latitude in scratch pad.

(d) Press Line Select key 5 left.

(e) Enter longitude in scratch pad.



NOTE
TO SELECT THIS PAGE, SET CDU PAGE SELECT SWITCH TO INS.

S 99893 (BH2)

Figure 3-17. INS Page EH

(f) Press Line Select key 7 left.

(g) Press Line Select key 1 right to display ACT.

(h) Enter channel number in scratch pad.

(i) Press Line Select key 3 right.

(j) Enter elevation of TACAN station on scratch pad.

(k) Press Line Select key 5 right.

(l) Press Page Slew toggle switch to display next TACAN page.

(m) Enter data as described in steps (a) through (m).

NOTE

In order for HSI steering command to be correct, a valid destination and steer point must be entered prior to switching the MODE selector to NAV.

Example: If DX is homebase (alignment point), the SX STEER point is invalid as an initial Destination/Steer Point.

i. Select an appropriate destination number and toggle the STR toggle switch to indicate the number, i.e., S1. (It is not necessary that the DX and SX numbers agree, only that SX is the desired destination.)

j. Set Mode Select switch to NAV. (Pull switch up; then rotate.)

k. Set Page Select switch to TACAN.

(1) Press Line Select key 3 left to display T/R.

(2) Press Line Select key 5 left to display UPDT.

l. On HST/VSI MODE SEL panel (Figure 3-15), press IINS switch. Note that bearing to destination (No. 1 needle), range to destination, course deviation and TO/FROM flag are displayed on the HSI.

m. On SYSTEM SELECT panel (Figure 3-14), set switches and observe indications as follows:

(1) Press HDG switch, INS illuminates and inertial derived heading is displayed on the HSI.

(2) Press ATT switch, INNS illuminates and inertial derived pitch and roll is displayed on the VSI.

3-120. Starting Procedure (FAST Alignment). EH

Switching to FAST mode commands the INU to perform either a stored heading alignment or best available time heading (BATH) alignment.

a. Stored Alignment.

NOTE

CDU display will remain blank for 30 seconds after turn on. Barometric pressure must be entered during alignment. Alignment will be complete when data display line 6 NAVRDY indicator begins to flash if a normal alignment was performed and the mode select switch was not set to NAV. Alignment will be complete when data display line 6 NAVRDY indicator lights if a normal alignment was performed and the mode select switch was set to NAV.

(1) Ensure system preoperational checks have been performed and that aircraft power is on.

(2) Set mode select switch (Figure 3-13) to FAST.

(3) Set page select switch to POS.

(4) Observe that data display line 7 right indicates desired coordinate system (UTM/LL). If it does not, press Line Select key 7 right until the desired coordinate system is deployed.

(5) If data display line 8 right indicates LTR, press LTR/USE key to place the keyboard in the numeric mode.

(6) Observe that data display line 5 left and line 7 left indicate present position latitude and longitude or grid zone, spheroid area, eastings and northings, respectively. If not, normal or BATH alignment must be performed:

(7) Set page select switch to INS. Observe that data display line 3 left indicates present position altitude. If not, a change must be made within the first 60 seconds of this alignment.

NOTE

The following steps are an example of entering barometric pressure. Substitute your own barometric pressure when performing these steps. Enter local barometric pressure to the nearest 0.01 inches Hg.

When making keyboard entries, if an incorrect key is pressed, press CLR key as required and begin again.

(8) Enter local barometric pressure on data display line 8 by pressing in sequence ABC/N2, XYZ/9, -/●, 0, and 1 keys. Observe that data display line 8 indicates 29.01.

(9) Press data display line 5 left line select key. Observe that data display line 5 left indicates ·> BARO 29.01.

(10) Observe that data display line 7 indicates alignment and status.

NOTE

Data display line 6 left indicates a flashing NAVRDY if a normal alignment was performed and the mode select switch was not set to NAV.

(11) When data display line 6 left NAVRDY indicator lights, set mode select switch to NAV.

b. BATH Alignment.

NOTE

CDU display will remain blank for 30 seconds after turn on. True or magnetic heading must be entered during the first 60 seconds of turn on. Present position must be entered within 2 minutes of turn on. Barometric pressure and altitude must be entered during alignment.

NOTE

Alignment will be complete when data display line 6 NAVRDY indicator lights.

(1) Ensure system preoperational checks have been performed and that aircraft power is on.

(2) Set mode select switch to FAST.

(3) Set page select switch to POS.

(4) Observe that data display line 7 right indicates desired coordinate system (UTM or L/L). If it does not, press Line Select key 7 right until desired coordinate system is displayed.

(5) If data display line 8 right indicates LTR, press LTR/USE key to place the keyboard in the numeric mode.

NOTE

The following steps are examples of entering present position data. Substitute your own present position and heading when performing these steps. Either true heading or magnetic heading can be entered. Magnetic heading is entered by pressing line select key. The following example uses true heading. When making keyboard entries, if an incorrect key is pressed, press CLR key as required and begin again.

(6) Enter true heading on data display line 8 by pressing in sequence DEF/3, KLM/5, UVW/S8, -/ and DEF/3 keys. Observe that data display line 8 indicates 358.3.

(7) Press data display line 1 right line select key. Observe that data display line 1 right indicates TH 358.3 <-.

(8) If required, enter present position latitude (or UTM, GRID ZONE and SPHEROID) on data display line 8 by pressing in sequence LTR/USE, ABC/N2, LTR/USE, DEF/3, GHJ/W4, 1, 0, DEF/3, and 0 keys. Observe that data display line 8 indicates N341030.

(9) Press data display 5 left line select key. Observe that data display line 5 left indicates - > N34° 10 30.

(10) If required, enter present position longitude (or UTM area, EASTING and NORTHING) on data display line 8 by pressing in sequence LTR/USE, GHJ/W4, LTR/USE, 1, 1, UVW/S8, DEF/3, and 0 keys. Observe that data display line 8 indicates W1183530.

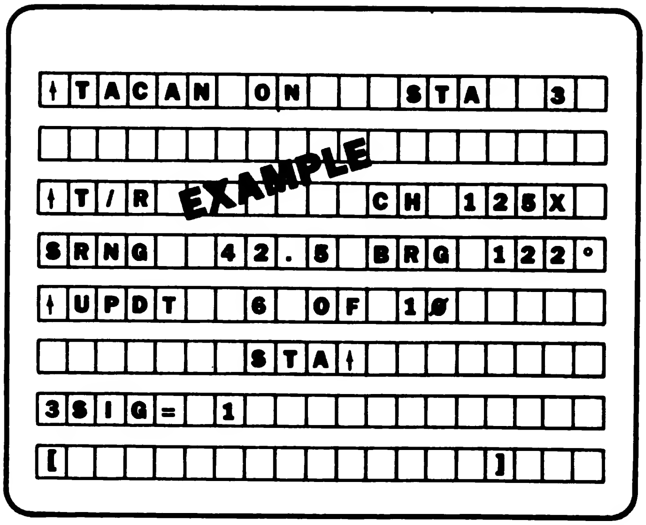
(11) Press data display line 7 left line select key. Observe that data display 7 left indicates - > W118° 35 30.

(12) Set page select switch to INS.

NOTE

When entering present position altitude, altitude must be entered to the nearest 100 feet (mean sea level). The range of valid entries from -1000 to 65,520 feet in increments of 100 feet. Entries are made in thousands of feet.

(13) If required, enter present position altitude on data display line 8 by pressing in sequence UVW/S8, -/●, and NPQ/E6 keys. Observe that data display indicates 8.6. This represents an altitude of 8,600 feet.



NOTE

TO SELECT THIS PAGE, SET CDU PAGE SELECT SWITCH TO TCN.

S 99894 (BH2)

Figure 3-18. TACAN Control Page EH

(14) Press data display line 3 left line select key. Observe that data display line 3 left indicates -> AALT 8.6.

NOTE

Enter local barometric pressure to the nearest 0.01 inches Hg.

(15) Enter local barometric pressure on data display line 8 by pressing in sequence ABC/N2, XYZ/9, -/●, 0, and 1 keys. Observe that data display line 8 indicates 29.01.

(16) Press data display line 5 left line select key. Observe that data display line 5 left indicates - > BARO 29.01.

(17) Observe that data display line 7 indicates alignment time and status.

(18) When data display line 6 left NAVRDY indicator lights, set mode select switch to NAV.

3-121. In-flight Procedures. EH

a. MARK Operation. Current aircraft position may be stored in one of the markpoint locations (destinations A-F) by pressing the MRK key when in NAV mode. The location where present position was stored is displayed in the CDU scratch pad regardless of currently selected page. Figure 3-17 illustrates "MARK C" in the scratch pad with the STR page selected.

(1) The MARK locations are used in sequence (-A, B, C, D, E, F, A, B,..). The MARK display will remain in the scratch pad unless it is cleared with the CLR key or the scratch pad is used to enter some other data.

(2) Pressing the MRK pushbutton will freeze, for 30 seconds, the display of present position on the Steering and Position pages; and the display of cardinal headings/distance on both the destination and Steering Page. After 30 seconds or after the CLR key is pressed, the current position will return.

b. Manual Updating (Overfly Position Updating). An overfly update represents a manual position update technique in which the pilot overflies his selected destination and signals the INU by pressing the MRK key. To initiate a manual update, proceed as follows.

NOTE

If indicated air speed is greater than 5 knots, the manual update will not remove 100% of the positional error or zero out the cardinal headings, time to go (TTG) or distance to destination. The percentage of actual update is a dynamic function of the computer software.

(1) Indicated airspeed greater than 5 knots.

(a) Ensure that the displayed Destination and Steerpoint indicators (Dx, Sx) are both set to the destination that the update will be performed on.

(b) Rotate the MODE SELECT switch to the UPDT position. The page shown in Figure 3-20 will be displayed.

(c) When the aircraft is directly over the destination point, depress the MRK key. The page shown in Figure 3-20 will be displayed.

(d) If the pilot decides to accept the update (ACCEPT here means to tell the INU that the positional update will be accepted) depress Line Select key 7 left to accept the update (REJECT here means to tell the INU that the positional update will not be accepted), depress Line Select key 7 right to reject the update. In either case, the page shown in Figure 3-20 will be redisplayed.

NOTE

The following display changes are not immediate. It will take approximately 5 seconds for the data to change.

(e) Rotate the MODE select switch to NAV.

(f) Observe that the Cardinal heading, time-to-go (TTG), and range decrease towards 0.0, and that present position changes to more closely reflect the coordinates stored in the selected destination.

(g) If the mission will continue, select a new steerpoint and proceed.

(2) Indicated air speed is 5 knots or less.

(a) Perform steps (1) (a) through (1) (f) above.

(b) If the Cardinal headings, time-to-go (TTG) and range do not decrease to 0.0, verify that both the Destination and Steerpoint indicators (Dx, Sx) are set to the destination that the update is being performed on. Repeat steps (1) (a) through (1) (f).

(c) To proceed with the mission, select a new steerpoint.

(3) Selection of the "UPDT" mode on the MODE Select switch deletes automatic TACAN updating during the period of the manual update.

3-122. Annunciations. EH

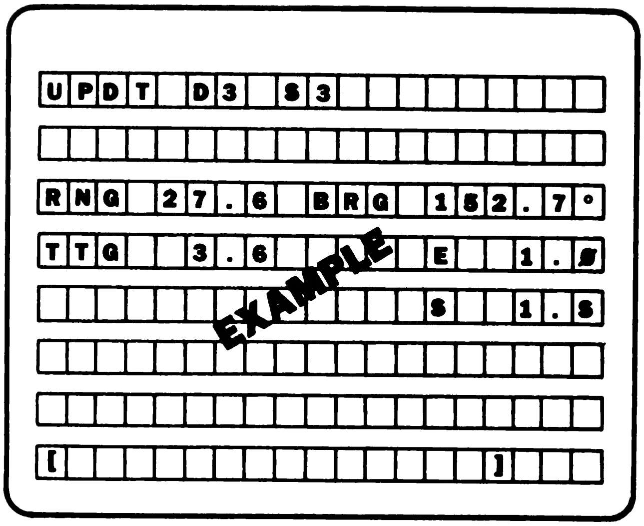
System status messages appear on line 2 and the left side of line 6 regardless of selected page. The following is a summary of messages that are presented and the failures/conditions they represent.

MESSAGE	CONDITION	LINE
MSC	Mission Computer has failed	2
NPU	Navigation Processor has failed	2
INU	INU navigation processing has failed Attitude may be valid.	2
ADC	Copilot's Altimeter-Encoder has failed.	2
TCN	TACAN has failed or is off.	2
PFM	Post Flight maintenance is required.	2
TTG	Aircraft is within two minutes of selected steerpoint (flashing).	2
FROM	Distance to steerpoint is increasing.	2
TO	Distance to steerpoint is decreasing.	2
SCU	Signal Converter Unit or ARINC BUS has failed. (See TEST page.)	2
NAVRDY (steady)	During alignment. INU attitude data and degraded nav performance are available.	6
NAVRDY (flashing)	During alignment. Full INU nav performance is available.	
ATTD	The INU is in attitude mode due to: (1) operator selection. (2) INU failure or (3) data bus failure. Attitude data is valid.	6
DEGRD	The INU is in navigate mode and a degraded performance alignment, not a full performance alignment was performed.	6
UPDT	The INU is being automatically updated by the TACAN.	6
DEGUPD	Degraded mode update by TACAN.	6

Placement of annunciation on their respective lines is shown in Figure 3-19. NPU and PFM annunciators occupy the same location. When a failure occurs, the annunciation will flash to attract the pilot's attention. Pressing the "FACK" key causes the annunciation to go from flashing to steady. If an LRU recovers from the failure, its annunciator will clear.

3-123. Gyro Magnetic Compass Set AN/ASN-43.

Gyro Magnetic Compass Set AN/ASN-43 provides heading information by reference to a free directional gyro when operating in the FREE mode, or by



NOTE
TO SELECT THIS PAGE, SET CDU MODE SELECT SWITCH TO UPDT. WHEN THIS PAGE IS SELECTED, TACAN UP-DATING IS DELETED.

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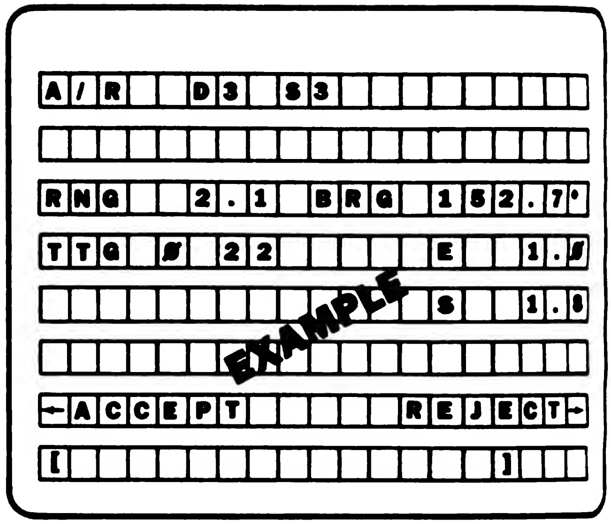
Figure 3-19. Update Page EH



NOTE
TO SELECT THIS PAGE, SET CDU MODE SELECT SWITCH TO UPDT AND PRESS MRK KEY.

S 99897 (BH2)

Figure 3-20. Accept/Reject Page EH

being slaved to the earth's magnetic field when operated in the SLAVED mode. It provides heading information to the horizontal situation indicator. Power to operate the AN/ASN-43 is provided from the ac essential bus through circuit breakers, marked COMPASS and AUTO XFMR under the general heading AC ESNTL BUS.

3-124. Compass Control C-8021/ASN-75.

Control C-8021/ASN-75 (Figure 3-22) is required to synchronize (electrically and mechanically align) the AN/ASN-43 to the correct magnetic heading when used in the SLAVED mode of operation. The synchronizing knob on the control panel may be used as a set heading knob for operation in the FREE mode.

3-125. Controls and Functions.

Controls for the magnetic compass set are on the front panel of the unit. The function panel of each control is as follows:

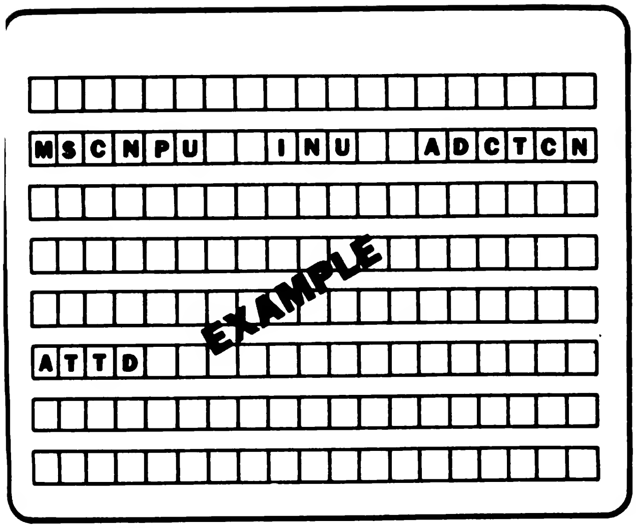
CONTROL	FUNCTION
Null Meter	Moves left (+) or right (●) of center to indicate misalignment (synchronization) of the AN/ASN-43.
Mode Selector (SLAVED-FREE)	Selects either magnetically SLAVED or FREE gyro operation of the AN/ASN-43.
Null Control PUSH-TO-SET	Is manually pressed and turned to null the annunciator, thereby synchronizing (electrically and mechanically aligning) the AN/ASN-43. Turns compass card of HSI for alignment.

126. Operation.

a. Starting procedure.

(1) Mode selector - As desired.

(2) Null control - Push, and turn in direction indicated by null meter (+ or ●) until annunciator is centered. In SLAVED mode, during normal operation, the annunciator will oscillate slightly about the center position; however, during certain helicopter maneuvers the annunciator will move off center.



NOTE

SYSTEM STATUS MESSAGES APPEAR ON LINE 2 (2) AND THE LEFT SIDE OF LINE 6(6) REGARDLESS OF SELECTED PAGE (EXCEPT NPU DATA PAGE). DATA APPEARING ON LINES 1 (1), 3 (3), 4 (4), 5 (5), 7 (7) AND 8 (8) WILL BE WHATEVER IS APPLICABLE TO THE PAGE SELECTED. THE FOLLOWING IS A SUMMARY OF MESSAGES THAT ARE PRESENTED AND THE FAILURES/CONDITIONS THEY REPRESENT:

S 99898 (BH2)

Figure 3-21. System Annuciators EH

(3) HSI - check to see that HSI heading agrees with a known magnetic heading.

3-127. Electronic Navigation Instrument Display System.

The instrument display system provides displays for navigation and command signals on a Vertical Situation Indicator (VSI) and a Horizontal Situation Indicator (HSI) for pilot visual reference. The system consists of the two VSIs and two HSIs on the instrument panel. The system has a common Command Instrument System Processor (CISP), two HSI/VSI Mode Select panels, and one CIS Mode Select panel.

3-128. Vertical Situation Indicator.

The VSI (Figure 3-23), provides a cockpit display of the helicopter's pitch, roll attitude, turn rate, slip or

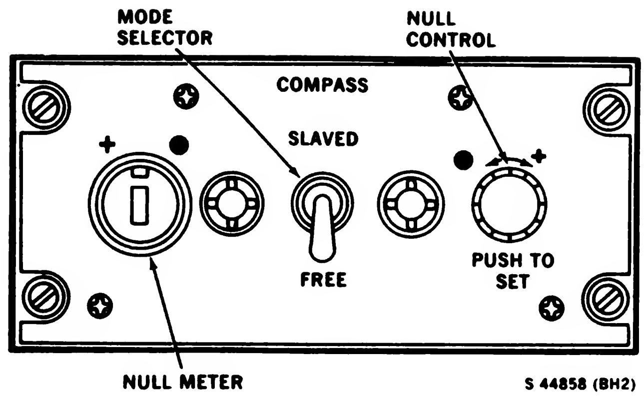


Figure 3-22. Compass Control Panel C-8021/ASN-75

skid, and certain navigational information. It accepts command instrument system processor signals and displays the flight command information needed to arrive at a predetermined point. The system also monitors and displays warnings when selected navigation instrument readings lack reliability. The VSI is composed of a miniature airplane, four warning indicator flags ATT, GS, NAV and CMD, two trim knobs ROLL and PITCH, a bank angle scale, a bank angle index on the spheroid, a turn rate indicator and inclinometer, pitch and roll command bars, collective position pointer, a course deviation pointer, and a glide slope deviation pointer. Refer to Chapter 2, Section XIV for a description of the Attitude Indicating system, and turn and slip indicator. The gyro erect switch (Figure 2-7) supplies a fast erect signal to the pilot and copilot displacement gyros, thereby considerably reducing the time required for the gyros to reach full operating RPM. The pilot and copilot's displacement gyros supply pitch and roll attitude signals to the vertical situation indicators, automatic flight control system, and the doppler navigation system. Power to operate the VSI is provided from the No. 2 ac primary bus through circuit breakers marked VSI PLT, CPLT.

3-129. Steering Command Bars and Pointer.

The roll and pitch command bars and the collective position pointer operate in conjunction with the Command Instrument System Processor (CISP) and the Command Instrument System/Mode Selector (CIS

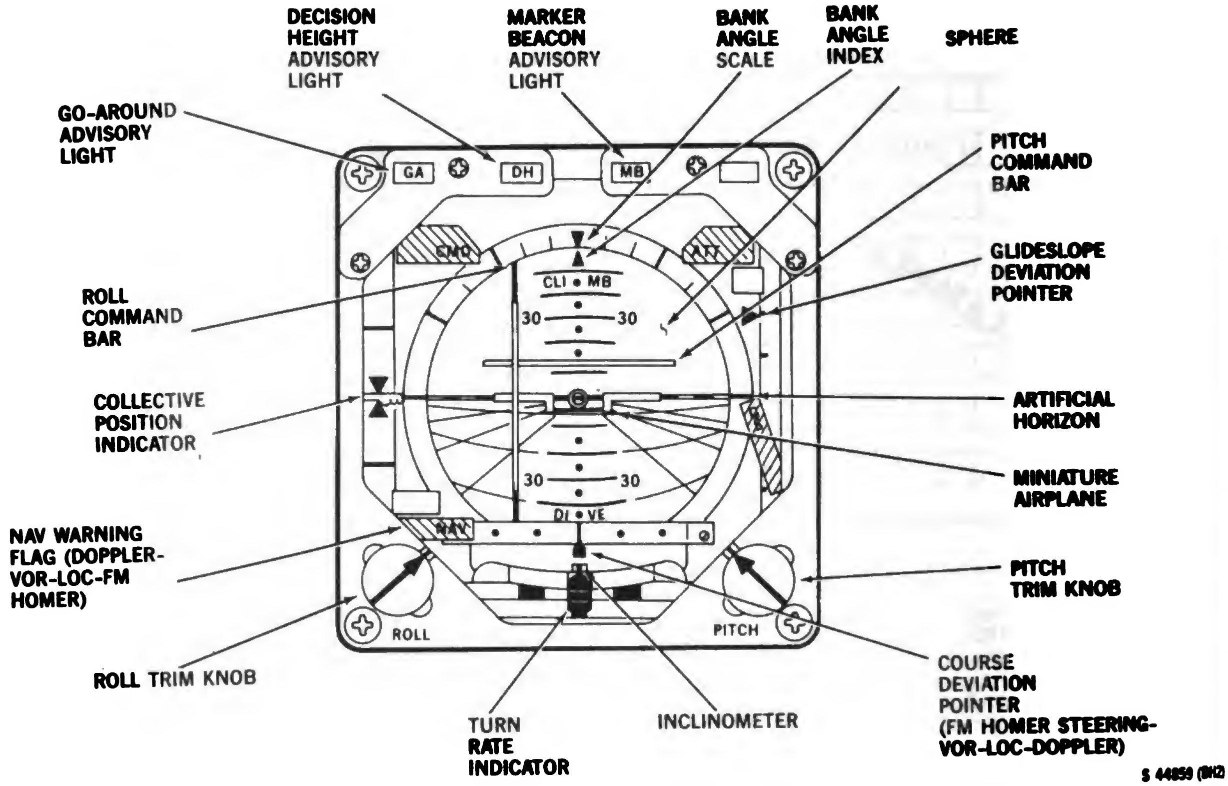


Figure 3-23. Vertical Situation Indicator

MODE SEL). Selection of HDG on the CIS MODE SEL panel provides a display of a roll signal by the roll command bar (Figure 3-23). The pitch command bar and the collective position pointer are out of view, and the CMD flag is held from view. Selecting the CIS MODE SEL switch NAV and the MODE SEL switch VOR ILS, the roll command bar will display roll commands from the CISP. If an ILS (LOC) frequency is tuned in, the pitch command bar and the collective command pointer will also display CISP signals. If a VOR frequency is tuned-in, the pitch command bar and collective position pointer will be held from view. The CMD warning flag will be held from view, indicating that the CISP functional integrity is being monitored. Refer to Figure 3-25 for VSI indications in other switch positions.

3-130. Command Warning Flag.

The command warning flag marked CMD is at the top left of the VSI face (Figure 3-23). It is held from view when initial power is applied to the CIS processor. When any CIS mode selector switch is on, and that navigation system operating properly, the CMD flag is not in view. During operation, if the navigation signal becomes unreliable, or is lost, the CMD flag will become visible.

3-131. Glide Slope Warning Flag.

A glide slope warning flag marked GS is on the right race of the indicator (Figure 3-23). The letters GS are black on a red/white stripe background. The warning flag will move out of view when the ILS receivers are operating and reliable signals are received.

3-132. Navigation Warning Flag.

A navigation flag marked NAV is installed on both the VSIs and the HSIs (Figures 3-23 and 3-24) to indicate when navigation systems are operating and reliable signals are being received. The VSI NAV flag is marked NAV with a white background and red strips and is on the lower left side of the indicator. The HS NAV flag is within the compass card ring. Both instrument flags will retract from view whenever a navigation receiver is on and a reliable signal is bein received.

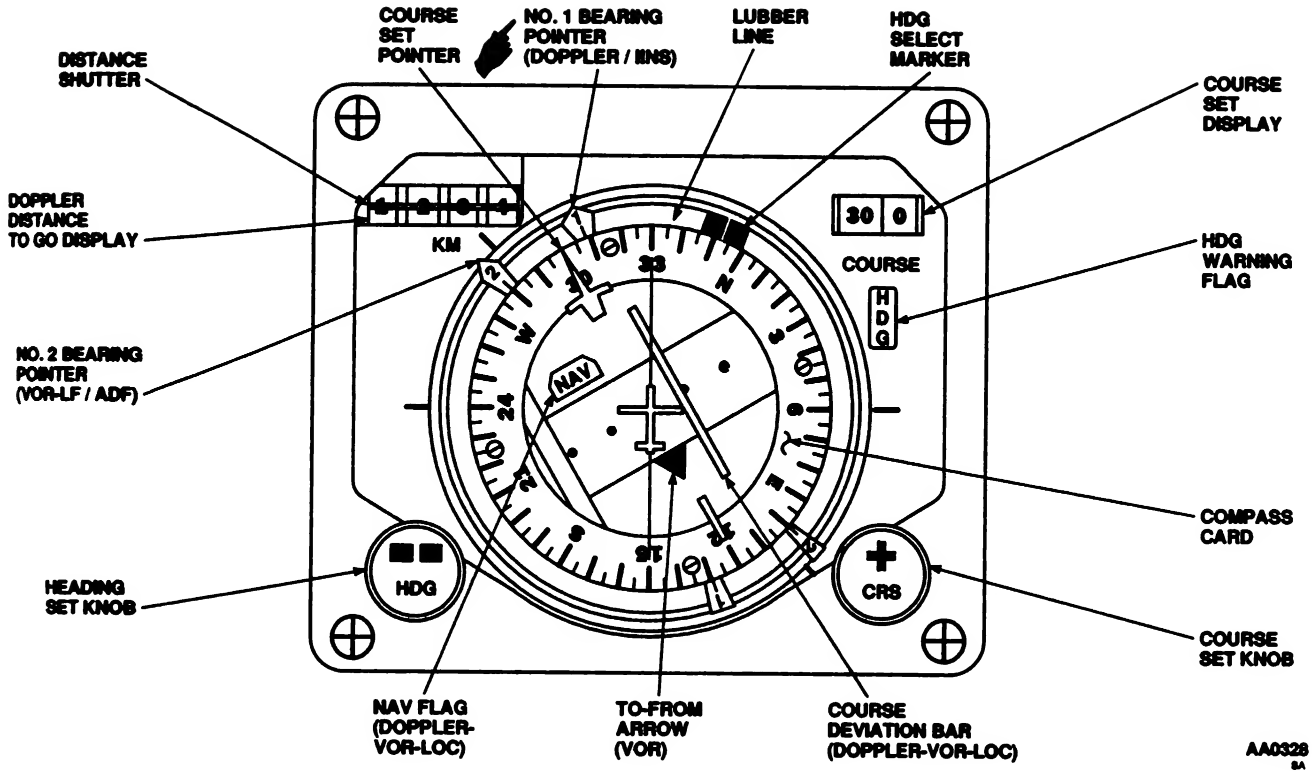


Figure 3-24. Horizontal Situation Indicator

3-133. Course Deviation Pointer.

The course deviation pointer is on the VSI instrument (Figure 3-23). The pointer works with the course bar on the HSI to provide the pilot with an indication of the helicopter's position with respect to the course selected on the HSI. The scales represent right or left off course, each dot from center (on course) is 1.25° for ILS, 5° VOR, and FM. The pilot must fly into the needle to regain on-course track.

3-134. Glide Slope Deviation Pointer.

The glide slope pointer, on the right side of the VSI (Figure 3-23), is used with ILS, the pointer represents the glide slope position with respect to the helicopter. Each side of the on-glide slope (center) mark are dots, each dot representing .25° above or below the glide slope.

3-135. Controls and Indicators.

Indicators of the VSI are on the face of the instrument. The function of each indicator is as follows:

CONTROL/ INDICATOR	FUNCTION
Miniature airplane/ horizon line	Provides reference to artificial horizon.
Bank angle scale	Right and left 0°, 10°, 20°, 30°, 45°, 60°, and 90° of bank.
Artificial horizon	Reference of helicopter's attitude to horizon.
Turn rate indicator	4-minute turn (one-needle width either side of center) 2-minute turn (two-needle width each side of center).
Pitch and roll command bars	Display to the pilot, control inputs he should make to arrive at a predetermined course, or glide slope.

CONTROL/ INDICATOR	FUNCTION
Collective position indicator	Display to the pilot the position of the collective relative to where it should be to arrive at a predetermined altitude.
GA	Go-around (GA) advisory light will go on whenever the GA switch on the pilot's or copilot's cyclic stick is pressed. The light will go off whenever the go-around mode is ended by engaging another mode on the CIS mode selector panel.
DH	Decision height (DH) advisory light will go on whever the radar altimeter is operating and the altitude indicator is at or below the radar altitude L (low bug) setting.
MB	Marker beacon (MB) advisory light will go on and the associated marker beacon tone will be heard, depending upon volume control setting, when the helicopter is over the marker beacon transmitter.
Glide slope pointer	Displays to the pilot the position of the ILS glide slope relative to the helicopter. Pointer above center indicates helicopter is below glide path.
Course deviation pointer	Displays to the pilot the position of the course reference (VOR, LOC, DPLR, FM HOME) relative to the helicopter.
ATT warning flag	Indicates loss of vertical gyro power or VSI malfunction.
NAV warning flag	Indicates loss, or unreliable signal indication.
GS warning flag	Indicates loss, or unreliable signal indicator.
PITCH trim knob	Adjust artificial horizon up (climb) from at least 4°, no more than 10° or down (dive) from at least 8°, no more than 20°.
ROLL trim knob	Adjust artificial horizon right or left from at least 8° to no more than 20°.

3-136. Horizontal Situation Indicator.

Two HSIs (Figure 3-24) are installed on the instrument panel, one in front of each pilot. The HSI consists of a compass card, two bearing-to-station points with back-course markers, a course bar, a KM indicator, heading set (HDG) knob and marker, a course set (CRS) knob, a COURSE digital readout, a to-from arrow, a NAV flag, and a compass HDG flag. The HSIs operating power is taken from the ac essential bus through a circuit breaker marked HSI PLT/CPLT.

3-137. Controls and Indicators.

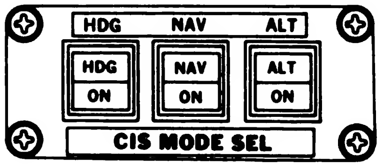
Controls of the horizontal situation and indicators (Figure 3-24) are as follows:

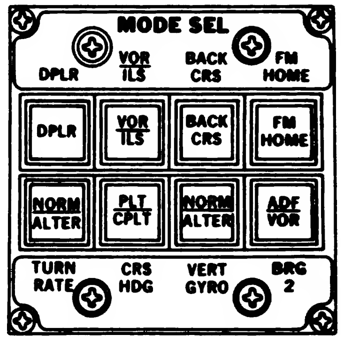
CONTROL/ INDICATOR	FUNCTION
Compass card	The compass card is a 360° scale that turns to display heading data obtained from the compass control. The helicopter headings are read at the upper lubber line.

CONTROL/ INDICATOR	FUNCTION
COURSE set display	Displays course to nearest degree. Indicates same as course set pointer.
Bearing pointer No. 1	The pointer operates in conjunction with Doppler or IINS. Indicates magnetic bearing to Doppler or IINS destination set on FLY-TO-DEST thumb wheel.
Bearing pointer No. 2	The pointer operates in conjunction with selected VOR or ADF receiver. The pointer is read against the compass card and indicates the magnetic bearing to the VOR or ADF station.
Course deviation bar	This bar indicates lateral deviation from a selected course. When the helicopter is flying the selected course, the course bar will be aligned with the course set pointer and will be centered on the fixed aircraft symbol.
CRS knob	Course set (CRS) knob and the course set counter operate in conjunction with the course pointer and allow the pilot to select any of 360 courses. Once set, the course pointer will turn with the compass card and will be centered on the upper lubber line when the helicopter is flying the selected course.
KM indicator	Digital distance display in kilometers (KM) to destination set on Doppler FLY TO DEST.
HDG knob	Heading set (HDG) knob operates in conjunction with the heading select marker, allows the pilot to select any one of 360 headings. Seven full turns of the knob produces a 360° turn of the marker.
HDG warning flag	Visible when a failure occurs in the magnetic compass system.
To-From arrow	To-from arrow indicates that the helicopter is flying to or away from a selected VOR.
NAV flag	The NAV flag at the top of the to indicator, turns with the compass card. The flag will retract from view when a reliable navigation signal is being applied to the instrument.

3-138. VSI/HSI and CIS Mode Selector Panels.

The mode select panels (Figure 3-25) are integrally lighted, instrument panel mounted controls for the VSI, HSI, and CIS. The panels provide a means for selecting and displaying various navigation functions. Power to operate the pilot's MODE SEL is taken from the No. 2 dc primary bus through a circuit breaker, marked PILOT MODE SELECT. The copilot's MODE SEL takes power from the No. 1 dc primary bus through a circuit breaker, marked COPILOT MODE SELECT.





MODE OF OPERATIONS	CIS MODE SELECTOR	HSI/VSI MODE SELECTOR
NONE	NONE	ANY
MANUAL HEADING	HDG	ANY
ALTITUDE HOLD	ALT	ANY
VOR NAVIGATION	NAV	VOR
ILS NAVIGATION	NAV	ILS
ILS APPROACH	NAV	ILS
ILS BACK COURSE	NAV	BACK CRS
LEVEL OFF	NAV	VOR/ILS/BACK CRS
GO-AROUND	NAV	VOR/ILS
DOPPLER	NAV	DPLR
FM HOMING	NAV	FM HOME

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Figure 3-25. CIS Modes of Operation (Sheet 1 of 2)

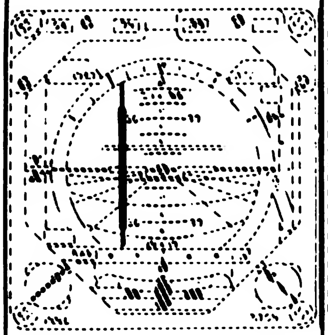
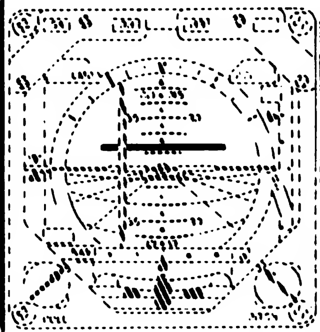
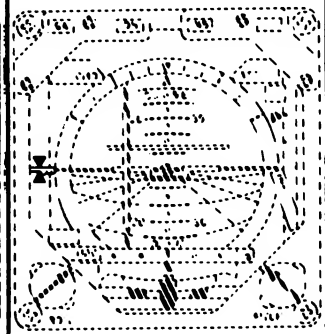
 CYCLIC ROLL COMMAND BAR	 CYCLIC PITCH COMMAND BAR	 COLLECTIVE POSITION INDICATOR
OFF SCALE	OFF SCALE	OFF SCALE
PROCESSED CYCLIC ROLL COMMAND	OFF SCALE	OFF SCALE
OFF SCALE	OFF SCALE	PROCESSED COLLECTIVE POSITION
PROCESSED CYCLIC ROLL COMMAND	OFF SCALE	OFF SCALE
PROCESSED CYCLIC ROLL COMMAND	PROCESSED CYCLIC PITCH COMMAND	PROCESSED COLLECTIVE POSITION
PROCESSED CYCLIC ROLL COMMAND	PROCESSED CYCLIC PITCH COMMAND	PROCESSED COLLECTIVE POSITION
PROCESSED CYCLIC ROLL COMMAND	OFF SCALE	OFF SCALE
PROCESSED CYCLIC ROLL COMMAND	OFF SCALE OR PROCESSED CYCLIC PITCH COMMAND	PROCESSED COLLECTIVE POSITION
PROCESSED CYCLIC ROLL COMMAND	PROCESSED CYCLIC PITCH COMMAND	PROCESSED COLLECTIVE POSITION
PROCESSED CYCLIC ROLL COMMAND	OFF SCALE	OFF SCALE
PROCESSED CYCLIC ROLL COMMAND	OFF SCALE	OFF SCALE

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Figure 3-25. CIS Modes of Operation (Sheet 2 of 2)

3-139. Controls and Functions.

Controls of the mode selector panel (Figure 3-25) are as follows:

CONTROL	FUNCTION
VSI/HSI Mode Selector	
DPLR	Directs Doppler lateral deviation and NAV flag signals to VSIs and HSIs.
VOR ILS	Directs VOR or ILS signals to VSIs, and HSIs. Provides a signal to NAV flag.
BACK CRS	Reverse polarity of back course signal to provide directional display for VSIs and HSIs. Provides a signal to NAV flag.
FM HOME	Directs FM homing deviation and flag signals to VSIs.
TURN RATE NORM	Provides pilot and copilot with his own turn rate gyro information displayed on his VSI.
ALTR	Allows copilot's turn rate gyro information to be displayed on pilot's VSI, or pilot's gyro information display on copilot's VSI.
CRS HDG PLT	Provides for pilot's omni-bearing selector to be connected to naviation receiver and concurrent connection of pilot's HSI course datum and heading datum output to command instrument system processor.
CPLT	Provides for copilot's omni-bearing selector to be connected to navigation receiver and concurrent connection of copilot's HSI course datum and heading datum output to command instrument system processor.
VERT GYRO NORM	Provides pilot and copilot with his own vertical gyro information displayed on his VSI.
ALTR	Allows copilot's vertical gyro information to be displayed on pilot's VSI, or pilot's gyro information to be displayed on copilot's VSI.
BRG2 ADF	Allows pilot or copilot to select ADF on his No. 2 bearing pointer, each independent of the other.
VOR	Allows pilot or copilot to select VOR on his No. 2 bearing pointer, each independent of the other.
CIS Mode Selector	Selects one of three modes of operation to direct navigational signals to the CISP for Command Signal display.
HDG ON	Direct heading and roll signals to CIS processor for steering commands that will allow pilot to maintain a selected heading.

CONTROL	FUNCTION
NAV ON	Gives heading commands to acquire and track a selected VOR, ILS, DPLR, or FM intercept, or to acquire and track glide slope beam.
ALT ON	Directs barometric pressure signals and collective stick position signals to CIS processor.

3-140. Off Mode.

The Command Instrument System off mode (no switch legends lit) causes the cyclic roll, cyclic pitch and collective command pointers on both Vertical Situation Indicators to be stowed out of view and the command warning flag on both VSIs to be biased out of view. The CISP is in the off mode upon initial application of electrical power, before the pilot selects either HDG, NAV or ALT mode on the CIS Mode Selector. When NAV mode is selected, the CISP remains in the off mode unless the DPLR, VOR ILS or FM HOME navigation data has been selected on the pilot's VSI/HSI Mode Selector. The CISP will return to the off mode whenever the HDG, NAV, and ALT hold modes are disengaged, as indicated by the respective ON legends going off, or by turning off the associated navigation receiver. Separate modes are manually disengaged by pressing the mode switch when ON is lit.

3-141. Heading Mode.

The heading mode processes the heading error and roll attitude signals to supply a limited cyclic roll command, which, when followed, causes the helicopter to acquire and track the heading manually selected on either pilot's HSI. The processed signal causes the VSI cyclic roll command bar to deflect in the direction of the required control response; i.e., bar deflection to the right indicates a coordinated right turn is required. When properly followed, the command results in not more than one overshoot in acquiring the selected heading and a tracking error of not more than 2°. The processor gain provides 1° of roll command for each degree of heading error up to a roll command limit of approximately 20°. The CISP heading mode is engaged by momentarily pressing the HDG switch on the pilot's CIS Mode Selector, or as described in paragraph 3-143.

3-142. Altitude Hold Mode.

The altitude hold mode processes barometric pressure signals from the Air Data Transducer in addition to the collective stick position signal. When the ALT switch on the pilot's CIS Mode Selector is pressed, the CISP provides collective command signals, which, when properly followed, cause the helicopter to maintain altitude to within plus or minus 50 feet. The altitude hold mode synchronizes on the engagement altitude for vertical rates up to 200 feet per minute and provides performance for altitude inputs between −1000 and +10,000 feet at airspeeds from 70 to 150 KIAS. It is possible to engage the altitude hold mode, regardless of whether the heading mode or navigation mode is engaged, except that the CISP logic prevents manual selection of the altitude hold mode whenever the NAV mode is engaged and an ILS frequency is selected. This prevents the operator from selecting altitude hold mode during an instrument approach. The altitude hold mode is manually engaged by pressing the ALT hold switch (subject to above restriction) or automatically engaged as described in paragraph 3-145. The altitude hold mode may be manually disengaged by pressing the ALT hold switch when the ON legend is lit. Altitude hold may be disengaged also by selecting any other mode which takes priority (e.g., Go Around).

NOTE

ALT hold mode should be manually disabled during ILS backcourse, VOR, and ADF approaches.

3-143. Navigation Mode.

The navigation mode causes the CISP to enter the VOR NAV, ILS NAV, DPLR NAV or FM NAV mode according to the navigation data preselected on the VSI/HSI Mode Selector. During the navigation mode the CISP provides steering commands based on the navigation signals displayed on the pilot's VSI. The CISP navigation mode is engaged by pressing the NAV switch on the CIS Mode Selector.

3-144. VOR NAV Mode.

The VOR NAV Mode is established by selecting the VOR/ILS switch on the VSI/HSI Mode Selector and pressing the NAV Switch on the CIS Mode Selector. The CISP processes the heading and course signals derived from either the pilot's or the copilot's HSI in addition to the lateral deviation and lateral flag signals applied to the pilot's VSI. The CISP provides a limited cyclic roll command, which, when followed, shall cause the helicopter to acquire and track the course setting manually selected on the HSI. Engagement of the VOR NAV when the helicopter position is in excess of 10°-20° from the selected radial will cause the initial course intersection to be made in the heading mode as described in paragraph 3-141. The CISP logic will light the CIS Mode Selector HDG switch ON legend during the initial course intersection. When the helicopter is within 10°-20° of the selected course, the CISP beam sensor will capture the VOR lateral beam. The processor logic will turn off the HDG switch ON legend and the final course interception, about 45°, acquisition, and tracking will be based on the VOR lateral deviation signals. The processor causes the roll command pointer to deflect in the direction of the required control response. When properly followed, the command will result in not more than one overshoot at a range of 10 NM at a cruise speed of 100 ± 10 knots, and not more than two overshoots at ranges between 5 and 40 NM at speeds from 70 to 140 knots. When passing over the VOR station, the CISP reverts to a Station Passage submode and remains in this submode for 30 seconds. Cyclic roll commands during the station passage submode will be obtained from the HSI Course Datum signal. Outbound course changes may be implemented by the HSI CRS SET knob during the station passage submode. Course changes to a new radial, or identification of VOR intersections, may be made before station passage by setting the HSI HDG control to the present heading and actuating the HDG switch. This will disengage the NAV mode and allow the pilot to continue on the original radial in the heading mode. A VOR intersection fix or selection of a new radial course may be made without affecting the CIS steering commands. Actuating the NAV switch reengages the VOR NAV mode to either continue on the original VOR radial or to initiate an intercept to the new selected radial.

3-145. ILS NAV Mode.

The Instrument Landing System NAV Mode is established by selecting the VOR/ILS switch on the VSI/HSI Mode Selector, tuning a localizer frequency on the navigation receiver and actuating the NAV switch in the pilot's CIS Mode Selector. During the ILS NAV mode the CISP processes the following signals in addition to those processed during the VOR NAV mode: (1) The vertical deviation and vertical flag signals, (2) the indicated airspeed (IAS) and barometric altitude signals, and (3) the collective stick position sensor and helicopter pitch attitude signals. The indicated airspeed and pitch attitude signals are processed to provide a limited cyclic pitch command, which, when properly followed, will result in maintaining an airspeed that should not deviate more than 5 knots from the IAS existing at the time the ILS NAV mode is engaged. The pitch command bar will deflect in the direction of the required aircraft response, i.e., an upward deflection of the pitch bar indicates a pitch up is required. The BAR ALT and collective stick position signals are processed to provide a limited collective position indication, which, when properly followed, will cause the helicopter to maintain the altitude existing at the time the ILS NAV mode is engaged. The collective position indicator will deflect in the opposite direction of the required control response, i.e., an upward deflection of the collective position indicator indicates a descent is required. The CISP will cause the ALT hold switch ON legend to light whenever the altitude hold mode is engaged. Actuating the ALT hold ON switch will disengage the altitude hold mode. Desired approach runway course must be set on the CRS window of the HSI selected by the PLT/CPLT indication of the CRS HDG switch. The initial course intersection and the localizer course interception, about 45°, acquisition, and tracking will be done as described for the VOR NAV mode except that not more than one overshoot at a range of 10 NM at 100 ± 10 KIAS, and not more than two overshoots at ranges between 5 and 20 NM should occur for airspeeds between 70 and 130 KIAS.

3-146. Approach Mode.

The approach mode, a submode of the ILS NAV mode, will be automatically engaged when the helicopter captures the glide scope. During the approach mode, the CISP processes the vertical deviation, GS flag, and collective stick position signals to provide a limited collective position indicator, which, when properly followed, shall cause the helicopter to acquire and track the glide slope path during an approach to landing. When the glide slope is intercepted, the CISP logic disengages the altitude hold mode and causes the ON legend of the ALT hold switch to go off. The CISP will provide a down movement of the collective position indicator to advise the pilot of the transition from altitude hold to glide slope tracking, and to assist in acquiring the glide slope path. The cyclic roll commands are limited to ± 15° during the approach submode. When properly followed, the roll commands will result in the helicopter tracking the localizer to an approach. The collective position indicator, when properly followed, will result in not more than one overshoot in acquiring the glidepath and have a glidepath tracking free of oscillations. The cyclic roll and collective steering performance is applicable for approach airspeed from 130 KIAS down to 50 KIAS.

3-147. BACK CRS Mode.

The back course mode is a submode of the ILS NAV mode and is engaged by concurrent ILS ON and BACK CRS ON signal from the pilot's HSI/VSI Mode Selector. The CISP monitors the localizer lateral deviation signals to provide cyclic roll commands, which, when properly followed, will allow the pilots to complete back course localizer approach in the same manner as the front course ILS. The desired final approach course should be set on the selected HSI CRS window.

3-148. Level-Off Mode.

The level-off mode will be activated when either the VOR NAV or ILS NAV modes are engaged, and will be deactivated by selection of another mode or when a radar altitude valid signal is not present. The level-off mode is not a function of a VOR or ILS CIS approach. During ILS or VOR approaches, the barometric altimeter must be used to determine arrival at the minimum altitude. Radar altimeter setting shall not be used for level off commands in the VOR NAV/ILS NAV modes because variations in terrain cause erroneous altitude indications. The level-off mode provides the pilots with a selectable low altitude command. This mode is automatically engaged when the radar altitude goes below either the pilot's or copilot's radar altimeter low altitude warning bug setting, whichever is at the higher setting. A DH legend on the VSI and a LO light display on the radar altimeter indicator goes on whenever the radar altitude is less than the LO bug setting. The CISP monitors the radar altimeter and the collective stick position sensor to provide a collective pointer command, which, when properly followed, will cause the helicopter to maintain an altitude within 10 feet of the low altitude setting for settings below 250 feet, and 20 feet for settings above 250 feet. The CISP causes the ALT switch ON legend to light and the altitude hold mode to be engaged.

3-149. Go-Around Mode.

The go-around mode processes roll and pitch attitude, altitude rate, collective stick position, and airspeed inputs in addition to internally generated airspeed and vertical speed command signals to provide cyclic roll, cyclic pitch and collective position indication. The go-around mode will engage when either pilot presses the GA (Go Around) switch on his cyclic control grip. When the go-around mode is engaged, the CISP immediately provides a collective position indication, which, when followed, will result in a 500 ± 50 fpm rate-of-climb at zero bank angle. Five seconds after the GA switch is pressed, the CISP will provide a cyclic pitch bar commands, which, when followed, will result in an 80-KIAS for the climbout. The go-around mode is disengaged by changing to any other mode on the pilot's CIS Mode Selector or VSI/HSI Mode Selector.

3-150. Doppler Mode.

The Doppler navigation mode is engaged by selecting the DPLR switch on the VSI/HSI Mode Selector and the NAV switch on the CIS Mode Selector. During the Doppler navigation mode, the CISP processes Doppler track angle error and the Doppler NAV flag signals in addition to the roll angle input from the attitude gyro. The CISP provides cyclic roll bar commands, which, when followed, result in a straight line, wind-corrected, flight over distances greater than 0.2 kilometer from the destination. The course deviation bar and course deviation pointer provide a visual display of where the initial course lies in relationship to the helicopter's position. The initial course is the course the Doppler computes from the helicopter's position to the destination at the time the fly to destination thumbwheel is rotated. To achieve a pictorially correct view of the course, rotate the course knob to the head of the No. 1 needle when the fly to destination thumbwheel is rotated. The DPLR NAV logic detects the condition of station passover, and automatically switches to heading mode. The switch to heading mode will be indicated by the HDG switch ON legend being turned on, and the NAV switch ON legend being turned off. The Doppler navigation mode will not automatically re-engage, but will require manual re-engagement of the NAV switch on the CIS Mode Selector.

3-151. FM HOME Mode.

The FM homing (Figure 3-25) is engaged by selecting the FM HOME switch on the pilot's VSI/HSI Mode Selector and the NAV switch on the pilot's CIS Mode Selector. Selecting FM homing on the VSI/HSI mode selector directs FM homing signals only to the VSI. Other NAV modes will be retained on the HSI if previously selected. During the FM HOME mode, the CISP processes the lateral deviation and flag signals displayed on the pilot's VSI in addition to the roll angle input from the attitude gyro. The CISP filters and dampens the FM homing deviation signals and provides cyclic roll commands to aid the pilot in homing on a radio station selected on the No. 1 VHF-FM communications receiver. When properly followed, the roll commands result in not more than two overshoot heading changes before maintaining a tracking error not to go over 3°. The CISP will revert to the heading mode whenever the lateral deviation rate is over 1.5°/sec for a period of over 1 second. The CISP will cause the CIS Mode Selector HDG switch ON legend to light, and remain in the heading mode until the FM mode or some other mode is manually selected. Concurrent VOR and FM or concurrent DPLR and FM mode inputs will be considered an FM mode input to the CISP.

3-152. TURN RATE Select.

The turn rate gyro selection provides each pilot the option of having his VSI display his own turn rate gyro signal (NORM operation) or of having the other pilot's turn rate gyro signal displayed (ALTR operation). The turn rate gyro selection is independent of the navigation modes selected by the top row of switches and is independent of which turn rate gyro the other pilot has selected. The NORM selection connects each pilot's VSI to his own turn rate gyro. The selection of NORM or ALTR operation is indicated by lighting the respective legend on the TURN RATE selector switch. The lamp power to the indicator legends is controlled through a relay so that the NORM legend is lit in case the mode selector logic or lamp drivers fail. Sequential operation of the TURN RATE switch alternates the rate gyro connected to the VSI.

3-153. CRS HDG Select.

The CRS HDG switch on the mode selector provides for either the pilot's or the copilot's course selector (CRS) to be connected to the navigation receiver, and for concurrent connection of the same pilot's HSI course and heading information to the command instrument system processor. The CRS resolver is normally connected to the pilot's HSI until selected by the copilot on his mode selector. CRS HDG control is transferred by pressing the CRS HDG switch. The pilot having the CRS HDG control is indicated by lighting of either the PLT or the CPLT legend on each mode selector. When power is first applied to the mode selector, the pilot's position is automatically selected. The CRS HDG selection is independent of the navigation modes selected by the top row of switches.

3-154. VERT GYRO Select.

The vertical gyro selection provides each pilot the option of having his VSI display his own vertical gyro attitude (NORM operation), or of having the other pilot's vertical gyro attitude displayed (ALTR operation). The vertical gyro selection is independent of the navigation modes selected by the top row of switches and is independent of which vertical gyro the other pilot has selected. Each pilot's VSI is normally connected to his own vertical gyro. The selection of NORM or ALTR operation is indicated by lighting the respective legend on the VERT GYRO selector switch. The lamp power to the indicator legends is controlled through a relay so that the NORM legend is lit in case the mode selector logic or lamp drivers fail. Sequential operation of the VERT GYRO switch alternates the vertical gyro connected to the VSI.

3-155. No. 2 Bearing Select.

The HSI number 2 bearing pointer selection allows the option of either the LF/ADF bearing or the VOR bearing to a selected station. The ADF/VOR selection is independent of the navigation modes selected by the top row of switches, and either pilot selects ADF or VOR, independent of the other pilot's selection. The number 2 bearing pointer is normally connected to the LF/ADF bearing output. The selection of either ADF or VOR bearing is indicated by lighting of the respective legend on the selector switch. The lamp power to the indicator legends is controlled through a relay, so that the ADF legend is lit in case the mode selector logic or lamp drivers fail. Sequential operation of the ADF/VOR switch alternates the bearing source connected to the No. 2 bearing pointer between ADF or VOR.

3-156. Operation.

a. Heading Hold.

(1) CIS MODE SEL switch - HDG.

(2) HDG set knob on HSI - Set as desired.

(3) Selected heading is achieved by banking helicopter, to center roll command bar.

b. VOR Course Intercept.

(1) Frequency - Set.

(2) HSI CRS set knob - Set to desired course.

(3) CIS mode selector switch - NAV.

(4) Follow roll command bar to initially follow intercept heading and then follow command bar to intercept VOR course.

c. ILS Approach.

(1) Frequency - Set.

(2) HSI CRS Set Knob - Set to desired course.

(3) CIS MODE SEL - NAV.

(4) At two dots localizer deviation on HSI, follow roll command bar to intercept localizer.

(5) As glide slope deviation pointer centers, follow collective position indications for glide slope tracking.

(6) At decision height, press GA switch for go-around mode if breakout has not occurred.

d. Back Course Localizer Approach.

(1) Frequency - Set.

(2) LO altitude bug - SET to missed approach point HAT.

(3) HSI CRS set knob - Set to inbound back course.

(4) CIS MODE SEL - NAV.

(5) MODE SEL - BACK-CRS.

(6) Fly same as front course (paragraph 3-156c(4). Turn off MODE SEL ALT legend to stow collective position indicator before making manual descent on back course approach.

Section IV TRANSPONDER AND RADAR

3-157. Transponder AN/APX-100(V)1 (IFF).

The transponder set (Figure 3-26) provides automatic radar identification of the helicopter to all suitably equipped challenging aircraft and surface or ground facilities within the operating range of the system. AN/APX-100(V) receives, decodes, and responds to the characteristic interrogations of operational modes 1, 2, 3/A, C, and 4. Specially coded identification of position (IP) and emergency signals may be transmitted to interrogating stations when conditions warrant. The transceiver can be operated in any one of four master modes, each of which may be selected by the operator at the control panel. Five independent coding modes are available to the operator. The first three modes may be used independently or in combination. Mode 1 provides 32 possible code combinations, any one of which may be selected in flight. Mode 2 provides 4096 possible code combinations, but only one is available and is normally preset before takeoff. Mode 3/A provides 4096 possible codes any one of which may be selected in flight. Mode C will indicate pressure altitude of the helicopter when interrogated. Mode 4 is an external computer mode and can be selected to provide any one of many classified operational codes for security identification. Power to operate the IFF system is provided from the No. 1 dc primary bus through a circuit breaker marked IFF, refer to TM's 11-5895-1199-12 and 11-5895-1037-12.

3-158. Antenna.

Flush-mounted antennas are installed on the top fairing between engine exhaust ports, (Figure 3-1) and under the transmission section behind the UHF-AM antenna. They receive signals of interrogating stations and transmit reply signals.

3-159. Controls and Functions.

All operating and mode code select switches for transceiver operation are on Control Panel RT-1296/APX-100(V) (Figure 3-26).

CONTROL/ INDICATOR	FUNCTION
TEST GO	Indicates successful BIT.

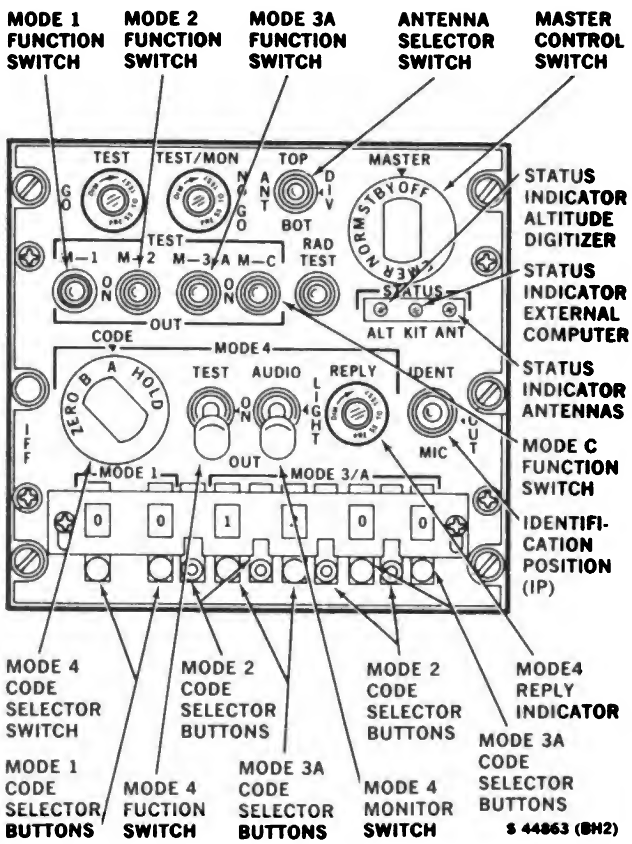

Figure 3-26. Control Panel RT-1296/APX-100(V)

CONTROL/ INDICATOR	FUNCTION
TEST/MON NO GO	Indicates unit malfunction.
ANT	Selects antenna(s) to be used.
MASTER/OFF/STBY/ NORM/EMER	Selects operating condition.
M-1 TEST/ON/OUT	Determines whether Mode 1 is on, off, or in BIT operation.
M-2 TEST/ON/OUT	Determines whether Mode 2 is on, off, or in BIT operation.

CONTROL/ INDICATOR	FUNCTION
M-3A/TEST/ON/OUT	Determines whether Mode 3A is on, off, or in BIT operation.
M-C TEST/ON/OUT	Determines whether Mode C is on, off, or in BIT operation.
RAD TEST/OUT	Enables TEST mode.
STATUS ALT	Indicates that BIT or MOD failure is due to Altitude Digitizer.
STATUS KIT	Indicates that BIT or MON failure is due to external computer.
STATUS ANT	Indicates that BIT or MON failure is due to high VSWR in antenna.
MODE 4 CODE Selector	Selects condition of code changer in remote computer.
ZERO	Zeroize code setting in computer.
A.	Selects mode 4 code setting for present period.
B.	Selects mode 4 code setting for succeeding period.
HOLD	Retains mode 4 code setting when power is removed from transponder.
MODE 4 TEST/ON/OUT	Determines whether Mode 4 is on, off, or in BIT operation.
MODE 4 AUDIO/ LIGHT/OUT	Controls method of monitoring Mode 4 operation.

CONTROL/ INDICATOR	FUNCTION
MODE 4 REPLY	Indicates that a Mode 4 reply is generated.
IDENT/OUT/MIC	Controls transmission of I/P pulse.
MODE 1 Selector buttons	Selects Mode 1 code to be transmitted.
MODE 2 Selector buttons	Selects Mode 2 code to be transmitted.
MODE 3/A Selector buttons	Selects Mode 3/A code to be transmitted.

3-160. OPERATION.

3-161. Starting Procedure.

If the MODE 2 code has not been set previously, loosen two screws which hold MODE 2 numeral cover, and slide this cover upward to expose numerals of MODE 2 code switches (Figure 3-26). Set these switches to code assigned to helicopter. Slide numeral cover down and tighten screws.

a. MASTER switch - STBY. NO-GO light should be on.

b. Allow 2 minutes for warmup.

c. MODES 1 and 3A CODE selector buttons - Press and release until desired code shows.

d. TEST, TEST/MON, and REPLY indicators - PRESS-TO-TEST. If MODE 1 is to be used, check as follows:

e. ANT switch - DIV.

f. MASTER switch - NORM.

g. M-1 switch - Hold at TEST, observe that only TEST GO indicator is on.

h. M-1 switch - Return to ON. If modes 2, 3A or M-C are to be used, check as follows:

i. M-2, M-3/A and M-C switches - Repeat steps g. and h.

NOTE

Do not make any checks near a radar site or with MASTER control switch in EMER, nor with M-3/A codes 7600 or 7700, without first, obtaining authorization from the interrogating station(s).

NOTE

The following steps can be done only with KIT/1A computer transponder installed.

j. MODE 4 CODE switch - A.

(1) Set assigned test code in the KIT/1A computer transponder.

(2) AUDIO-ON-OUT switch - OUT.

(3) MODE 4 TEST-ON-OUT switch - Place to TEST and hold, then release.

(4) TEST GO light - ON, MODE 4 REPLY light off, KIT STATUS light off.

k. When possible, request cooperation from interrogating station to activate radar TEST mode.

(1) Verify from interrogating station that MODE TEST reply was received.

(2) RAD TEST switch - RAD TEST and hold.

(3) Verify from interrogating station that TEST MODE reply was received.

3-162. Normal Procedures.

Completion of the starting procedure leaves the AN/APX-100(V) in operation. The following steps may be required, depending upon mission.

a. MODE 4 CODE selector switch - A or B as required.

(1) If code retention is desired, the MASTER control switch must be turned off within 15 seconds following placing the MODE 4 CODE selector switch to HOLD.

(2) If code retention in external computer is not desired during transponder off mode, place MODE 4 CODE selector switch to ZERO to dump external computer code setting.

b. Mode M-1, M-2, M-3/A, M-C, or MODE 4 switches - Select desired mode.

c. Identification of position (I/P) Switch - IDENT, when required, to transmit identification of position pulses or set I/P switch to MIC to transmit I/P pulse only when microphone press-to-talk switch is actuated. (I/P pulses will be for 15- 30-second duration when activated.)

3-163. Emergency Operation.

During a helicopter emergency or distress condition the AN/APX-100(V) may be used to transmit specially coded emergency signals on mode 1, 2, and 3/A and 4 to all interrogating stations. Those emergency signals will be transmitted as long as the MASTER control switch on the control panel remains in EMER.

MASTER control switch - EMER.

3-164. Stopping Procedure.

Refer to paragraph 3-162, step a. (1) and (2) before stopping transponder.

MASTER switch - OFF.

3-165. Transponder Computer KIT-1A/TSEC.

The transponder computer in the nose section of the helicopter operates in conjunction with mode 4. A caution light on the caution panel, marked IFF, will go on when a malfunction occurs in mode 4 or the computer that will prevent a reply when interrogated. Mode 4 operation is selected by placing the MODE 4 switch ON, provided the MASTER switch is at STBY or NORM. Placing the MODE 4 switch to OUT disables mode 4. MODE 4 CODE switch is placarded ZERO, B, A, and HOLD. The switch must be lifted over a detent to switch to ZERO. It is spring-loaded to return from HOLD to the A position. Position A selects the mode 4 code for the present code period and position B selects the mode 4 code for the succeeding period. Both codes are mechanically inserted by a code-changing key. The codes are mechanically held in the transponder computer, regardless of the position of the MASTER switch or the status of helicopter power, until the first time the helicopter becomes airborne. Thereafter, the mode 4 codes will automatically zeroize any time the MASTER switch or helicopter power is turned off. The code setting can be mechanically retained. With weight on the landing gear, turn the MODE 4 CODE switch to HOLD (only momentary actuation is required) and release the MASTER switch or helicopter power must be turned OFF within 15 seconds following placing MODE 4 CODE select switch to HOLD. Mode 4 codes can be zeroized any time the helicopter power is on and the MASTER switch is not in OFF, by turning the CODE switch to ZERO. Power to operate the transponder computer is provided automatically when the AN/APX-100(V) is on. The transponder computer KIT-1A/TSEC operation is classified.

3-166. Altimeter Set AN/APN-209(V).

The radar altimeter system (Figure 3-27) provides instantaneous indication of actual terrain clearance height. Altitude, in feet, is displayed on two radar altimeter indicators on the instrument panel in front of the pilot and copilot. The radar altimeter indicators each contain a pointer that indicates altitude on a linear scale from 0 to 200 feet (10 feet per unit) and a second-linear scale from 200 to 1500 feet (100 feet per unit). An ON/OFF/LO altitude bug set knob, on the lower left corner of each indicator, combines functions to serve as a low level warning bug set control, and an ON/OFF power switch. The system is turned on by turning the LO control knob, marked SET, of either indicator, clockwise from OFF. Continued clockwise turning of the control knob will permit either pilot to select any desired low-altitude limit, as indicated by the LO altitude bug. Whenever the altitude pointer exceeds low-altitude set limit, the LO altitude warning light will go on. Pressing the PUSH-TO-TEST HI SET control provides a testing feature of the system at any time and altitude. When the PUSH-TO-TEST control knob is pressed, a reading between 900 feet and 1100 feet on the indicator, and a reading between 900 and 1100 feet on the digital display, and the OFF flag removed from view, indicates satisfactory system operation. Releasing the PUSH-TO-TEST SET control knob restores the system to normal operation. A low-altitude warning light, on the center left of the indicator, will light to show the word LO any time the helicopter is at or below the altitude limit selected by the low altitude bug. Each pilot may individually select a low-altitude limit and only his LO light will go on when the low-altitude is reached or exceeded. Loss of system power will be indicated by the indicator pointer moving behind the dial mask and the OFF flag appearing in the center of the instrument. If the system should become unreliable, the flag will appear and the indicator pointer will go behind the dial mask, to prevent the pilot from obtaining erroneous readings. Flight operations above 1600 feet do not require that the system be turned off. The pointer will go behind the dial mask but the transmitter will be operating. Power to operate the AN/APN-209 is supplied from the No. 1 dc primary through circuit breakers, marked RDR ALTM.

3-167. Antennas.

Two identical radar altimeter antennas (Figure 3-1) are on the cockpit section under the avionics compartment. One is for the transmitter and the other is for the receiver. The antennas are flush-mounted in the fuselage on the bottom of the helicopter.

3-168. Controls or Indicator Function

Control of the radar altimeter set is provided by the LOW SET OFF knob on the front of the height indicator. The knob, marked HI SET, also controls the PUSH TO TEST (Figure 3-27).

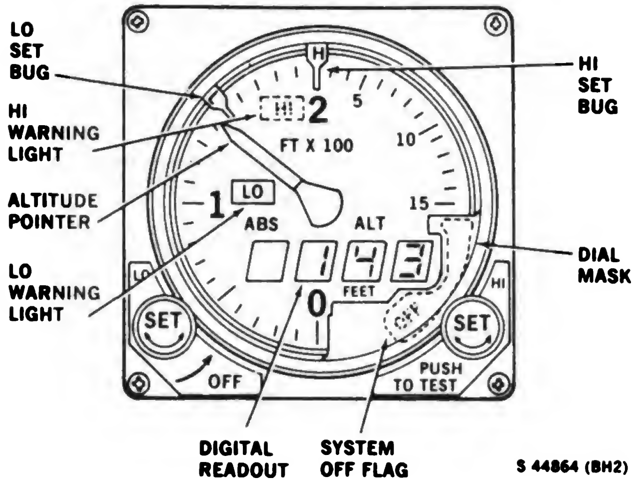

Figure 3-27. Altimeter Set AN/APN-209

CONTROL/ INDICATOR	FUNCTION OR INDICATION
LO SET knob	Power control turned counterclockwise to OFF, clockwise to on.
LO SET bug	Sets altitude trip point of LO warning light.
HI SET bug	Sets altitude trip point of HI warning light.
HI SET knob	Pushing knob actuates built-in test system to self-test altimeter.
Altitude pointer	Provides an analog indication of absolute altitude from zero to 1500 feet.
Digital readout	Gives a direct-reading four digit indication of absolute altitude from zero to 1500 feet.
LO warning light	Lights whenever dial pointer goes below L altitude bug setting.
HI warning light	Lights whenever dial pointer goes above H altitude bug setting.

CONTROL/ INDICATOR	FUNCTION OR INDICATION
OFF flag	Moves into view whenever altimeter loses track while power is applied.

3-169. Operation.

a. Starting Procedure.

(1) LO SET knob - On.

(2) LO set bug - Set to 80 feet.

(3) HI set bug - Set to 800 feet.

(4) Indicator pointer - Behind mask above 1500 feet.

b. Track Operation. After about 2 minutes of warmup, the altimeter will go into track mode with these indications:

(1) OFF flag - Not in view.

(2) Altitude pointer - 0 ± 5 feet.

(3) Digital readout - 0 to +3 feet.

(4) LO warning light - Will light.

(5) HI warning light - Will be off.

c. HI SET knob - Press and hold. The altimeter will indicate a track condition as follows:

(1) OFF flag - Not in view.

(2) Altitude pointer - 1000 ± 100 feet.

(3) Digital readout - 1000 ± 100 feet.

(4) LO warning light - Will be off.

(5) HI warning light - Will light.

(6) HI SET knob - Release. The altimeter will return to indications in step b, Track Operation.

3-170. Stopping Procedure.

LO SET knob - OFF.

3-171. Mission Equipment Interface. EH

CAUTION

The ECM antenna can be extended with the helicopter on the ground if the radar altimeter is turned off or removed from the installation, or the L (LO set) indicator is set below the radar altimeter indication.

Two signals are provided by the radar altimeter to the AN/ALQ-151(V)2 mission equipment. RADAR ALTIMETER ON indicates the altimeter is installed and has power applied. If this signal is not present, and the ECM antenna is not fully retracted, a signal is generated to light the ANTENNA EXTENDED capsule on the CAUTION/ADVISORY panel. The other signal, RADAR ALTITUDE LOW, is sent to the mission equipment when the aircraft altitude drops below the LO bug setting of the radar altimeter. The signal initiates automatic retraction of the ECM antenna, lights the ANTENNA EXTENDED capsule until the antenna is fully retracted, and disables the ECM ANTENNA switch.

CHAPTER 4
MISSION EQUIPMENT

Section I MISSION AVIONICS

4-1. Troop Commander's Antenna.

The troop commander's antenna (Figure 3-1), on the upper trailing edge of the tail rotor pylon, provides for use of a VHF/FM mobile/man pack radio, such as the AN/PRC-25 or AN/PRC-77, from the cabin area. The antenna gives the troop commander the capability of liaison, command, and control of ground elements. A coaxial cable, coiled in the cabin ceiling near the left cabin door, is for connecting the antenna to the radio set.

4-2. Crew Call Switch/Indicator. EH

The CREW CALL switch/indicators are on the instrument panel (Figure 2-8) and in the cabin at the DF and ECM consoles. The switches are used to provide signals between crew members to indicate communication is desired, and establishing ICS circuits between cockpit and cabin. When the pilot/copilot's CREW CALL switch is pressed in, it lights steady. This allows only one-way communication, from pilot/copilot to mission equipment operator(s). All stations desiring to communicate must then place their respective intercom switches to ICS. To establish two- or three-way communications, the flashing switches must be pressed in. The pilot's ICS audio overrides all other mission equipment operator's audio. To establish communication from mission equipment operator(s) to pilot/copilot, the DF and/or ECM operator must press in their respective CREW CALL switch. The DF and/or ECM operator(s) CREW CALL switch(es) will light steady. The pilot/copilot's CREW CALL light flashes. When the pilot/copilot's CREW CALL switch is pressed in, the switch lights steady, and communications can then be established. In establishing communications, the first CREW CALL switch pressed will light steady, all others will flash until pressed in. To terminate two-way communication, the pilot/copilot and mission equipment operator(s) must press the respective CREW CALL switch(es), causing all indicators to go off. In terminating communications, CREW CALL switches pressed in must be pressed to release. Power to operate the CREW CALL system is provided from the No. 1 dc primary bus through a circuit breaker marked LIGHTS ADVSY.

4-3. Chaff Dispenser Kit XM130.

The General Purpose Dispenser XM130 (Figure 4-1) consists of a single system (dispenser assembly, payload module assembly, electronics module and dispenser control panels) and a CHAFF DISP control button (on the lower console) designed to dispense decoy chaff, M-1. The system provides effective survival countermeasures against radar guided weapon systems threats. The dispenser system, XM130, has the capability of dispensing 30 chaff. Power to operate the chaff dispenser system is provided from the No. 1 dc primary bus through a circuit breaker, marked CHAFF/FLARE DISP.

4-4. Flare Dispenser XM-130. EH

The General Purpose Dispenser (Figure 4-1) consists of a single system dispenser assembly, payload module assembly, electronics module, and dispense control button (on the instrument panel), designed to dispense decoy flares M206. The system provides effective survival countermeasure against infrared sensing missile threats. The dispenser system has the capability of dispensing 30 flares. Power to operate the flare dispenser system is provided from the No. 1 dc primary bus through a circuit breaker marked CHAFF/FLARE DISP.

4-5. Controls and Function.

The dispenser control panel (Figure 4-1) contains all necessary controls to operate the dispenser system from the cockpit. The control panel is on the lower console.

CONTROL OR INDICATOR	FUNCTION
CHAFF counter	Shows the number of chaff cartridges remaining in payload module.
CHAFF counter setting knob	Adjusts counter to correspond to number of chaff cartridges remaining in payload module.

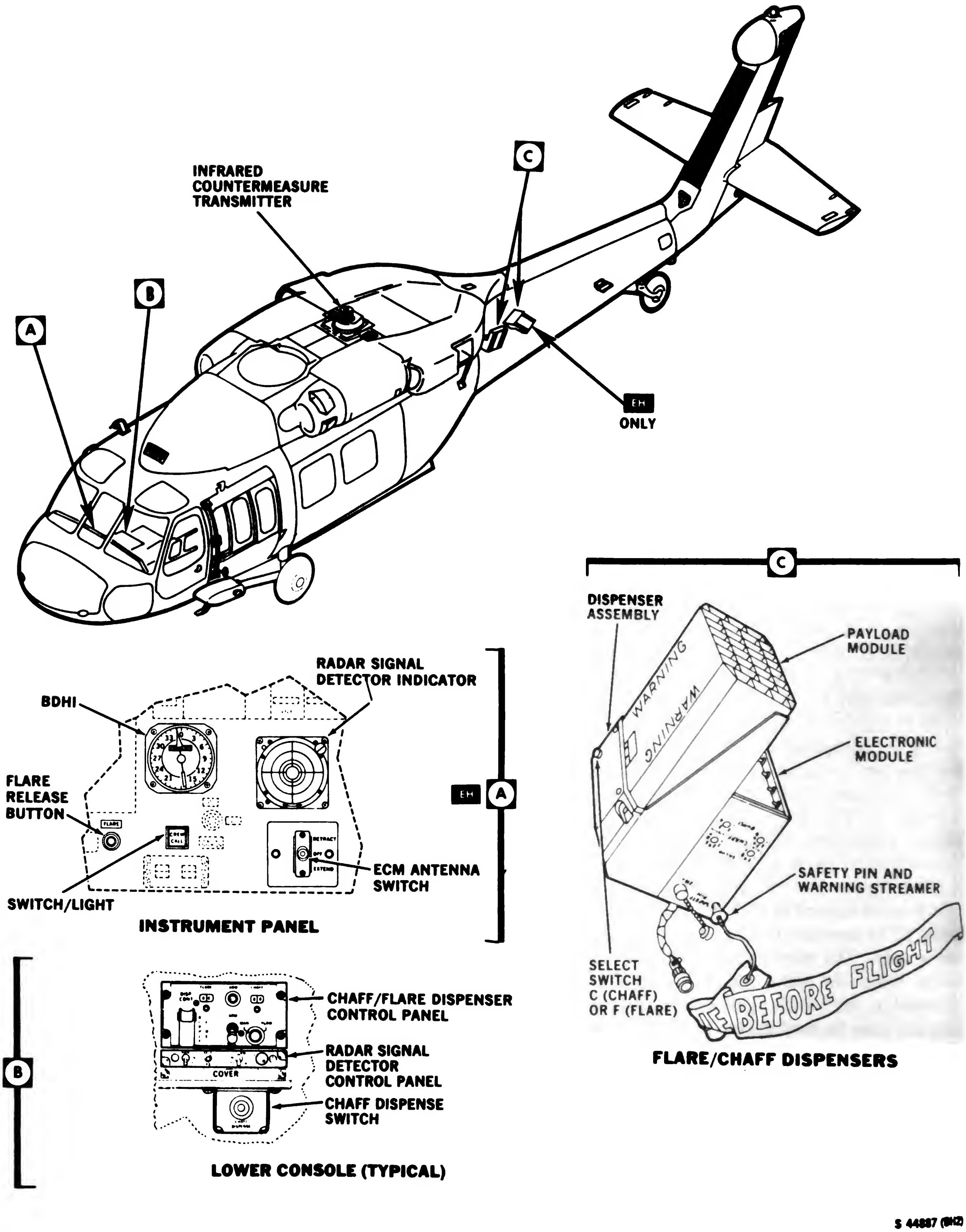

Figure 4-1. Mission Kits

CONTROL OR INDICATOR	FUNCTION
PUSH-RESET	When pushed, resets chaff counter to "00".
ARM indicator light	Indicates that arming switch is at ARM, safety flag pin is removed, and payload module is armed.
ARM-SAFE switch	
ARM	Applies electrical power through safety flag switch to DISPENSE button, and flare firing switch. Flare firing system is not used in this installation.
SAFE	Removes power from dispenser system.
FLARE counter UH	Not used in this installation.
FLARE counter setting knob UH	Not used in this installation.
DISP CONT UH	Not used in this installation.
Mode selector	Selects type of chaff release operation.
MAN	Dispenses one chaff cartridge each time dispense button is pressed.
PRGM	Dispenses chaff according to predetermined burst/salvo and number of salvos automatically.
CHAFF DISP	Ejects chaff cartridges from payload module.

4-6. Controls and Function. EH

CONTROL OR INDICATOR	FUNCTION
FLARE Counter	Indicates the number of flare cartridges remaining in payload module.
FLARE Counter Set Knob	Adjusts counter to correspond to number of flare cartridges in payload module.
DISP CONT RIPPLE FIRE	Release (jettison) all flares from payload module without pressing FLARE switch for each flare.
FLARE Switch (Instrument panel)	Fires one flare from payload module each time switch is pressed.

4-7. Dispenser Assembly.

The dispenser assembly (Figure 4-1) contains the breech assembly, C-F selector switch for either chaff or flares, a reset switch, and a housing containing the sequencer assembly. The sequencer assembly receives power through the firing switches circuit and furnishes pulses to each of the 30 contacts of the breech assembly, in sequential order 1 through 30, thus firing each of the impulse cartridges.

4-8. Payload Module Assembly.

The payload module assembly (Figure 4-1) consists of the payload module and retaining plate assembly. The payload module has 30 chambers which will accept chaff. The chaff cartridges are loaded through the studded end of the module, one per chamber, and are held in place by the retaining assembly. The payload module assembly is assembled to the dispenser assembly.

4-9. Electronic Module Assembly (EM).

The EM (Figure 4-1) contains a programmer and a cable assembly which includes a 28-volt supply receptacle and a safety switch, actuated by inserting the safety pin with streamer assembly. The programmer consists of a programming circuit which allows the setting of chaff burst number, chaff burst interval, chaff salvo number, and chaff salvo interval.

4-10. Electronics Module Controls.

Controls on the electronic module are used to program the chaff dispenser for predetermined release of chaff cartridges. Controls on the electronic module are as follows:

CONTROL	FUNCTION
SAFETY PIN	Safety switch to accept the safety pin with streamer, placing the dispenser in a safe condition when the helicopter is on the ground.
SALVO COUNT	Programs the number of salvos; 1, 2, 4, 8 or C (Continuous).
SALVO INTERNAL	Programs the time in seconds between salvos; 1, 2, 3, 4, 5, 8 or R (Random 2, 5, 3, 4, 3).
BURST COUNT	Programs the number of burst; 1, 2, 3, 4, 6 or 8.
BURST INTERVAL	Programs the time in seconds for burst intervals; 0.1, 0.2, 0.3 or 0.4.

4-11. Safety Procedures.

The safety pin shall be installed in the safety switch when the helicopter is parked. Safety pin is removed immediately before takeoff.

4-12. Operation.

a. Counter(s) - Set for number of cartridges in payload module(s).

b. Mode switch - MAN.

NOTE

Mode switch should always be at MAN when the ARM-SAFE switch is moved to ARM to prevent immediate salvo of chaff.

c. ARM SAFE switch - ARM. ARM indicator light on.

d. Dispense button press or mode switch PGRM, as required.

4-13. Flare Operation. EH

a. FLARE counter - Set for number of flare cartridges in payload module.

b. Mode Switch - OFF.

c. ARM Switch - ARM.

d. FLARE switch (instrument panel) - Press for each release.

NOTE

If the flare detector does not detect burning of the first flare fired, another flare is automatically fired within 75 milliseconds; if burning is still not detected, a third and final flare is fired. If all three flares do not fire, automatic rejection of flares will stop until the system is activated again by the FLARE switch.

4-14. Stopping Procedure.

ARM SAFE switch - SAFE.

4-15. Radar Signal Detector Set AN/APR-39V-1.

(Refer to TM 11-5841-238-12)

4-16. Controls and Functions.

The operating controls of the AN/APR-39V-1 panel (Figure 4-1) are as follows:

CONTROL	FUNCTION
PWR	Controls 28 V from No. 1 dc primary bus.

CONTROL	FUNCTION
ON	Turns set on. Fully operational after 1-minute warmup.
OFF	Turns set off.
DSCRM	Selects mode of operation.
ON	Activates discriminator circuit.
OFF	Deactivates discriminator circuit.
SELF-TEST	When pressed, initiates self-test confidence check (except antenna, and receiver).
AUDIO	Controls volume to the interphone system.
DIRECTION DISPLAY (scope display)	Shows a line-of-bearing radial strobe for each processed emitter signal.
MA Indicator	Flashes on and off to indicate time correlation between missile guidance and associated tracking radar.
BRIL Control	Varies brilliance of cathode ray tube (CRT) display.
Filter Control	Varies density of red polarized faceplate filter (used for day or night operation) by moving a tang right or left.

4-17. Modes of Operation.

The radar detector AN/APR-39V-1 may be operated in either the discriminator off or discriminator on mode.

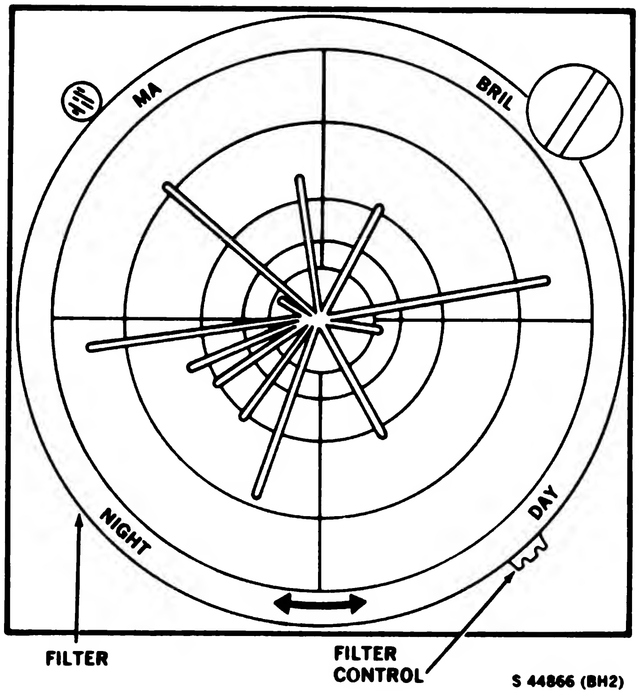

Figure 4-2. Discriminator Off Mode Display

NOTE

Display strobe lengths indicate only received signal amplitude. Since many variables can affect the atmospheric attenuation of the signals, strobe length should not be considered as a direct interpretation of the distance to the emitter.

a. Discriminator Off Mode. When operated in the discriminator off mode, the DSCRM switch is placed OFF. In this mode all high band received signals with an amplitude greater than the predetermined threshold level are displayed on the CRT and an audio signal, representative of the combined amplitudes and pulse repetition frequencies (PRF's), is present at the headset. The displays indicate the total radar environment in which the helicopter is operating. Each radial strobe on the CRT is a line of bearing to an active emitter. When a SAM radar complex becomes a threat to the helicopter (low band signals correlated with high band signals), the unique alarm audio is superimposed on the PRF audio signal and the MA lamp and associated strobe start flashing. Lengths of strobes and audio levels depend on the relative strength of the intercepted signals. A typical display when operating in the discriminator off mode is shown in Figure 4-2.

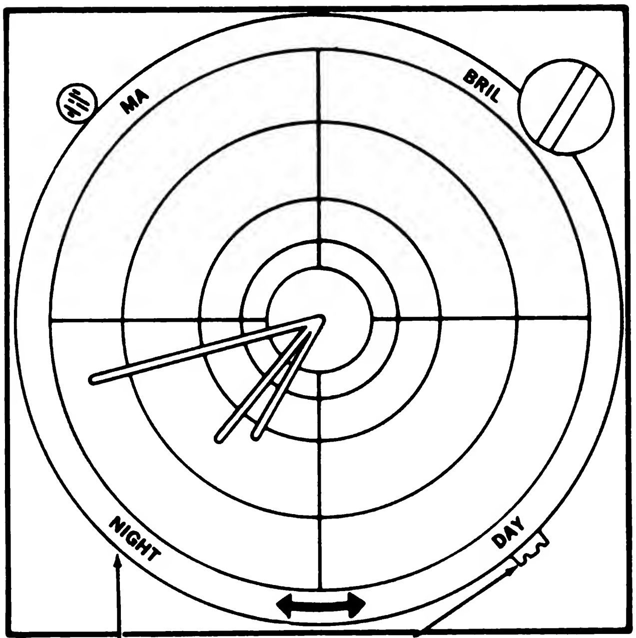

Figure 4-3. Discriminator On Mode Display

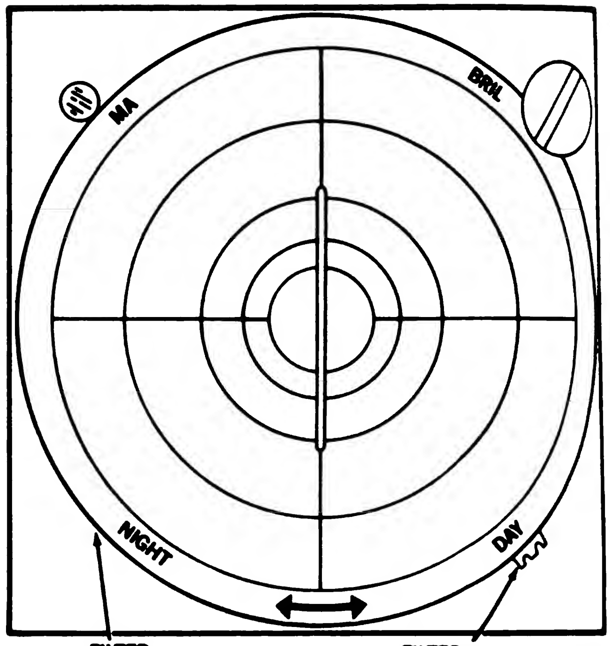

Figure 4-4. Typical Self-Test Mode Display

NOTE

In this mode, received low band signals which are not correlated with a wide band intercept will cause the MA lamp to flash, and an alarm audio will be present.

b. Discriminator On Mode. When operating in the discriminator on mode, the DSCRM switch is placed ON. In this mode, signals are processed to determine their conformance to certain threat-associated criteria.

(1) The signal level must be greater than the minimum threshold level.

(2) Pulse width must be less than the maximum pulse width.

(3) PRF must be greater than the minimum pulses per second (PPS).

(4) The pulse train must exist with not less than minimum pulse train persistence.

(5) The CRT display is divided into eight sectors. Strobes are displayed only in those sectors in which signals meeting all threat criteria are present. This reduces display clutter by eliminating low-level and wide-pulse width signals and by selective sector display. Intercepts which meet these requirements are displayed as described in a. above.

NOTE

In this mode, uncorrelated low band signals will not give any indications.

(6) A typical display when operating in the discriminator ON mode is shown in Figure 4-3. Conditions are the same as for Figure 4-2, but is assumed that one or more threats have been identified in the 225° to 270° sector only.

4-18. Self-Test Procedures.

The self-test confidence checks all AN/APR-39(V)1 circuits except, antennas, high-pass filters and detectors in the high-band receivers, bandpass filter and detector in the low-band receiver, analysis signal commutator, and high- and low-band blanking circuits. The self-test procedure is done before operation or when any malfunction is detected.

1. Apply power to AN/APR-39. Control unit panel lamps go on.

NOTE

In well-lighted areas it may be necessary to shade the panel to determine whether panel is lighted.

2. Place control unit DSCRM switch OFF, PWR switch ON, and wait 1 minute for warmup. Monitor indicator CRT and audio and press and hold SELF TEST.

a. Fwd and aft strobes appear, extending to about the third circle on the indicator graticule, and 2.5 kHz (approximately) PRF audio present immediately.

b. Within about 6 seconds, alarm audio present and the MA lamp starts flashing.

3. Turn indicator BRIL control cw and ccw. Indicator strobes brighten (cw) and dim as control is turned. (Set control for desired brightness level.)

4. Turn control unit AUDIO control between max ccw and max cw. Audios not audible at max ccw and clearly audible at max cw.

5. Release SELF TEST. All indications cease.

6. Place DSCRM to ON. Press and hold SELF TEST.

a. Within about 4 seconds a fwd or aft strobe (either may appear first) and 1.2 kHz (approximately) PRF audio present.

NOTE

Occasionally, during the period between pressing SELF TEST and appearance of the first strobe, a distorted dot on the indicator and intermittent audio will be present. This is not a fault indication.

b. Within about 6 seconds the other strobe will appear and PRF audio frequency will double.

c. Several seconds later alarm audio present and MA lamp starts flashing.

7. Release SELF TEST. All indications cease.

8. Place control unit PWR switch OFF.

4-19. Operation Procedure.

4-20. Starting Procedure.

The procedure for turning on the equipment is as follows:

CAUTION

To prevent damage to the receiver detector crystals, assure that the AN/APR-39(V)1 antennas are at least 60 yards from active ground radar antennas or 6 yards from active airborne radar antennas. Allow an extra margin for new, unusual, or high power emitters.

1. PWR switch - ON, allow at least 30 seconds for warmup.

2. SELF TEST switch - Press and hold. Display should be a vertical line scope centerline.

3. BRIL, filter and AUDIO controls - Adjust as desired.

4. SELF TEST switch - Release.

5. PWR switch - As desired.

4-21. Stopping Procedure.

PWR switch - OFF.

4-22. Bearing, Distance, Heading Indicator (BDHI). EH

The BDHI at the center of the instrument panel consists of three indicators. The position of the indicator allows easy viewing by both pilot and copilot. The functions of the indicators are as follows:

a. Compass Rose - displays the magnetic heading of the helicopter.

b. Bearing Pointer - displays bearing to the signal received from an airborne or ground emitter/transmitter. The DF operator selects signal to be displayed.

c. Distance Readout - displays, in kilometers, the distance to a signal emitter selected by the DF operator.

4-22.1. Radar Signal Detecting Set (AN/APR-39(V)2). EH

The radar signal detecting set indicates the relative position of search radar stations. Differentiation is also made between various types of search radar and tracking stations. Audio warning signals are applied to the pilot's and copilot's headsets. The radar signal detecting set is fed through the 50-ampere LH MAIN AVIONICS and RH MAIN AVIONICS circuit breakers on the copilot's circuit breaker panel and protected by the 7.5-ampere APR-39 circuit breaker on the copilot's circuit breaker panel. The associated antennas are shown in Figure 2-1. For operating instructions refer to (C) TM 11-5841-283-20-1.

4-23. Infrared Countermeasure Set AN/ALQ-144(V).

WARNING

Do not continuously look at the infrared countermeasure transmitter (Figure 4-1) during operation, or for a period of over 1 minute from a distance of less than 3 feet. Skin exposure to countermeasure radiation for longer than 10 seconds at a distance less than 4 inches shall be avoided.

The countermeasures system provides infrared countermeasure capability. The system transmits radiation modulated mechanically at high and low frequencies using an electrically-heated source. A built-in test feature monitors system operation and alerts the pilot should a malfunction occur. The system is made up of a control panel on the instrument panel and a transmitter on top of the main rotor pylon aft of the main rotor. On helicopters Serial Nos 78-22987 and subsequent, the countermeasure system functionally interfaces with the caution/advisory warning sytem through the left relay panel. The countermeasures system gets dc electrical power from the No. 2 dc primary circuit breaker panel and the No. 2 junction box. The 28 vdc is routed through the IRCM PWR circuit breaker in the No. 2 junction box to the transmitter. The No. 2 dc primary bus also supplies 28 vdc through the IRCM CONTR circuit breaker on the No. 2 dc primary circuit breaker panel to the control unit. Panel lighting of the control unit is controlled by the INSTR LTS NON FLT control on the upper console. When the control unit ON-OFF switch on the control panel is momentarily placed ON, the power distribution and control circuits are activated and the ON lamp is lit for about 60 seconds on helicopters prior to Serial No. 78-22987. The source begins to heat, the servo motor and drive circuits are energized, turning on the high and low speed modulators, and a signal is applied to stabilize system operations before energizing the built-in test function. After a warmup period the stabilizing signal is removed, and the system operates normally. Placing the ON-OFF control switch momentarily to OFF causes the power distribution and control circuits to de-energize the source and initiates a cool-down period. During the cooldown period, the servo motor drive circuits remain in operation, applying power to the motors that cause the modulators to continue turning, and the INOP indicator will remain on during cooldown cycle. On helicopters Serial Nos 78-22987 and subsequent, also during the cooldown period, the IRCM INOP caution light will be lit. After the cooldown period, the power distribution and control circuits de-energize, all system operating voltage is removed and the IRCM INOP capsule, or the INOP light, will go off. On helicopters prior to Serial No. 78-22987, if a malfunction occurs during system operation, the INOP light on the control unit will go on and the cooldown period will automatically begin. On helicopters Serial Nos 78-22987 and subsequent, if a system malfunction causes the IRCM INOP caution light on the caution panel to go on, the IRCM INOP capsule will remain lit until the control panel ON/OFF switch is momentarily placed OFF. The system can be returned to operating mode by momentarily placing ON-OFF switch OFF, then ON, provided the cause of the malfunction has cleared, refer to TM 11-5865-200-12.

4-24. Infrared Countermeasure System Control Panel.

Control of the Countermeasure Set is provided by the operator control panel on the helicopter instrument panel. On helicopters prior to Serial No. 78-22987, the control panel has one switch (ON/OFF) and an ON indicator light. On helicopters Serial No. 78-22987 and subsequent, only a power ON/OFF switch is on the control panel. Power to operate the countermeasure set is supplied from the No. 2 dc primary bus through a circuit breaker, marked IRCM CONTR.

4-25. Controls and Function.

Controls for the AN/ALQ-144 are on the front panel of the control unit. The function of each control is as follows:

CONTROL	FUNCTION
Power switch	Turns set on and off.
ON indicator light (green) (Helicopters prior to Serial No. 78-22987)	Indicates system is in a 45-75 second warmup mode.
INOP indicator light (red) (Helicopters prior to Serial No. 78-22987)	Indicates malfunction has occurred or countermeasure system is in cooldown cycle.
IRCM INOP caution light (Helicopters Serial Nos 78-22987 and subsequent)	Indicators malfunction has occurred or the countermeasure system is in cooldown cycle.

4-26. OPERATION.

1. ON and INOP PRESS TO TEST indicator light - Press. Indicator light should go on. (On helicopters prior to Serial No. 78-22987.)

2. Power switch - ON momentarily, then release. (Switch will return to center position when released.) ON (green) indicator - Should light for 45 -75 seconds, then go off. (On helicopters prior to Serial No. 78-22987.)

NOTE

If the INOP indicator or IRCM INOP caution light goes on after the ON indicator (helicopters prior to Serial No. 78-22987) goes off, place the power switch OFF.

3. Power switch - ON momentarily, then release. Switch will return to center position when released (helicopters Serial Nos 78-22987 and subsequent).

4-27. Stopping Procedure.

Power switch - OFF. The transmitter will continue to operate for about 60 seconds during the cooldown cycle. INOP indicator or IRCM INOP caution light as applicable should remain on during cooldown cycle.

4-28. ECM ANTENNA Switch. EH

The ECM antenna switch is a three-position switch on the instrument panel (Figure 2-8), providing control of ECM antenna deployment and retraction. The switch is spring-loaded to center (OFF), with positions marked EXTEND and RETRACT. Normal operation of the switch is as follows:

CAUTION

The ECM antenna can be extended with the helicopter on the ground if the radar altimeter is turned off or removed from the installation, or the L (LO SET) indicator is set below the radar altimeter indication.

a. Extend.

When the helicopter is on the ground with all stems working properly and the radar altimeter L LO SET) indicator is set above the radar altimeter dication, the antenna cannot be extended because of e interlock system. When the helicopter is in flight, ith the copilot's radar altimeter indication above the (LO SET) indicator, the antenna can be extended ntil it reaches the fully extended position, by momenrily placing the switch to EXTEND. Once the exten-on or retraction process has started, it cannot be over-dden with another command from the ECM NTENNA switch. The cycle can be interrupted by rning off the radar altimeter or setting L SET bug bove radar altitude indication. When the antenna is lly extended, a light on the ECM operator's console arked ANTENNA DEPLOYED, will go on. The NTENNA EXTENDED caution light on the caution/ dvisory panel will not go on when the antenna is xtended. It is a condition light rather than an antenna osition light.

b. Retract.

NOTE

Automatic ECM antenna retraction is controlled by the copilot's radar altimeter L (LO SET) indicator when the altimeter is turned on.

If the antenna is extended, the pilot may nomentarily select RETRACT to return the antenna o the retracted position. The antenna will automatcally retract if the helicopter descends below the altimeter L indicator setting or a failure occurs in the radar ltimeter. When the antenna is fully retracted, the ANTENNA RETRACTED status advisory light on the caution/advisory panel will go on and remain on as long as the antenna stays in that position. The ANTENNA DEPLOYED and ANTENNA EXTENDED lights should be off with antenna retracted. An emergency retract switch accessible to the ECM operator may be used to retract the ECM antenna if a failure occurs in the cockpit retract system. A light next to the switch indicates when the antenna is extended.

c. Emergency ECM Antenna Retract Switch.

An emergency ECM antenna retract switch on the antenna relay assembly on the ECM equipment rack, provides a backup mode of retraction of the antenna if a failure occurs in the cockpit ECM ANTENNA switch. To retract, the switch must be held at up until the antenna is fully retracted and the ANTENNA RETRACTED advisory light is on.

4-28.1. Countermeasures Set AN/ALQ-156(V)2. EH

Countermeasure set AN/ALQ-156(V)2 consists of Receiver Transmitter RT-1220. Control Indicator C-10031, and four each Circular Horn Antenna AS-3650. Antenna locations are illustrated on Figure 3-1. The countermeasures set provides aircraft protection against infrared-seeking missiles by detecting valid targets and sending pulses to Flare Dispenser M-130. Decoy flares are then launched away from the aircraft. Power to operate the countermeasures set is taken from the No. 1 DC primary and No. 1 AC primary buses through circuit breakers located on the copilot's circuit breaker panel (Figure 2-19).

4-28.2. Basic Principles of Operation. EH

Incoming and outgoing RF signals are routed between the circular horn antennas and the receiver transmitter through coaxial cables. The transmit signal is modulated and amplified in the receiver transmitter, and routed alternately to forward and aft antennas. After each pulse transmission, return signals are received by the same antenna used for transmission and routed to the receiver transmitter for processing. When an approaching missile is detected, the countermeasures set sends a pulse to Flare Dispenser M-130. If armed, the flare dispenser launches a decoy flare to draw the missile away from the aircraft.

4-28.3. Controls, Displays, and Functions. EH

Control Indicator C-10131, located on the instrument panel (Figure 2-8) to the right of the ECM ANTENNA switch, contains controls and status indicators for system operation. The control indicator front panel is illuminated by integral lighting. Controls and indicator of C-10131 are described below:

WARNING

During take-off, landing and ground operations, the ALQ-156 POWER switch must be in the OFF position. Failure to comply may cause inadvertant release of flares resulting in personal injury or damage to equipment.

CONTROL/ INDICATOR	FUNCTION
POWER switch	Places countermeasure set in operate (ON) mode. The switch is a positive-locking type and cannot be accidentally shut off. The switch must be pulled out and then down to turn off the countermeasure set.
TEST FLARE switch	Tests ALQ-156/M-130 systems and enables test flare launch in ON condition. The switch is a momentary depress-release type. It should be used only in conjunction with Flare Dispenser M-130 test procedures.
PUSH FOR STANDBY STATUS pushbutton	Places countermeasure set in standby or operate mode. When depressed, switch places system in standby mode and upper half of indicator shows STBY. In "out" position, switch places system in operate mode. During initial warmup, lower half of indicator shows WRMUP. After warmup, the indicator is blank to show that the system is on and ready for flare dispense.

4-28.4. Operation. EH

The following procedures shall be followed to operate the countermeasure set:

NOTE

Prior to beginning the turn-on procedure, ensure that the push for standby pushbutton is in the "out" position (not depressed).

WARNING

When the countermeasures set is on, electromagnetic radiation is present. Stand at least six feet from antennas. High frequency electromagnetic radiation can cause internal burns without causing any sensation of heat.

WARNING

When ALQ-156 POWER switch is ON, and the M-130 Flare system is armed, a flare can be fired.

a. M-130 Flare system ARM/SAFE switch SAFE (see Figure 2-7).

b. ALQ-156 POWER switch - ON. Observe that status indicator shows WRMUP, indicating that receiver transmitter is in warmup mode.

NOTE

The actual length of time that the WRMUP lamp remains on depends upon a combination of equipment operating status and environmental temperature. Under normal operating conditions, and with air temperature about 77°F (25°C), WRMUP lamp will go out in approximately 8 - 10 minutes.

c. Observe that WRMUP lamp goes out, indicating that the receiver transmitter is now in the on condition.

d. PUSH FOR STANDBY/STATUS pushbutton - Push once to place the countermeasure set in standby. Subsequent depressions switch the countermeasure set alternately from on to standby.

e. M130 flare system ARM/SAFE switch - ARM (Figure 2-7).

4-28.5. Stopping Procedure. EH

The following procedure shall be used to turn off the countermeasures set:

a. ALQ-156 POWER switch - OFF.

4-28.6. Countermeasures Set AN/ALQ-162(V)2. EH

Countermeasures set AN/ALQ-162(V)2 consists of Receiver Transmitter RT-1377, Control Unit C-11080, and two each Antenna AS-3554. Antenna locations are illustrated on Figure 3-1. The countermeasures set provides warning and protection against surface-to-air (SAM) and airborne interceptor missiles (AIM). Missile radar signals are detected by the system, modulated internally, and retransmitted as false, misleading echoes. Power to operate the countermeasures set is taken from the DC MON and No. 2 AC primary buses through circuit breakers located on the pilot's circuit breaker panel (Figure 2-19), refer to TM 11-5865-229-10.

4-28.7. Basic Principles of Operation. EH

Incoming signals received from SAM and AIM missiles using Continuous Wave (CW) for guidance are validated by the countermeasures set. Depending upon validation results, the system initiates jamming action and/or warns the crew of approaching missiles. Automatic jamming/warning decisions are determined by warning and jamming thresholds pre-programmed in the system. The countermeasures set may be used in stand-alone fashion or in conjunction with AN/APR-39(V)2 Radar Warning Receiver (RWR). The RWR processes and displays threat information. A Built-In Test (BIT) automatically and continually tests systems operations. Malfunctions cause a no-go lamp to light in the control unit front panel. The countermeasures set can be structured to counter different threats by programming the program module assembly in the front of the receiver transmitter. The programming is done before flight by the ground crew, as the receiver transmitter is not within operator reach.

4-28.8. Controls, Displays, and Functions. EH

Located in the center of the lower console, Control Unit C-11080 contains controls and indicators necessary for countermeasures set operation. The control unit is described below:

CONTROL/ INDICATOR	FUNCTION
VOLUME control	Controls tone generator volume. A tone is generated in the aircraft headset immediately upon threat detection.
BIT test switch	Initiates automatic and continuous Built-In-Test of countermeasures set operations.
Lamp test switch	Tests lamp functions of WRMUP, NO GO lamps.
Function switch	Controls countermeasures set operation. OFF removes power from the set. STDY provides warmup power but does not enable transmit-receive circuits. RCV turns on the receiver for maintenance testing of antenna, sensing, and processing circuits. OPR provides full operational power to both receiver and transmitter.
Warm up & No Go Lamps	Indicates countermeasures set status. WRMUP appears when unit is first turned on and goes out after approximately 3 minutes. NO GO will light if BIT operation detects a system failure.

4-28.9. Operation. EH

The following procedures shall be used to operate the countermeasure set under usual conditions:

WARNING

When the countermeasures set is operating, electromagnetic radiation is present. DO NOT OPERATE if personnel are within six (6) feet of transmit antennas. High frequency electromagnetic radiation can cause internal burns without causing any sensation of heat.

NOTE

A complete operational test consisting of a lamp test, operator-initiated BIT test, and a signal test is incorporated in normal operational procedures. The test shall be performed before flying any mission that requires use of the countermeasures set.

OPERATOR-INITIATED BIT TEST

NOTE

Before beginning step a, turn control unit VOLUME control fully clockwise.

a. Control unit function switch - STBY. Observe front panel and WRMUP lamps light. A tone should be heard briefly in the headset.

b. Lamp test switch - Press and observe all four lamps light in pushbutton switch.

NOTE

If the countermeasures set has been without power for 30 seconds or more, a 3 minute warmup period is required. Do not attempt operation of the unit until warmup is successfully completed.

c. WRMUP lamp - Check that lamp goes out after 3 minutes.

WARNING

The countermeasure set will radiate powerful, high-frequency electromagnetic energy when countermeasures set function switch is set to OPR. Ensure personnel are at least six feet from antennas while countermeasures set is in operate mode.

d. Control unit function switch - OPR.

e. BIT switch - Depress. A tone should be heard in the headset.

4-28.10. Stopping Procedure. EH

The following procedure shall be used to turn off the countermeasures set:

a. Control unit function switch - OFF.

Section II ARMAMENT

4-29. Armament Subsystem.

The subsystem is pintle-mounted in each gunner's window at the forward end of the cabin section (Figure 4-5). The two M60D 7.62 millimeter machineguns are free-pointing but limited in traverse, elevation, and depression field of fire. Spent cartridges are collected by an ejector control bag on the right side of the weapon. An ammunition can assembly is on the left side, refer to TM 9-1005-224-10.

4-30. Machinegun 7.62 Millimeter M60D.

The machinegun (Figure 4-6), is air-cooled, gas-operated and automatic. It uses standard 7.62 mm ammunition (Table 4-1). Headspace is fixed to permit quick change of barrels. Designed primarily for operation in the air, the M60D has an aircraft ring-and-post sighting system. The weapon is pintle-mounted and is held by a quick-release pin. The weapon mount is on a rotating arm assembly which allows the weapon to be locked outboard in the firing position, or stowed inside the aircraft when the rotating arms are locked in the inboard position. It is easily removed from the helicopter and can be used for ground defense with the bipod extended. For more detail of the M60D, refer to TM 9-1005-224-10.

4-31. Controls.

Controls for the M60D are on the weapon and consist of: barrel lock lever, safety, cocking handle, cover, latch grip and trigger and magazine release latch.

4-32. Barrel Lock Lever.

The lever (Figure 4-6) is at the right front of the receiver. It is attached to the barrel locking shaft and turns to lock or unlock the barrel assembly.

4-33. Safety.

The safety (Figures 4-6 and 4-7), at the lower front of the receiver, consists of a cylindrical pin with a sear clearance cut which slides across the receiver to block the sear and prevent firing. The ends of the pin are marked S (safe) and F (fire). The exposed letter shows the operating state of the weapon.

4-34. Cocking Handle.

The handle (Figure 4-6), at the right front of the receiver, is used to manually cock the weapon.

4-35. Cover Latch.

The latch (Figure 4-6) is at the right rear side of the cover assembly. When the latch lever is vertical it locks the cover in the closed position. When moved to the horizontal it unlocks the cover.

4-36. Grip and Trigger Assembly.

The assembly (Figure 4-6) at the rear section of the receiver, includes the spade grips. The U-shaped trigger design permits the weapon to be fired by thumb pressure from either hand.

4-37. Magazine Release.

The magazine release latch (Figure 4-6) is on the left side of the receiver. The latch spring automatically locks when the ammunition box is seated on the magazine bracket. Pressing the release latch manually releases the ammunition box.

4-38. Installation of Machinegun M60D.

NOTE

Use of M60D door gun is prohibited when the inboard vertical pylons are being utilized.

a. Install one machinegun M60D on the right side and one on the left side of the helicopter at the crew chief/gunner's stations.

b. Attach gun to pintle with quick-release pin, and safety by passing a plastic tie or 0.032-in. safety wire through quick-release ring and around the pintle (Figure 4-8).

c. Check that each gun moves freely in azimuth and can be depressed.

Table 4-1. Authorized Ammunition

7.62mm: NATO M59, Ball
7.62mm: NATO M61, Armor pierce
7.62mm: NATO M62, Tracer
7.62mm: NATO M63, Dummy
7.62mm: NATO M80, Ball

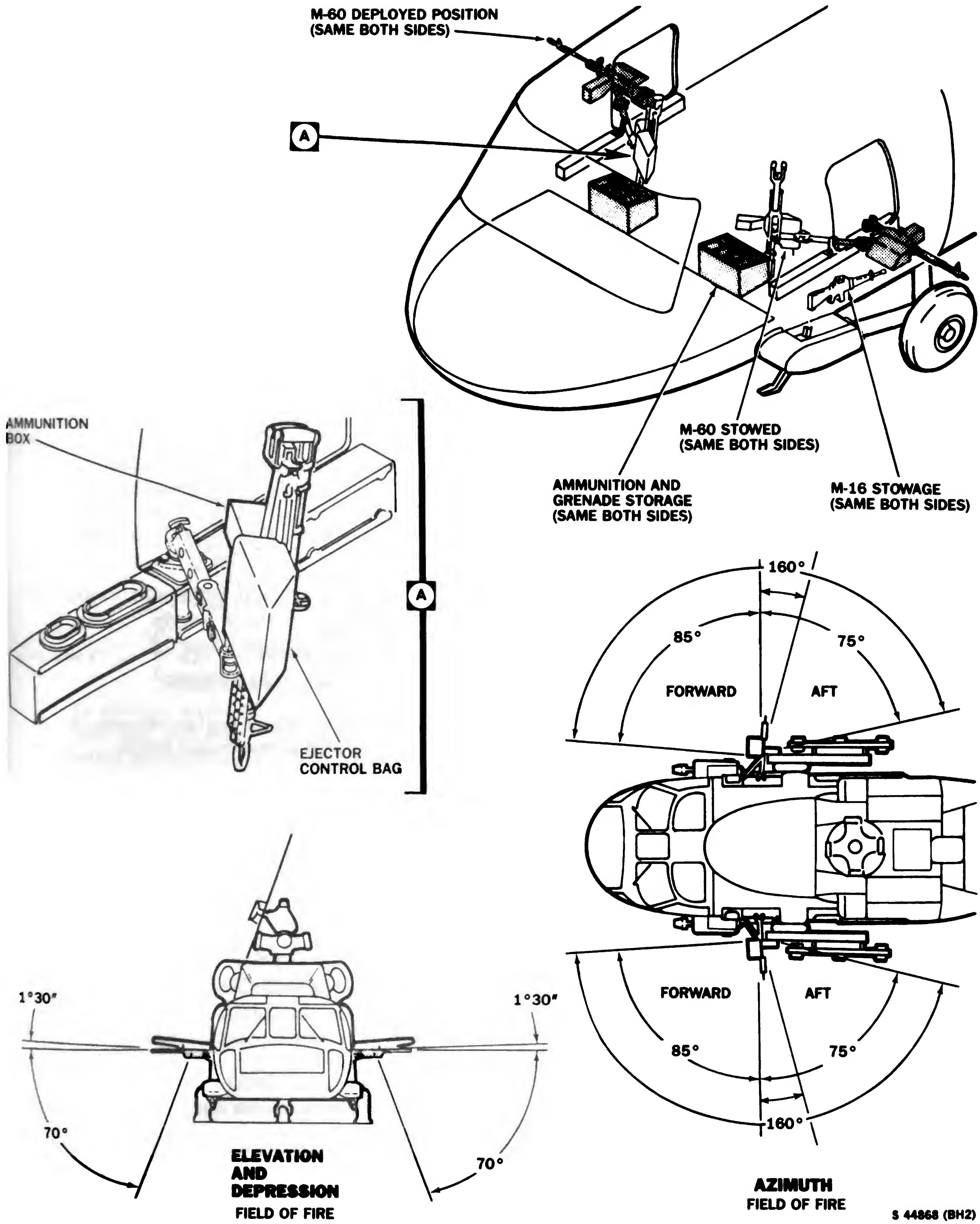

Figure 4-5. Machinegun M60D Installation

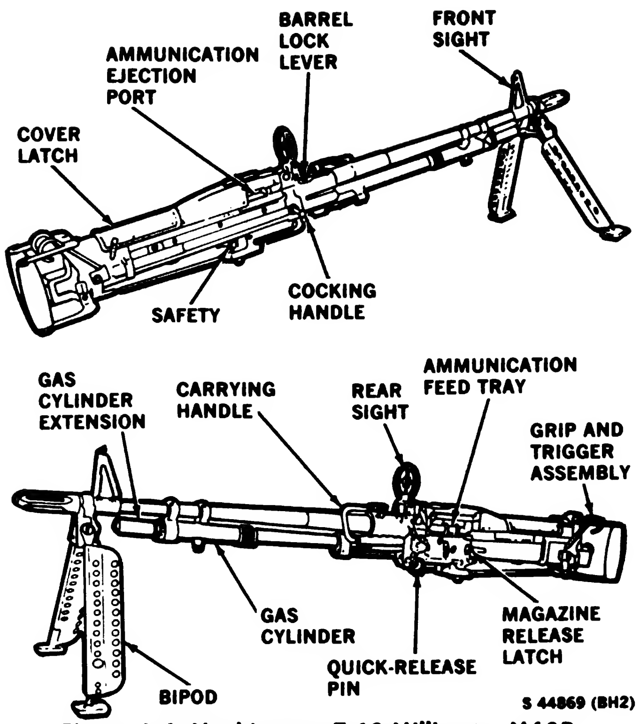

Figure 4-6. Machinegun 7.62 Millimeter M60D

d. Removal of gun is reverse of installation.

4-39. Installation of Ejector Control Bag.

a. Position bag on right side of gun (Figure 4-9).

b. Position forward arm bracket of bag in front of matching forward mounting point on gun adapter. At the same time, press down on rear bracket safety latch lever. Slide bag basket rearward on mounting points and plate.

c. Position rear bracket of bag behind mounting plate on bottom of receiver.

d. Release latch to lock bag in place.

e. Check bag for positive attachment to gun.

f. Removal of ejector control bag is reverse of installation.

4-40. Installation of Ammunition Can.

a. Open release latch and install can assembly (Figure 4-10).

b. Check that latch makes positive lock, holding can in place.

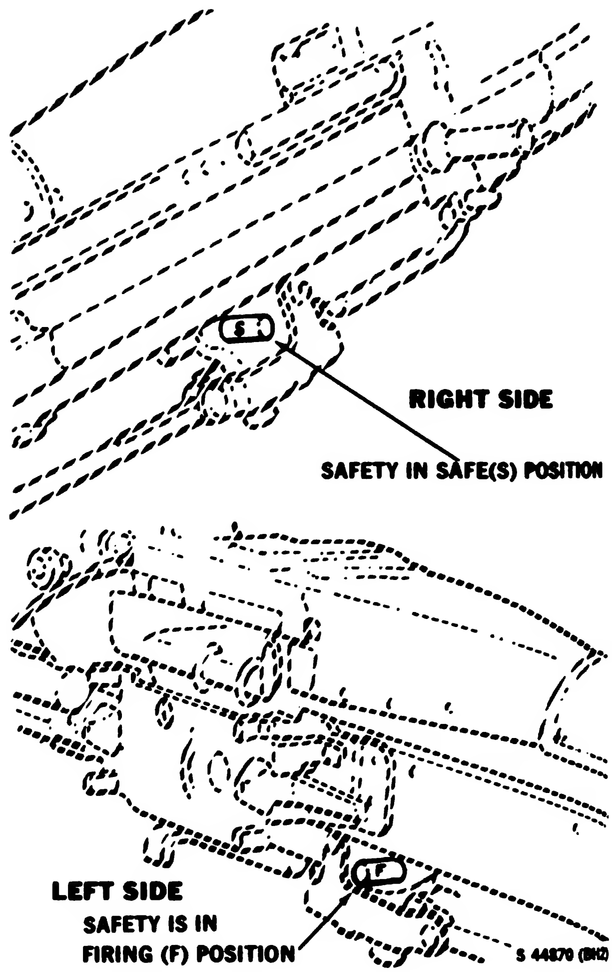

Figure 4-7. Location and Identification of Safety on Machinegun M60D

c. Removal of ammunition can is reverse of installation.

4-41. Loading Ammunition.

WARNING

Observe all safety precautions for uploading ammunition in accordance with TM 9-1095-206-13.

a. With ammunition can installed, retract bolt fully.

b. Press safety button to (S) position.

c. Open latch and raise cover assembly.

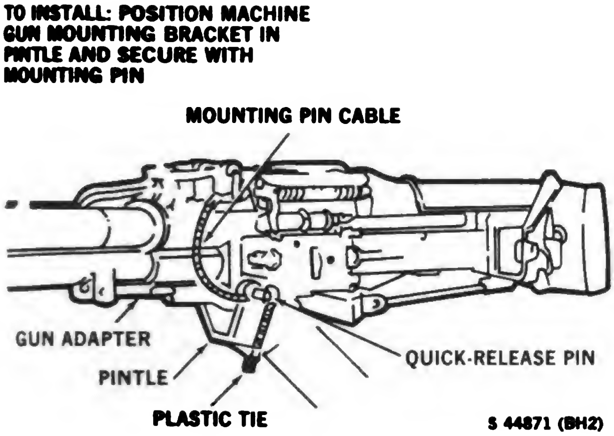

Figure 4-8. Installation of Machinegun M60D on Pintle

d. Insert link belt with open side of links down on tray assembly (Figure 4-11).

e. Close cover and latch in place.

4-42. Cocking Machinegun M60D.

WARNING

To prevent accidental firing, do not retract bolt and allow it to go forward if belted ammunition is in feed tray, or a live round is in chamber. Move cocking handle forward by hand.

a. Open ejector control bag and pull cocking handle fully to rear (Figure 4-12).

WARNING

Cocking handle assembly must be returned to full foward (locked) before firing.

b. Move cocking handle full forward to locked position.

c. Press safety button to (S) position (Figure 4-7).

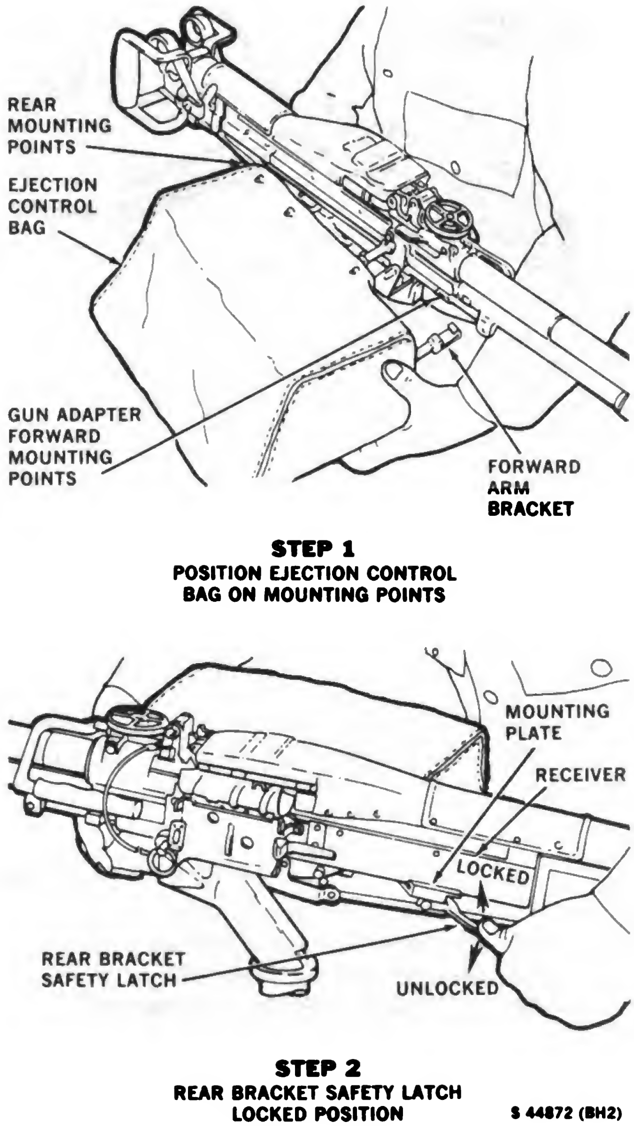

Figure 4-9. Installation of Ejector Control Bag on Machinegun M60D

CAUTION

Do not fire machinegun unless the ejector control bag is mounted in place.

a. With machinegun M60D positioned, loaded, and aimed, push safety button (Figure 4-7) to firing (F) position.

b. To fire gun automatically, press trigger fully and hold. See Figure 4-5 for field of fire.

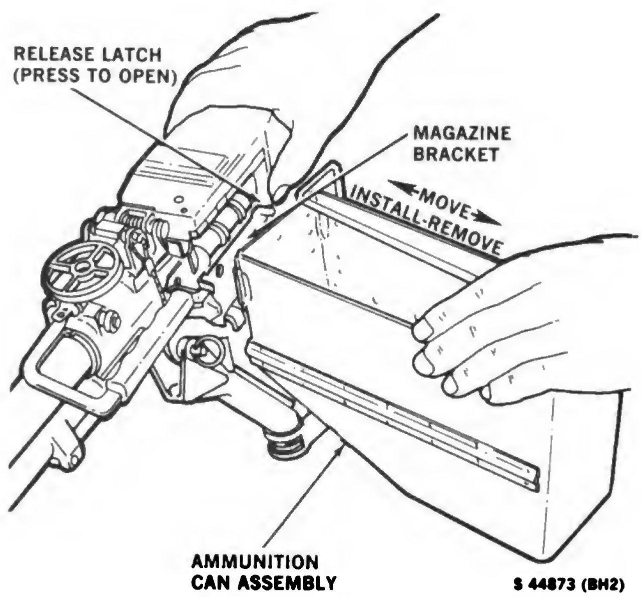

Figure 4-10. Installation and Removal of Ammunition Can on Machinegun M60D

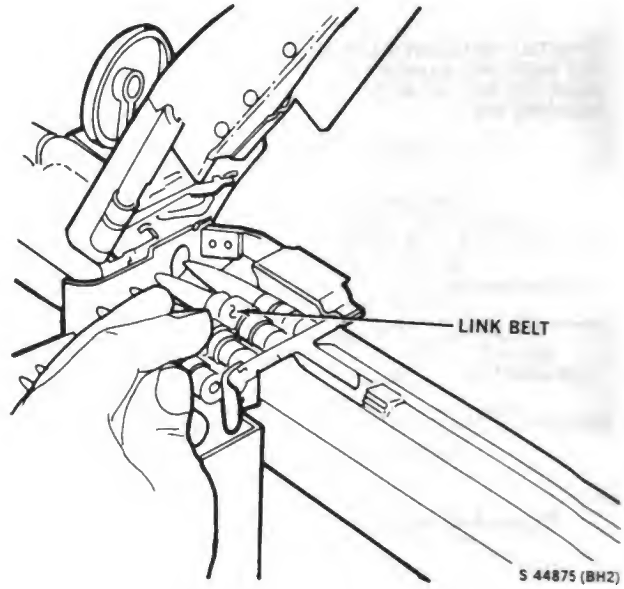

Figure 4-11. Positioning Cartridge Link Belt on Machinegun M60D

c. Low cycle rate of fire of machinegun M60D allows firing of single rounds or short bursts. Trigger must be completely released for each shot.

NOTE

When ammunition is exhausted, the last link will remain in tray assembly. The link assembly can be removed by hand after the cover assembly is opened for loading.

WARNING

If a stoppage occurs, never retract bolt assembly and allow it to go forward again without inspecting chamber to see if it is clear. Such an action strips another cartridge from belt. If an unfired cartridge remains in the chamber, a second cartridge can fire the first and cause injury to personnel and/or weapon damage.

4-43. Firing Malfunctions.

a. Misfire. This is a complete failure to fire. It must be treated as a hangfire until this possibility is eliminated.

b. Hangfire. This is a delay in functioning of the propelling charge. Time intervals set out in paragraph 4-43 must be observed after a failure to fire.

c. Cookoff. This is firing of the chambered cartridge from a hot barrel. A cookoff may occur from 10 seconds to 5 minutes after cartridge has been in contact with barrel.

d. Runaway Gun. If gun continues to fire after trigger has been released, grasp belt, twist and break belt, allowing the gun to run out of ammunition (usually when the belt is broken only 3 to 5 rounds will remain).

4-44. Failure to Fire Procedure.

a. If a stoppage occurs, wait 5 seconds. Pull handle assembly to rear, making sure operating rod assembly is held back.

b. If cartridge ejects, return handle assembly forward, re-aim machinegun, and attempt to fire. If machinegun does not fire, it must be cleared.

c. If cartridge does not eject, retract bolt assembly. Move safety button to SAFE (S), position. Remove ammunition and links and inspect receiver assembly. Move safety button to FIRING (F) and attempt to fire. If cartridge does not fire and barrel is considered hot enough to cause a cookoff (200 rounds fired within 2 minutes), wait 5 minutes with bolt assembly in forward position. Remove cartridge and reload. If weapon is not hot enough to cause a cookoff, disregard 5-minute wait.

4-45. Extracting a Ruptured Cartridge Case.

Position ruptured cartridge case extractor in chamber. Run cleaning rod through barrel assembly from muzzle end. Tap cleaning rod against extractor until extractor and ruptured cartridge case come out of chamber.

4-46. Double Feeding.

When a stoppage occurs with bolt assembly in forward position, assume there is an unfired cartridge in chamber. Treat this as a hangfire (paragraph 4-43b).

4-47. Unloading.

Raise cover assembly and remove linked cartridges. Inspect chamber.

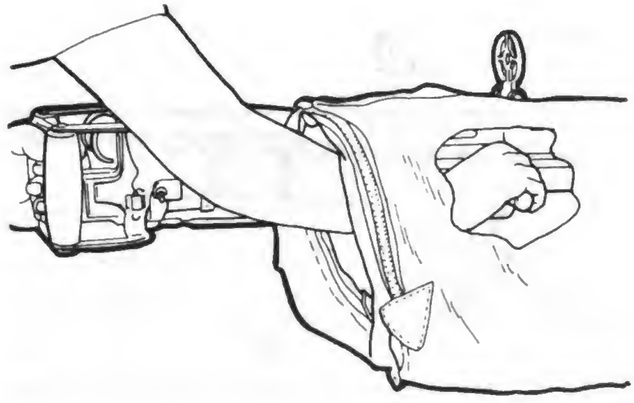

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Figure 4-12. Charging (Cocking) Machinegun M60D

4-48. Ammunition.

Ammunition for the machinegun is connected to form a link belt; the rounds are used to hold two links together. When a round is fired, the cartridge and link separate and is contained in the ejector bag assembly. Ammunition stowage in the cabin has compartments for six grenades and extra rounds of ammunition.

Section III CARGO HANDLING SYSTEMS

4-49. Cargo Hook System.

The system consists of a hook assembly configuration A or configuration B, (Figure 4-13) mounted on the lower fuselage, a control panel on the upper console (Figure 2-6), a normal release button on each cyclic stick grip, one emergency release switch on each collective stick grip, and a firing key in the cabin for use by the crew chief. The hook capacity is limited to a maximum of 8,000 pounds, and has a throat and load beam of adequate area and configuration to accommodate load attachments with nylon slings. The system incorporates three modes of load release, an electrical circuit actuated from the cockpit, a manual release worked by the crewmember through a covered hatch in the cabin floor, or by personnel on the ground, and an emergency release system using an electrically-activated explosive charge.

4-50. Cargo Hook Stowage.

The cargo hook shall be maintained in the stowed position during periods of non-use. The cargo hook can be placed in a stowed position (Figure 4-13) by opening the cargo hook access cover in the cabin floor, and pulling the hook to the right and up. When the hook is in the stowed position, the load beam rests on a spring-loaded latch assembly and is prevented from vibrating by a Teflon bumper applying downward pressure on the load beam. To release the hook from its stowed position, downward pressure is placed on the latch assembly lever, retracting the latch from beneath the load beam, allowing the cargo hook to swing into operating position. Stowage of configurations A and B is the same.

4-51. Cargo Hook Control Panel.

The CARGO HOOK control panel (Figure 4-13), on the upper console, consists of an EMER RLSE NORM, OPEN, SHORT test switch, a TEST light, CONTR CKPT or ALL station selector switch and an ARMING, SAFE, ARMED switch. Before the normal release (electrical) can operate, the ARMING switch must be at ARMED to provide electrical power to the release switches. The pilot and copilot CARGO REL switches, on the cyclics, will release the load when the

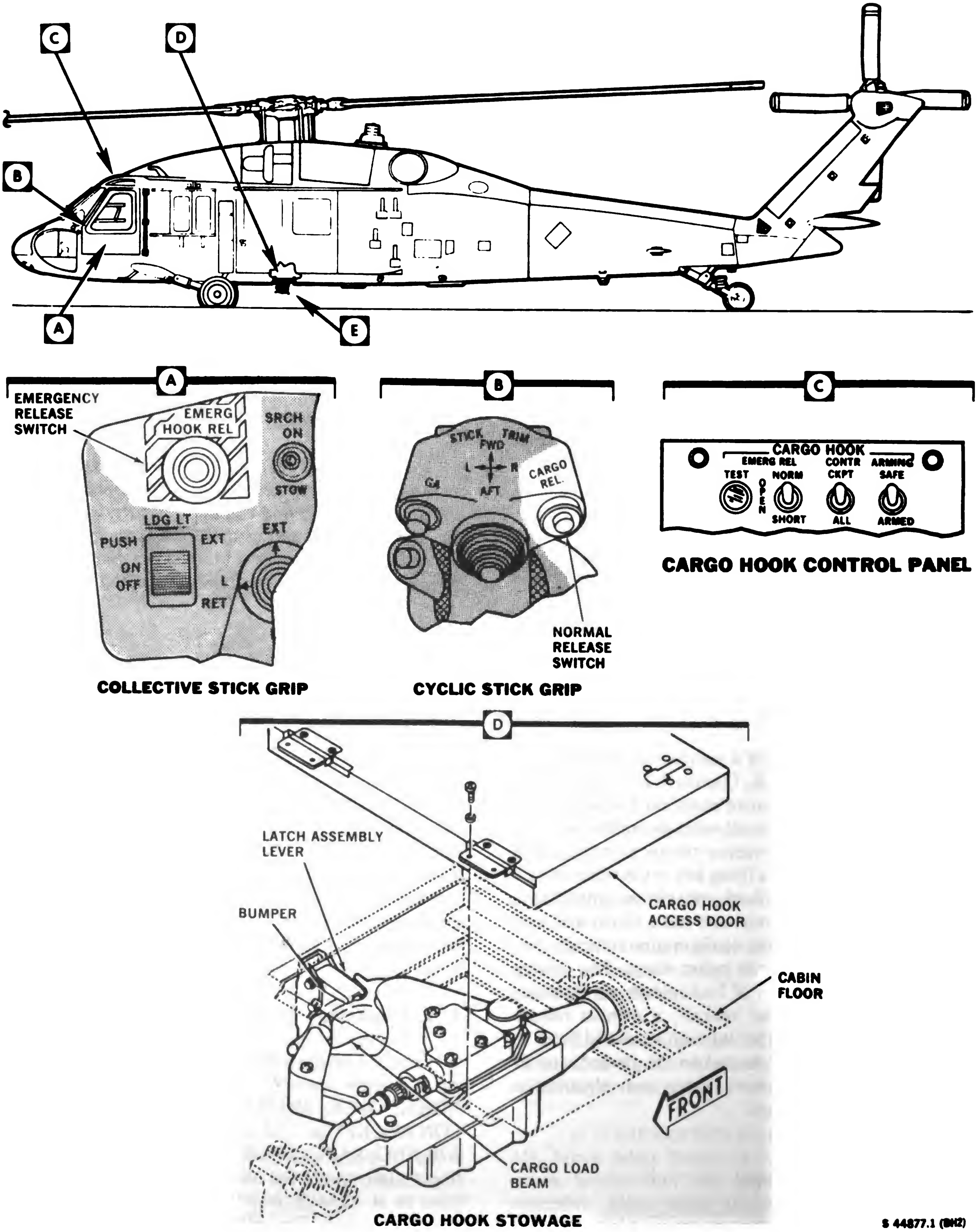


Figure 4-13. Cargo Hook System (Sheet 1 of 2)

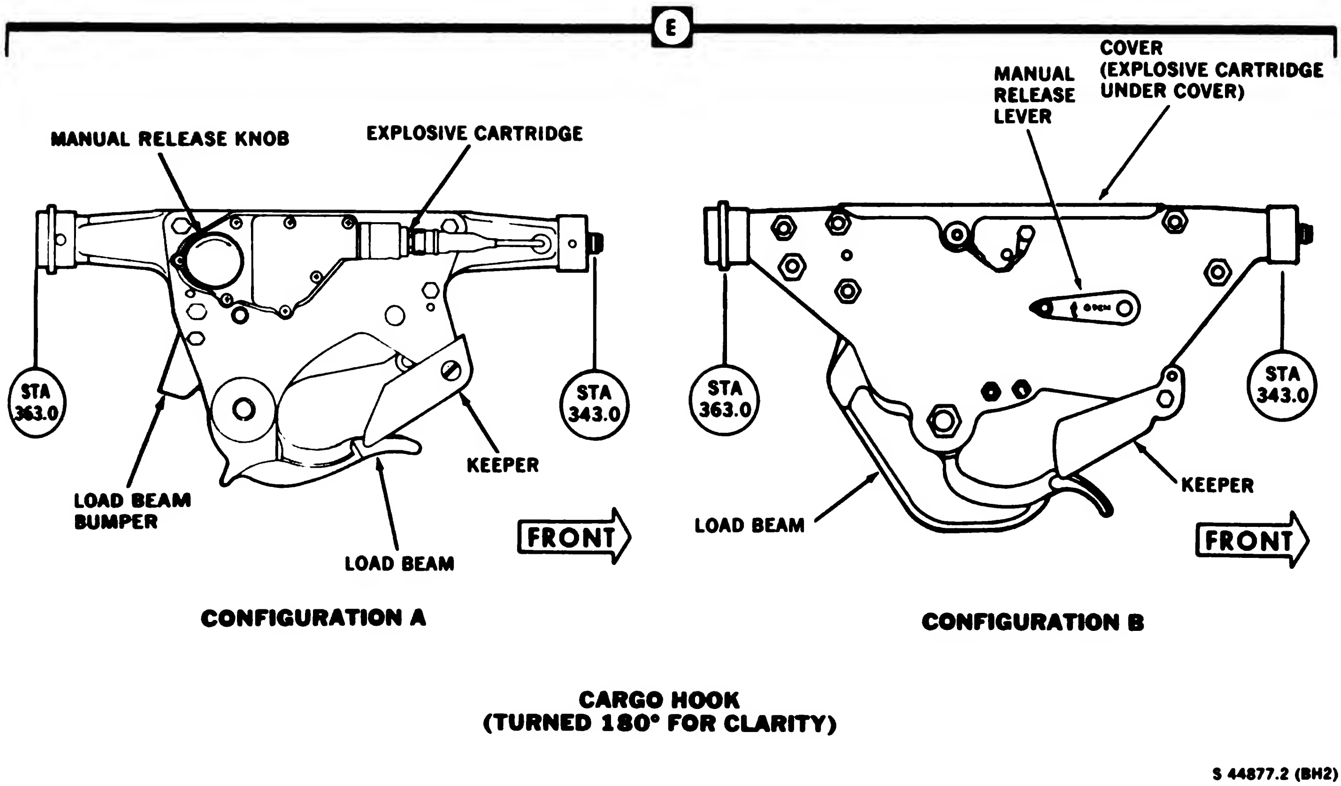


Figure 4-13. Cargo Hook System (Sheet 2 of 2)

CONTR switch is at CKPT or ALL. The crewmember's NORMAL RLSE switch will release the load when the CONTR switch is at ALL. The EMER RLSE switch and TEST light permits checking the emergency release circuit when at SHORT or OPEN. In both cases of testing, if the release circuit is good, the TEST light will go on when the EMERG REL switch on pilot's or copilot's collective, or the EMER REL switch on the crewmember's pendant, is pressed.

4-52. Crewmember's Cargo Hook Control Pendant.

The crewmember's cargo hook control pendant (Figure 4-14), in the aft cabin, provides the crew chief with an electrical release and jettison of an external load when the CARGO HOOK CONTR switch is placed to ALL. The NORMAL RLSE and EMER RLSE switches are covered by guards to prevent accidental activation. When the cover is raised the switch can be pressed. When not in use, the pendant is stowed in the stowage bag at the back of the pilot's seat. Electrical power to operate the pendant is provided from the No. 2 dc primary bus through a circuit breaker, marked CARGO HOOK CONTR.

4-53. Normal Release.

Normal release of external cargo with configuration A or B is done by pressing the CARGO REL switch on either cyclic stick grip or the CARGO HOOK NORMAL RLSE on the crewmember's cargo hook pendant, after placing the CARGO HOOK ARMING switch to ARMED. A light on the advisory panel will go on, indicating HOOK ARMED. This informs the pilot that electrical power is applied to the control circuit; the actuation of any of the release switches will release the load. When the CARGO REL switch is pressed and the release solenoid begins to move, a switch closes, lighting the CARGO HOOK OPEN advisory light. The load arm will swing open, releasing the cargo. When the sling is detached from the load

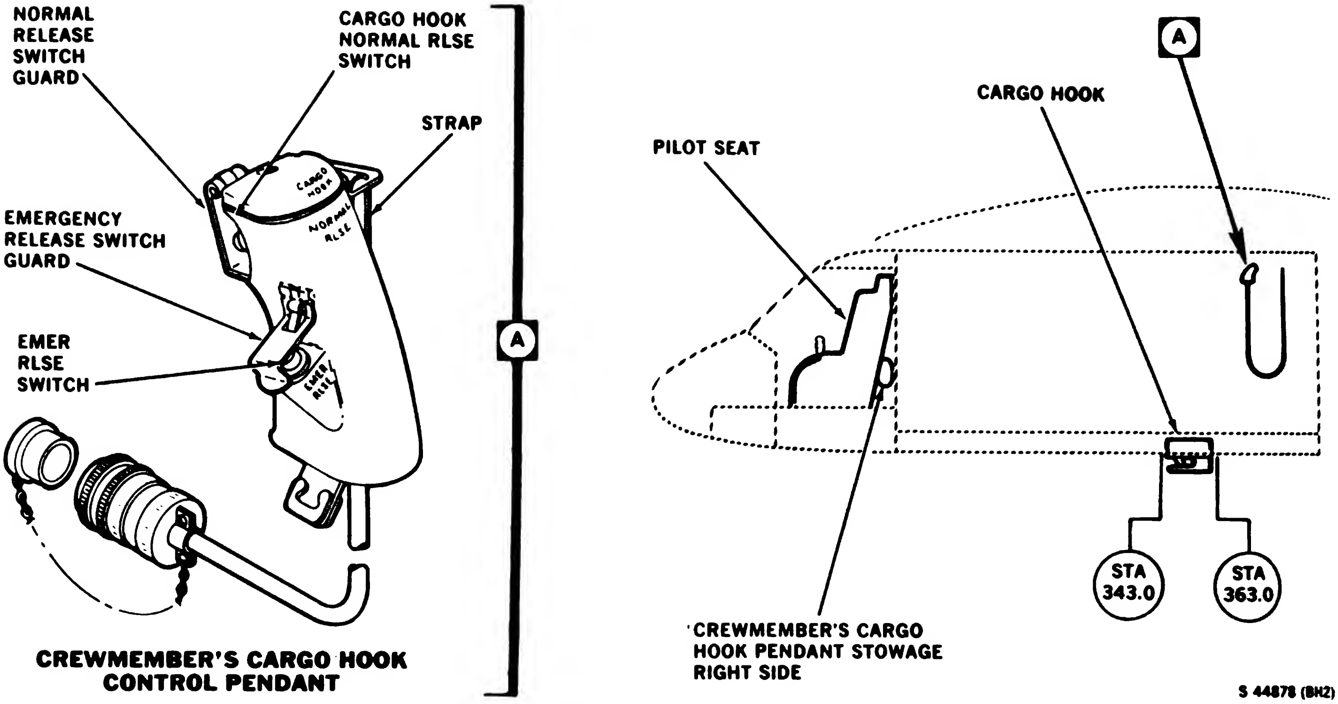


Figure 4-14. Crewmember's Cargo Hook Control Pendant UH

beam, spring tension on the arm will cause it to close and relatch, putting out the CARGO HOOK OPEN advisory light. The normal release system is a one-shot cycle; once the solenoid travel begins and the load arm relatches, the release cycle can again be initiated. Power to operate the normal release system is supplied from the No. 2 dc primary bus through circuit breakers marked CARGO HOOK CONT and PWR.

4-54. Operational Check - Normal Release Mode.

1. CARGO HOOK CONTR Switch - As required. CKPT for pilot and copilot check, or ALL for crewmember check.

2. CARGO HOOK ARMING switch ARMED.

3. HOOK ARMED advisory light - On.

4. Place about 20 pounds downward pressure on load beam.

CAUTION

Cargo hook release solenoid will be damaged if cargo hook release button is pressed more than 12 seconds.

5. CARGO REL switch (Pilot and Copilot); NORMAL RLSE (crewmember) - Press and release.

6. CARGO HOOK OPEN advisory light - On.

7. CARGO HOOK OPEN advisory light - Off when hook closes.

8. Repeat steps 4. through 7. for copilot and crewmember position.

4-55. Manual Release.

Manual release of external cargo can be done from the cabin, through a covered port in the floor, or by ground personnel from outside the helicopter, with power on or off. Turning the release control on the right side of the hook (Figure 4-13) clockwise, causes the latching mechanism to release the load beam. The load beam will not move unless a downward pressure is exerted to cause opening. With power applied to the helicopter and the CARGO HOOK ARMING switch at ARMED, the CARGO HOOK OPEN advisory light will go on at the start of release control turning, and will remain on until the load beam closes and latches for configuration A, and will go off at the end of release control rotation for configuration B.

4-56. Operational Check - Manual Release Mode.

1. Manual release lever spring - Installed. Check that spring is straight and provides positive pressure on the lever.

2. Place about 20 pounds downward pressure on load beam.

3. Manual release control - Pull up/turn fully clockwise and release.

4. Load beam - Check open.

5. CARGO HOOK OPEN advisory light - On.

6. When downward pressure is released, load beam will close and latch.

7. CARGO HOOK OPEN advisory light - Off when hook closes.

4-57. Emergency Release Circuit Tester.

The cargo hook emergency release circuit tester (Figure 2-6) marked CARGO HOOK EMERG REL on the upper console, contains a test light and switch. The test light, marked TEST, goes on during circuit testing to indicate the system is functioning properly. The switch, with marked positions NORM, OPEN, and SHORT, is normally at NORM. When the tester switch is placed to OPEN or SHORT and the cargo EMERG HOOK REL switch on the pilot's or copilot's collective, or EMER RLSE switch on the crewmember's cargo hook control pendant is pressed, the circuit tester light will go on if the circuit is good.

4-58. Cargo Hook Emergency Release Circuit Check.

1. EMERG REL TEST light - Press. Light should be on.

NOTE

To prevent unintentional discharge of the cargo hook explosive cartridge, the pilot shall call off each procedural step of the emergency release circuit test before that step is done. Station being checked shall reply to pilot's command.

2. Pilot's release - Check.

a. Short test.

(1) CARGO HOOK EMERG REL switch - SHORT.

(2) Pilot's EMERG HOOK REL button - Press and hold.

(3) CARGO HOOK TEST light - On.

(4) EMERG HOOK REL button - Release. TEST light off.

(5) Repeat steps (2) through (4) for copilot's EMERG HOOK REL button, and crewmember's cargo hook control pendant EMER RLSE button.

b. Open test.

(1) CARGO HOOK EMER REL switch - OPEN.

(2) Pilot's EMERG HOOK REL button - Press and hold.

(3) CARGO HOOK TEST light - On.

(4) EMERG HOOK REL button - Release. TEST light off.

(5) Repeat steps (2) through (4) for copilot's EMERG HOOK REL button, and crewmember's cargo hook control pendant EMER RLSE button.

3. CARGO HOOK EMERG REL switch NORM. If the cargo hook is not to be used immediately after completing the circuit test check, the EMERG REL switch shall remain at OPEN until ready for load pickup.

4-59. Emergency Release.

NOTE

When the emergency hook release has been used and a replacement squib (explosive cartridge) is not available, the hook can not be used until the explosive device is replaced, since the hook load beam will not close and lock.

Emergency release of an external cargo load is done by an electrically-fired explosive cartridge, initiated from either of the collective stick grip switches, marked EMERG HOOK REL, or the crewman's cargo hook control pendant, marked EMER RLSE. The emergency release is used when the electrical and manual releases are inoperative, and the load must be jettisoned. With the CARGO HOOK EMER RLSE switch at NORM, power will be applied to the emergency release switch. Pressing the switch applies 28 vdc to the explosive cartridge, producing a high gas pressure to drive a piston in the lock assembly, releasing the load arm lock. The weight of the load will cause the load arm to open. Once the emergency release is used, the hook will remain open and the CARGO HOOK OPEN advisory light will remain on until the explosive cartridge device is replaced. When the explosive cartridge device is replaced the load arm will close, the light will go off, and the emergency release mode is returned to operation. Power to operate the emergency release system is from the dc essential bus through a circuit breaker, marked CARGO HOOK EMER.

4-60. Preflight.

When cargo hook loads are to be carried, checks within this paragraph and procedures of paragraphs 4-61, 4-62, 4-63 and 4-64 apply.

1. Cargo hook - Check condition, security and explosive cartridge installed.

2. Emergency release system - Check. (Go to paragraph 4-57.)

3. Manual release - Check. (Go to paragraph 4-55.)

4-61. Before Takeoff.

1. CARGO HOOK EMERG REL switch - NORM.

2. CARGO HOOK ARMING switch - ARMED.

4-62. Emergency Release Procedure.

1. Pilot or Copilot EMERG HOOK REL or Crewman's Control pendant EMERG REL - Press.

2. CARGO HOOK OPEN advisory light - On until the explosive cartridge is removed and replaced for configuration A, off for configuration B.

4-63. In-flight Procedures.

CAUTION

Cargo suspended from the cargo hook should not be over a 30° cone angle. To prevent damage to the cargo hook keeper, the pilot shall use extreme care to prevent placing load pressure on the keeper.

CARGO HOOK ARMING switch - As required. ARMED for low altitude/low airspeed. SAFE at cruise altitude and airspeed.

4-64. Before Landing.

CARGO HOOK ARMING switch - ARMED.

Section IV MISSION FLEXIBLE SYSTEMS

4-65. Mission Readiness Circuit Breaker Panel.

The mission readiness circuit breaker panel (Figure 2-19) is on the No. 1 electrical junction box in the cabin, and contains all required circuit breakers for mission equipment.

4-66. Rescue Hoist System Kit.

The high performance, two speed rescue hoist (Figure 4-15) is post-mounted in the cabin on the right side of the helicopter when installed. The hoist system consists of modular components, electrically-driven and electronically-controlled, to provide maximum lift capacities of 300 pounds at 0-250 feet-per-minute and 600 pounds at 0-125 feet-per-minute. The heaviest weight that may be suspended from the hoist is 600 pounds. A speed mode switch at the back of rescue hoist control panel assembly on the hoist support assembly, provides a selection of either SLOW speed (0-125 feet-per-minute), or FAST speed (0-250 feet-per-minute). The hoist motor mounted at the top of the pole provides selectable 125 or 250 feet-per-minute reel-in and reel-out drive of a 250-foot hoist cable. A fail safe mechanism limits the induced loading to the hoist to 1200 pounds at all times. A continuously running circulating fan cools the hoist motor. The hoist is controlled through a lower console mounted RESCUE

HOIST CONTROL panel and/or crewman's control pendant grip in the cabin. A hoist cable cutter system is used to cut the hoist cable in case of emergency, by exploding a squib-actuated cable-cutter. The cut cable then drops free of the hoist boom. Power to operate the rescue hoist system is from the No. 2 primary dc bus through a circuit breaker on the mission readiness circuit breaker panel, marked RESQ HST. Power for the cable cutter system is from the essential dc bus through a circuit breaker, marked HOIST CABLE SHEAR. Refer to Table 2-2 for servicing.

4-67. Controls and Function.

The RESCUE HOIST CONTROL panel (Figure 4-15) was all necessary controls for operating the hoist from the cockpit, and contains the system MASTER switch, controlling ON or OFF for both cockpit and cabin. The hoist will respond to the first control signal received.

CONTROL/ INDICATOR	FUNCTION
BOOM switch	Swings hoist boom in or out from cockpit. Static position, removes electrical power from hoist boom positioning motor.
OFF	
IN	Provides power to boom motor to position boom inboard from cockpit.
OUT	Provides power to boom motor to position boom outboard from cockpit.
MASTER switch	Selects control point for hoist operation.
OFF	Disconnects all electrical power from hoist operating controls.
ON	Provides power to both cockpit controls and crewman's pendant for hoist operation.
CABLE	Provide cable up or down control from cockpit.
OFF	Static position, removes electrical power from hoist reel motor for cockpit operation.
UP	Provides power to hoist reel motor to reel in cable operation from cockpit at 250 feet-per-minute only.
DOWN	Provides power to hoist reel motor to reel out cable operation from cockpit at 250 feet-per-minute only.
SQUIB switch	Selects either TEST or NORM operation.
TEST	Checks condition of CABLE SHEAR circuit through squib to indicate circuit is complete.
NORM	Places squib circuit in a ready for fire condition.
IND	Lights when test of CABLE SHEAR circuit through squib is good.
CABLE SHEAR switch	Controls cable cutter firing circuit.
FIRE	Directs electrical power to cable cutter squib for shearing hoist cable.
SAFE	Removes electrical power from cable cutter circuit.

4-68. Boom Assembly Module.

The boom assembly module consists of the boom structure boom head, up limit switch, cable-cut device, and a cable guide, all installed in the boom. The boom

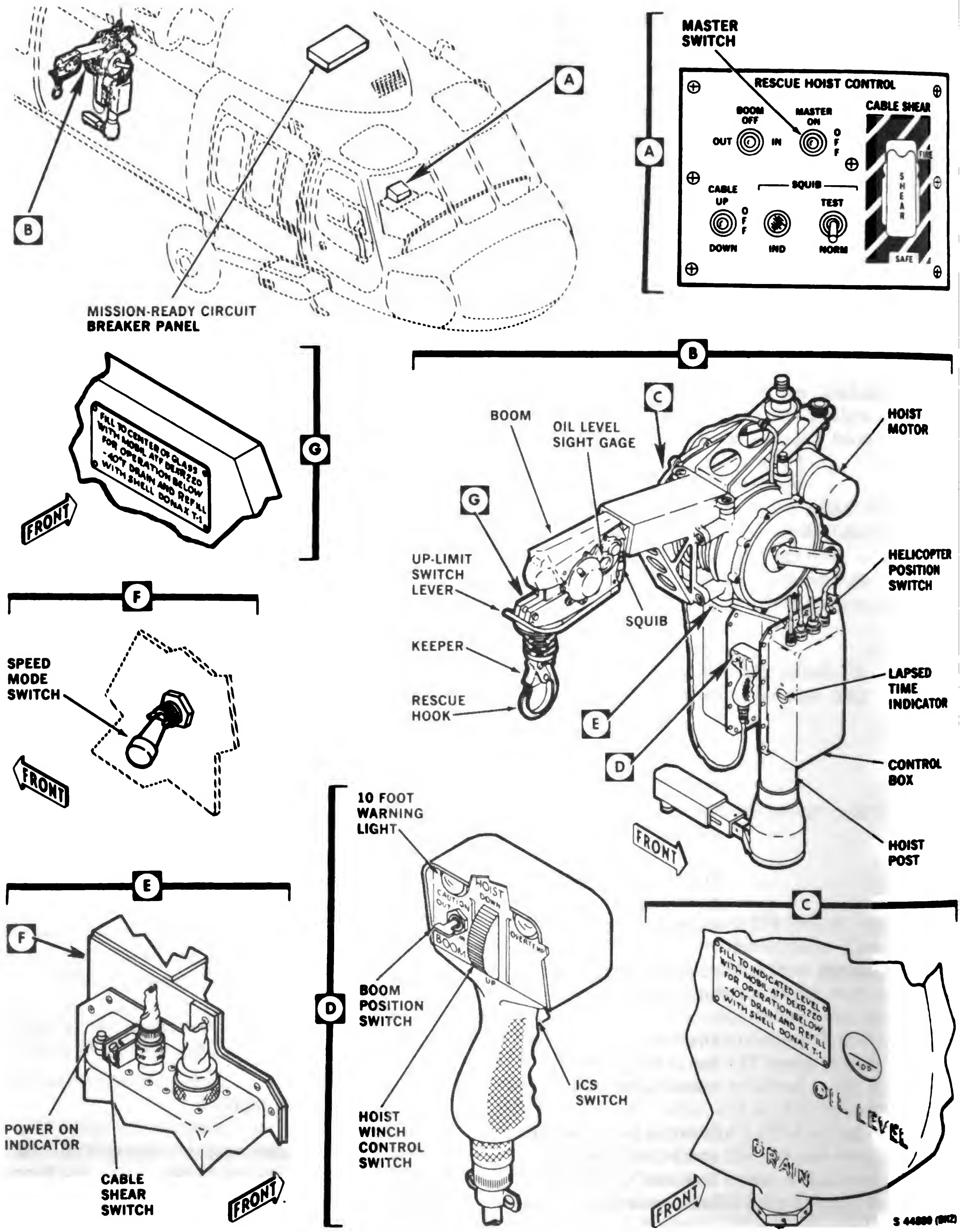


Figure 4-15. Rescue Hoist Kit UH

head is allowed to swivel 65° above the boom cable and 30° from side-to-side and guide the cable to wrap or unwrap from a 30° cone angle. The upper limits of cable control includes an automatic means for decelerating the cable to 67 feet-per-minute cable speed. At 8 to 10 feet below the boom head, a caution light on the crewman's control pendant marked CAUTION will go on. The cable will again decrease speed to 12 feet-per-minute at 12 to 18 inches below the boom head.

4-69. Limit Switches.

Four limit switches are actuated by actuation assembly cams. They are: a down all stop, that actuates when 250 feet of cable is reeled out; a down limit switch, that actuates at 247 feet, to provide deceleration; a 10-foot caution switch that actuates when the hook is within 10 feet of the boom head or within 10 feet of the down limit (240 feet); and an up deceleration switch, that actuates when the cable hook is within 12 inches of the boom head.

4-70. Crewman's Control Pendant Grip.

The crewman's control pendant grip (Figure 4-15) is a hand-held control in the cabin. The pendant grip is connected to the control box by a cable connector. The control pendant contains three switches and two caution/warning lights, HOIST cable control, BOOM positioning, and ICS OVERTEMP and cable 10-foot CAUTION light. The HOIST control is a directional and variable speed spring loaded to center switch, with marked positions of OFF, UP and DOWN. As the switch is moved further away from OFF, the hoist speed increases in the marked direction. When the switch is released the hoist will stop. The BOOM position switch, with marked positions OUT and IN, operates in the same manner as the HOIST switch, except the boom moves in or out at a single speed. Two lights are installed on the crewman's control pendant. They are: The 10-foot CAUTION light to warn the crewman whenever the hoist cable is 10 feet or less from the all stop limits. A red OVERTEMP light that warns the crewman of an overtemperature condition in either the hoist lubrication systems or the hoist motor. Whenever the OVERTEMP light is on, the hoist should be allowed to cool down until the light goes off. The ICS control switch, on the front of the pendant, provides the operator with inter-helicopter communication.

4-71. Cable Shear System.

A cable shear feature releases a rescue hoist load in case of an emergency. The system consists of a squib-actuated cable cutter, a CABLE SHEAR switch on the pilot's control panel and a shear switch at the hoist assembly and a SQUIB test circuit. The cutter may be fired by the pilot or the copilot from the SHEAR switch on the control panel (Figure 4-15) or by the hoist operator using the CABLE-CUT switch on top of the control box. The SQUIB test circuit consists of a TEST-NORM switch and a test good IND light. When the SQUIB switch is at NORM and the SHEAR switch is placed to FIRE, electrical power is sent to the dual squib for firing. The exploding cartridge then drives a cutter into the hoist cable and shears it. The rescue hoist cable shear feature is operational whenever power is applied to the helicopter. Once fired, a replacement cable cutter kit and cable must be replaced. Power to operate the cable shear is provided from the dc essential bus, through a circuit breaker marked HOIST CABLE SHEAR.

4-72. Operation.

4-72.1. Preflight (If use is anticipated).

1. Check oil level:

a. Release reaction arm and pivot hoist to operating position.

b. Check oil level in hoist and boom head.

c. Return hoist to stowed position and secure reaction arm.

2. Check upper attachment.

3. Check lower attachment (mounting plates, pip pins, and star plate).

4. Check position switch (positions 2 and 4).

5. Insure hoist main power cable cannon plug is saftied at junction box.

6. Cable cut switches - Down and saftied

7. Make sure metallic shorting strip is removed from cable cut cannon plug.

8. Cable cutter connector attached.

9. Check recovery devices are functional and complete. Make sure recovery devices are secure.

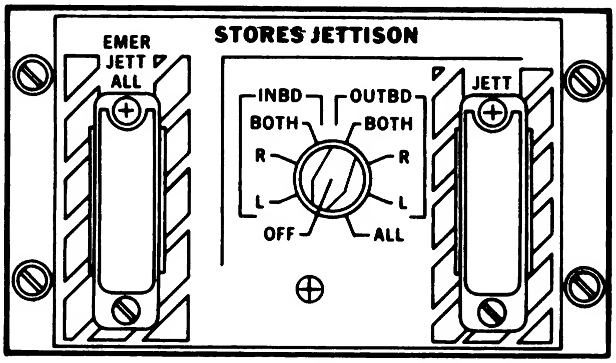


Figure 4-16. Stores Jettison Control Panel ES

10. Hoist Control Circuit Breaker - In (mission essential circuit breaker panel).

NOTE

To test boom position and hoist cable reel in and out, refer to paragraph 4-74.

4-73. Rescue Hoist Test.

To test the squib circuit, do this:

1. SQUIB switch - Hold at TEST.

2. SQUIB IND light - On.

3. SQUIB switch - Release to NORM.

4-74. Boom Position and Hoist Cabin Control Operation.

To position the rescue hoist inboard or outboard, do this:

1. MASTER switch - ON.

2. BOOM switch on RESCUE HOIST control panel - IN and OUT as required.

3. Repeat step 2 using crewman's control pendant.

To reel in or out hoist cable, do this:

4. CABLE control switch on RESCUE HOIST CONTROL panel UP and DOWN (crewman's control pendant grip) as required one at a time. Release when reaching desired position.

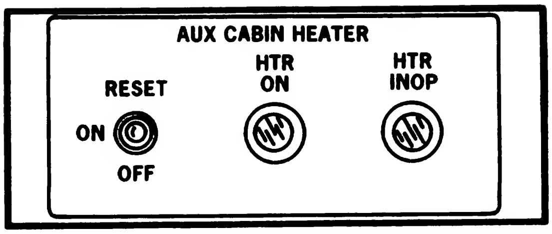
5. Repeat step 4 using crewman's control pendant HOIST switch.

4-75. Stopping.

MASTER switch - As desired.

4-75.1. Auxiliary Electrical Cabin Heater. (On helicopters equipped with auxiliary cabin heater kit.)

A 55,000 BTU/hr electrical auxiliary cabin heater is installed in the transition section to provide an increase in cabin temperature in extremely cold environments. The auxiliary heater system consists of a heater control panel on the lower console replacing the retransmission control panel when the heater kit is installed (Figure 4-16.1), a blower and electrical heater unit in the transition section, a heater inlet port on the cabin aft bulkhead (Figure 2-5), a temperature control located under the left gunner's window, and ducting throughout the cabin. The auxiliary heater system is turned on from the cockpit by a switch, marked OFF-ON-RESET on the AUX CABIN HEATER control panel. With both main generators operating and AUX CABIN HEATER switch ON, the HTR ON light on the control panel will go on indicating that power is applied through the heater control relay to the duct temperature sensor and to the blower motor and cabin heater elements. If a heater unit overheats, an element thermostat circuit will automatically open, causing the heater to shut off. When the element cools, the AUX CABIN HEATER switch must be momentarily placed at RESET to restore the system. A heater outlet duct cycling thermostat is also provided at the air outlet side of the heater. If duct temperature exceeds 82° ± 8°C, the temperature sensor contacts will open, temporarily interrupting power to the heater elements. On decreasing temperature, the contacts will automatically reset to closed at 77° ± 8°C to restore power. A redundant duct overheat sensor/shutoff switch is installed next to the duct cycling thermostat to shut off power to the heater elements if the delivered air flow temperature exceeds 99° ± 8°C due to heater cycling sensor failure.



(ON HELICOPTERS EQUIPPED WITH AUXILIARY CABIN HEATER)

LOWER CONSOLE

UH60/EH60A 112050 (BH18)

Figure 4-16.1. Auxiliary Cabin Heater Control Panel

sensor switch contacts reset closed on decreasing temperature. However, the cockpit heater panel switch must be momentarily placed at RESET to restart system operation. Heated air is carried through the cabin via ducts along each side of the cabin at the ceiling. Power to operate the auxiliary cabin heater elements is provided from the No. 1 ac primary bus through the No. 1 junction box and protected by current limiters. Blower power is provided from the No. 2 ac primary bus and protected by a circuit breaker, marked AUX HTR BLOWER. Control of both heater elements and blower is provided by power from the No. 1 dc primary bus through a circuit breaker, marked AUX HTR CONTROL.

4-76. Rotor Blade Deice Kit.

Refer to Chapter 2 for description and operation of the Blade Deice Kit.

4-77. External Extended Range Fuel System Kit. ES

The external extended range fuel system is supported by the external stores support system extending horizontally from each side of the fuselage aft of the cockpit doors (Figure 4-17). 230-gallon and 450-gallon jettisonable tanks may be suspended from the vertical stores pylons (VSP). Removable fuel lines, bleed-air lines, valves, and electrical connectors are within the horizontal stores supports (HSS). A tank pressurizing system, using bleed-air, transfers fuel to the main tanks. Fuel lines carrying fuel to the No. 1 and No. 2 main fuel tanks contain check valves to prevent backflow. The extended range system cannot supply fuel directly to the engines; they must be used to replenish the fuel to the main tanks only. The external tanks are gravity refueled only. Defueling is done by inserting a suction hose into the refuel port and sucking fuel from the tank, or gravity defueling by opening the sump drain valve. Control of the system is provided by a control panel on the aft part of the lower console. Power to operate the fuel transfer system is provided from the NO. 1 DC PRI BUS through circuit breakers marked EXT FUEL XFER LH, and from the NO. 2 DC PRI BUS through a circuit breaker marked EXT FUEL XFER RH and NO. 2 XFER and from the NO. 2 AC PRI BUS through a circuit breaker marked AUX FUEL GAGE on the mission readiness circuit breaker panel.

4-78. External Range Fuel Transfer Modes. ES

Fuel can be transferred from external tanks to main tanks in either of two modes, AUTO MODE or MANUAL. AUTO (primary) transfers fuel automatically after switches are manipulated. Fuel transfer will be managed by the microprocessor as described in paragraph 4-82. The pilot need only occasionally monitor the AUXILIARY FUEL MANAGEMENT panel to ensure that during AUTO MODE of fuel transfer, fuel in external tanks is decreasing as it should. The second mode of transfer is the MANUAL XFR (secondary) mode. In the MANUAL mode the pilot may replenish main tank fuel in any quantity or frequency desired. Transfer must be initiated by the pilot. The pilot must constantly monitor the fuel quantity indicator in order to start and terminate transfer to remain within CG limits. It is possible to transfer fuel from any one tank while in MANUAL mode. Transfer is shut off by the pilot when the external tank low-level sensor signals that the tank is empty.

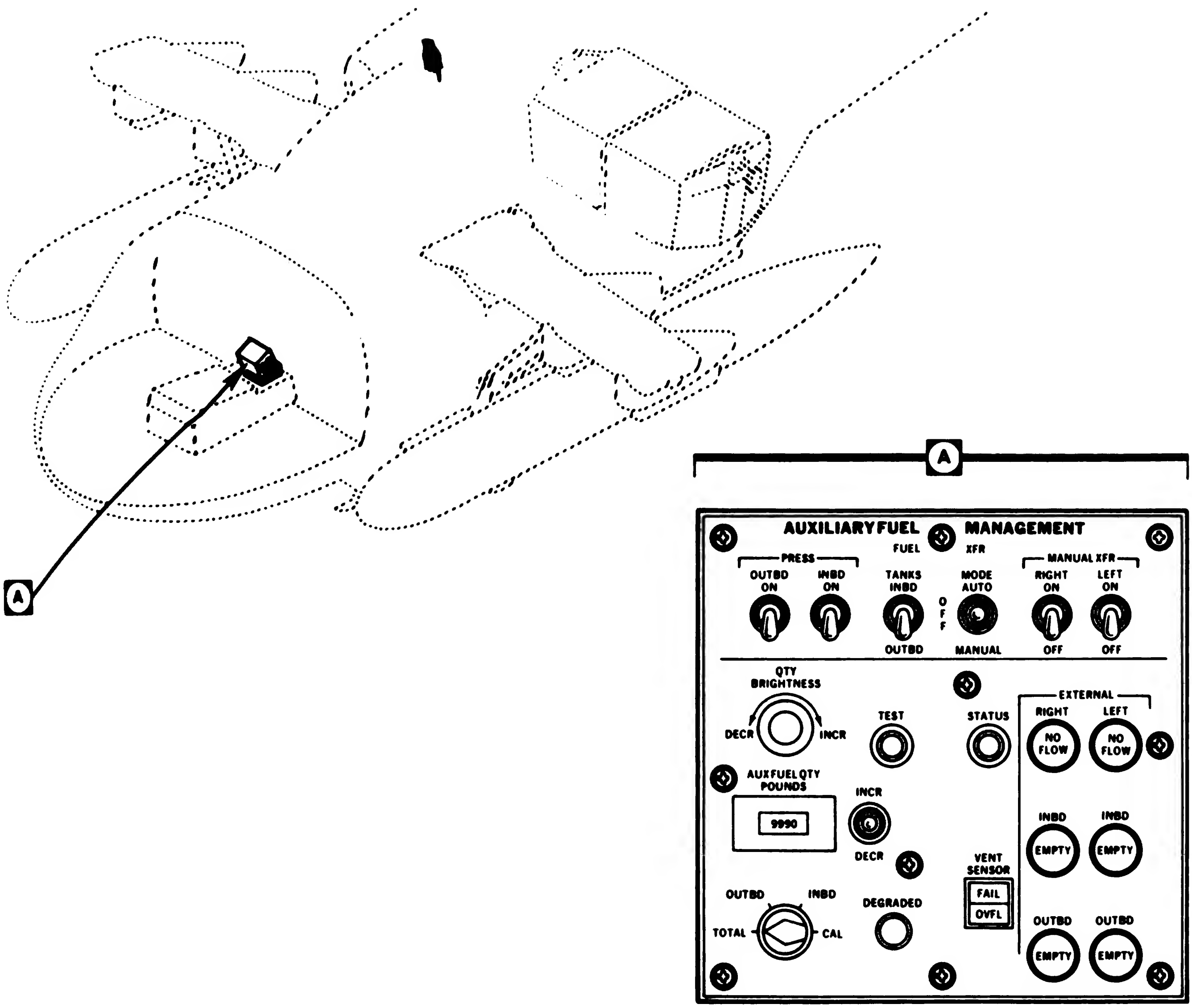
4-79. Auxiliary Fuel Tank Systems. ES

External extended range system contains two or four tanks suspended from supports outboard of the fuselage. The tanks contain baffles to prevent fuel sloshing. Quick-disconnect valves are provided in external fuel and bleed-air lines to provide seals when tanks are jettisoned or removed. If tanks are not installed cccc will be displayed in the AUX FUEL QTY POUNDS display when OUTBD or INBD is selected on the rotary fuel quantity selector. The preferred location of the External Range Fuel System (ERFS) auxiliary fuel tank is the outboard pylon. This facilitates ingress and egress of troops, loading of cargo, and the use of the M60D door gun.

4-80. Auxiliary Fuel Management Panel. ES

The AUXILIARY FUEL MANAGEMENT control panel (Figure 4-17) contains all controls for operating the external extended range fuel system. Controls description is as follows:

CONTROL/ INDICATOR	FUNCTION
EXTERNAL FUEL TRANSFER	Controls fuel management of external extended range system.



UH60A-45303 (C8)

Figure 4-17. Auxiliary Fuel Management Control Panel

CONTROL/ INDICATOR	FUNCTION
PRESS	
OUTBD ON	Opens bleed-air valves to outboard tanks for pressurization.
OFF	Closes bleed-air valves to tanks.
INBD ON	Opens bleed-air valves to inboard tanks for pressurization.
OFF	Closes bleed-air valves to tanks.

CONTROL/ INDICATOR	FUNCTION
TANKS INBD	Selects fuel transfer valves from inboard tanks for fuel transfer to main tanks; deselects outboard valves.
OUTBD	Selects fuel transfer valves from outboard tanks for fuel transfer to main tanks; deselects inboard valves.
MODE	Selects AUTO-OFF-MANUAL mode of fuel transfer from external fuel tanks.
AUTO	Automatically transfers fuel to main tanks from selected external tanks, until empty sensor in each tank interrupts transfer. Transfer occurs in levels as shown under Fuel Transfer Sequence. When tanks are empty, NO FLOW and EMPTY indicators and AUX FUEL caution light will be turned on.
OFF	Interrupts automatic or manual transfer mode of operation.
MANUAL	Provides electrical path to MANUAL XFR switch(es), which allows transfer from selected tank(s) until switch is moved to off.
MANUAL XFR	
RIGHT ON	Transfers from right tank used in conjunction with MODE switch in MANUAL position of the pair selected by TANKS select switch.
OFF	Interrupts transfer operation.
LEFT ON	Transfers from left tank of the pair selected by TANKS select switch.
OFF	Interrupts transfer operation.
AUX FUEL QTY POUNDS	Indicates pounds of external fuel remaining in symmetrical pair of tanks total of auxiliary tanks, self-test indication or failure codes. Displays "K" factors of flow meter.

NOTE

Fuel tanks selector and quantity indicators are also used in conjunction with INCR-DECR switch when initializing fuel quantity of tanks.

CONTROL/ INDICATOR	FUNCTION
OUTBD	Total pounds of fuel remaining in outboard pair of tanks.
INBD	Total pounds of fuel remaining in inboard pair of tanks.
TOTAL	Pounds of fuel remaining in all external extended range tanks.
CAL	Adjusts K factor of flow switch on AUXILIARY FUEL MANAGEMENT PANEL.
INCR switch position	Increases setting of digital readout to adjust for fuel remaining in tanks selected by fuel tank selector.
DECR switch position	Decreases setting of digital readout to adjust for fuel remaining in tanks selected by fuel tank selector.
STATUS button	Resets AUX FUEL caution light and stores condition of NO FLOW and EMPTY indicators.

CONTROL/ INDICATOR	FUNCTION
TEST	Checks display and indicator lights. Performs memory checksum, displays 8 sequentially in each digital display. Verifies that temperature probe is connected; verifies that flow meter is connected; performs trail calculation based on a known temperature and flow meter input, compares it with a known good value, and displays setting of fuel density switch. At completion of test, one of the following will be displayed: Refer to Figure 4-18 for description of failures. Good - Successful test. E01 - Error with microprocessor. E02 - Temperature sensor out of range. E03 - Flow meter not connected. E04 - Error with fuel flow circuitry. E05 - Error with fuel flow computation. E06 - Memory Error.
DEGRADED Light	- Error in critical function has occurred. Error code will be displayed as shown under TEST. Only E02 error will allow microprocessor to clear failure code and regain fuel remaining information by doing two self-tests.

CONTROL/ INDICATOR	FUNCTION
EXTERNAL	
RIGHT NO FLOW Light	- Fuel flow does not exit from selected right tank.
INBD EMPTY Light	- Right inboard tank fuel exhausted.
OUTBD EMPTY Light	- Right outboard tank fuel exhausted.
LEFT NO FLOW Light	- Fuel flow does not exit from selected left tank.
INBD EMPTY Light	- Left inboard tank fuel exhausted.
OUTBD EMPTY Light	- Left outboard tank fuel exhausted.
VENT SENSOR	Detects the presence of fuel on the vent thermistor.
OVFL	Indicator fuel venting overboard.
FAIL	Open in vent sensor line.

4-81. ESSS Fuel Quantity Indicating System. ES

The AUX FUEL QTY POUNDS digital readout (Figure 4-17) displays the amount of fuel remaining. Fuel type is preset by switches in the extended range tanks control panel. After presetting of fuel quantity in tanks using the rotary selector and the INCR-DECR switches, the fuel quantity indicates AUX FUEL QTY POUNDS of fuel remaining in 1-pound units. Preset can only be done when the helicopter weight is on the wheels. The WOW switch interlock prevents adjustment during flight. When measuring quantity, the readout is used in conjunction with the rotary selector switch to select tank pair subtotal, or TOTAL remaining in all tanks. Fuel used is sensed from a common flow transmitter within the fuel line to the main tanks. As fuel is transferred, the flow transmitter produces a signal proportional to the volume of fuel transferred. The microprocessor uses this signal, along with fuel temperature and fuel type, to compute the mass of fuel transferred. This amount is subtracted from the preset fuel quantity input and is displayed on the digital readout as pounds remaining. Fuel quantity accuracy is estimated to be about 5%. A green system DEGRADED light will go on, indicating a complete failure has occurred in the microprocessor, or an error condition is detected by the microprocessor, or a failure of the temperature sensor or the subsequent use of a preselected fuel temperature value. Only the temperature error (E02) will allow the microprocessor to clear the error by doing two self-tests. If the cause of error was corrected, a self-test will clear the error display. Power for the fuel quantity subsystem is provided from the NO. 2 AC PRI BUS through a circuit breaker marked AUX FUEL QTY, on the mission readiness circuit breaker panel.

4-81.1. ESSS Auxiliary Fuel Management Panel Test. ES

a. Test button - Press and release.

b. Digital display indicates Good, then fuel type.

c. STATUS button - Press-to-test and release.

d. Auxiliary fuel quantity switch - CAL.

e. INCR/DECR switch - Set calibration.

f. Auxiliary fuel quantity switch - INBD.

g. INCR/DECR switch - Set inboard fuel quantity.

h. Auxiliary fuel quantity switch - OUTBD.

i. INCR/DECR switch - Set outboard fuel quantity.

j. Auxiliary fuel quantity switch move to TOTAL - Check.

k. PRESS switches INBD and OUTBD - As desired.

4-82. Fuel Transfer Sequence. ES

WARNING

FUEL BOOST PUMP CONTROL switches shall remain on during external range fuel transfer and remain on for 10 minutes after PRESS switches are moved to OFF. Failure to observe this warning may cause engine flameout.

CAUTION

Fuel transfer sequence must be carefully planned and executed in order to maintain CG within limits.

Fuel transfer sequence shall be based on mission requirement and center of gravity limitations. Automatic transfer is started when the proper switches are manipulated and fuel level is as shown below and external range tanks internal pressure is increased enough to force fuel to the main tanks. Transfer will continue until the main tank signal conditioner provides a signal through the microprocessor to stop fuel transfer. This cycle is done as required until interrupted by placing the MODE switch to OFF or MANUAL or placing the PRESSURE switch OFF. Manual transfer will be started on selection of MANUAL and appropriate switches, and external fuel tanks are bleed-air pressurized to start fuel transfer from external tank(s) to main tanks. Transfer will continue until tanks are full. They will remain full as long as the manual mode remains engaged. Manual transfer requires close monitoring of fuel level to initiate and stop transfer to remain within CG limits. The automatic transfer sequence is as follows:

TOTAL AUXILIARY FUEL REMAINING (BASED ON JP-4 DENSITY)	TRANSFER START WHEN ONE MAIN FUEL TANK QUANTITY LESS THAN	TRANSFER STOP WHEN EACH MAIN FUEL TANK QUANTITY MORE THAN
8840-7041 lbs.	950 lbs.	1000 lbs.
7040-5001 lbs.	750 lbs.	1000 lbs.
5000-0 lbs.	600 lbs.	1000 lbs.

O 4-83. **Fuel Transfer Procedure.** ES

a. AIR SOURCE HEAT/START switch - ENG

b. FUEL BOOST PUMP CONTROL switches - ON

c. PRESS switches INBD and OUTBD - as desired

d. MODE select - as desired

O 4-83.1. **Fuel Transfer Stopping Procedure.** ES

a. PRESS switches INBD and OUTBD - OFF

b. MODE select - OFF

c. FUEL BOOST PUMP switches - as required.

SYSTEM FAILURE CODES AND INDICATIONS	DEGRADED LIGHT	AUX FUEL CAUTION LIGHT	DESCRIPTION OF DEGRADED OPERATION
E01 MICROPROCESSOR ERROR E03 FLOWMETER DISCONNECTED E04 ERROR FUEL FLOW CIRCUITS E05 ERROR FUEL FLOW COMPUTATION E06 MEMORY ERROR	ON	ON	1. AUTO XFR CAPABILITIES REMAIN 2. DEFAULTS TO CURRENT XFR SCHEDULE 3. PILOT MUST COMPUTE FUEL USAGE
E02 TEMPERATURE SENSOR NOT CONNECTED OR OUT OF RANGE	ON	ON	1. AUTO XFR CAPABILITIES REMAIN 2. PERFORMING TWO SELF-TESTS WILL: A. CLEAR FAILURE CODE AND REGAIN FUEL REMAINING INFO B. RESET AUX FUEL LIGHT C. DEFAULT TO PRESELECTED TEMP VALUE
LOSS OF DIGITAL READOUT	ON	ON	1. AUTO XFR CAPABILITIES REMAIN 2. NO FLOW AND EMPTY MONITORING INDICATIONS REMAIN 3. PILOT MUST COMPUTE FUEL USAGE
LOSS OF ONE MAIN TANK LEVEL QUANTITY SENSOR OR LOSS OF ONE SIGNAL CONDITIONER INPUT	OFF	OFF	NO DEGRADATION

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Figure 4-18. ESSS Fuel System Degraded Operation Chart ES

n. TANKS switch INBD - OFF. PRESS switch - INBD OFF.

o. Main tank FUEL QTY TOTAL FUEL readout - Check for increase of about 20 pounds.

p. PRESS, MODE, and MANUAL XFR switches - OFF or as desired. AIR SOURCE HEAT-START switch as desired.

4-84. EXTERNAL STORES SUPPORT SYSTEM (ESSS). ES

ESSS provides a means of carrying a variety of external stores, including external extended range fuel tanks. The ESSS consists of fixed and removable provisions.

4-85. External Stores Fixed Provisions. ES

Fixed provisions are: upper fuselage fixed fittings for attaching the horizontal stores support (HSS) subsystem, and lower fuselage strut support fittings for attaching two struts for each HSS. In addition to exterior components, fixed provisions are: interior helicopter provisions, including electrical harnesses, fuel lines, bleed-air lines, and circuit breakers.

4-86. External Stores Removable Provisions. ES

The external stores removable subsystem extends horizontally from each side of the helicopter at station 301.5, buttline 42.0. Extending below each horizontal stores support (HSS) are two vertical stores pylons (VSP) and attaching ejector racks. The racks are used to attach fuel tanks or other external stores dispensers.

4-87. ESSS Side Position Lights. ES

A position light is on each outboard end of HSS. Those lights use the power source provided to operate the standard installed position lights, colors are the same. Upon installation of the HSS, the electrical connectors connected to the jumper plugs, providing power for the standard position lights, are removed and reconnected to the connectors from the HSS position lights. Operation and power source for the ESSS position lights are the same as for the standard installed position lights.

4-88. External Stores Jettison Control Panel. ES

The jettison control panel (Figure 4-16) provides the capability of phase jettison of all external stores or symmetrical jettison of fuel tanks. Interlock circuitry prevents jettison of fuel tanks other than in pairs. Emergency jettison is completely independent of the primary jettison subsystem.

WARNING

The BRU-22A/A and MAU-40/A Ejector Rack CARTRIDGES are explosive devices and must not be exposed to heat, stray voltage or static electricity. Refer to TM 9-1300-206 for information concerning handling and storage of ammunition.

The jettison control panel (Figure 4-16) contains all controls for jettisoning external stores. Jettison controls are as follows:

CONTROL	FUNCTION
EMER JETT ALL	Applies 28 volts from essential dc bus to all stores stations when the helicopter weight is off the wheels, regardless of the rotary selector switch. A 1-second time delay permits the outboard stations to jettison before the inboard stations.
Rotary Selector Switch	Determines which station receives primary jettison signal.
OFF	Prevents jettison signal from going to any stores station.
INBD	
L	*Directs jettison signal to inboard left station.
R	*Directs jettison signal to inboard right station.
BOTH	Directs jettison signal to inboard left and right stores stations.
OUTBD	
L	*Directs jettison signal to outboard left station.
R	*Direct jettison signal to outboard right station.
BOTH	Directs jettison signal to outboard left and right stores stations.
ALL	Directs primary jettison signal to all stores stations. Outboard stores will jettison and 1 second later inboard stores will jettison.

NOTE

*If fuel tanks are connected to the left, right, or both stores stations, the BOTH mode of jettison is automatically selected even if the selector switch is at L or R.

CONTROL	FUNCTION
JETT	Applies 28 volts from primary dc bus through the rotary selector switch to the selected stores station if the weight is off the wheels and the selector switch is not OFF.

4-89. Stores Jettison Control Operation.

The jettison system provides two modes of jettisoning external stores, primary and emergency. The primary subsystem uses the rotary selector switch and the JETT toggle switch. The emergency jettison subsystem uses only the EMER JET ALL toggle switch. Primary jettison is used when selective jettison is desired. The rotary switch is used to select the stores point for release, and the JETT toggle switch is used to actuate the release. Emergency jettison is used to release all external stores through one actuation of the EMER JETT ALL toggle switch, regardless of rotary switch position. During primary (rotary switch ALL selected) and emergency jettison, a 1-second delay is provided after the outboard stores are released, before the inboard stores will be released. When fuel tanks are jettisoned, cccc will appear on the AUX FUEL QTY POUNDS digital readout when the corresponding fuel quantity position is selected. The fuel remaining in the tanks jettisoned will be subtracted from the total displayed when TOTAL is selected. Power to operate the primary jettison subsystem is from the No. 1 dc primary bus through circuit breakers marked ESSS JTSN INBD and OUTBD. The emergency jettison subsystem is powered from the dc essential bus through circuit breakers marked ESSS JTSN INBD and OUTBD.

CAUTION

To prevent unintentional jettison of external stores when the helicopter weight is on the wheels, do not actuate any jettison switch.

4-90. Rappeling Rope Connectors.

Rappeling rope connectors consist of four cabin ceiling tie down fittings.

4-91. Medical Evacuation (Medevac) Kit.

A medevac kit consisting of a pedestal support assembly and provisions for three rear-facing troop seats may be installed in the UH-60 helicopter (Figure 4-17) after removing the existing troop seats. The medevac pedestal assembly, when installed, is directly below the main transmission. The pedestal can be turned about a vertical axis. Litter supports are cantilevered from the pedestal. The litter supports may be positioned to accept four to six litter patients, up to six ambulatory patients or essential medical personnel, or combination thereof. The pedestal is positioned along the longitudinal axis of the helicopter for flight and to allow full attention to the patients by the medic. The pedestal contains restraint belts for each litter, restraint lap belts for each ambulatory occupant, eight individually operated lights for the four-man litter configuration, provisions for eight 1000 ml. intravenous fluid bags, and provisions for two size D oxygen bottles. Another feature of the medevac kit is a 115 vac, 60 Hz frequency converter to provide electrical power for use of standard hospital equipment. On missions not requiring electrical power, the power pack may be left out. The three-man rear-facing seat provisions are in the forward portion of the cabin, and accommodate standard troop seats. The four-man litter configuration allows rotation of the pedestal so that the litter patients can be loaded from either side of the helicopter. The six-man litter configuration also allows for side loading; however, the pedestal must be rotated back to the locked position along the longitudinal axis of the helicopter after four litters are loaded. Floor restraints are then installed to the cabin floor tiedown studs on both sides of the pedestal. The last two litters are placed on both sides of the pedestal between the floor restraints and secured. Only the upper supports are capable of being tilted for loading or unloading of the litters. Unloading the patients is the reverse of loading. To convert to the six-man ambulatory patient or essential medical personnel configuration, the upper litter supports are folded down to accommodate three patients or essential medical personnel seated side by side on either side of the pedestal.

NOTE

The medevac pedestal ambulatory configuration provides significantly less crashworthiness capability (energy attenuation and occupant restraint) than the troop seats.

4-92. Litter Support.

Each litter support is attached to the center pedestal by two end pivot shafts, (Figure 4-19) and by two T-shaped fittings, which allows removal, interchange, or repositioning of the supports. Crashload absorption works on the deformation principal. There are five pivot shaft support holes on the right and left side of

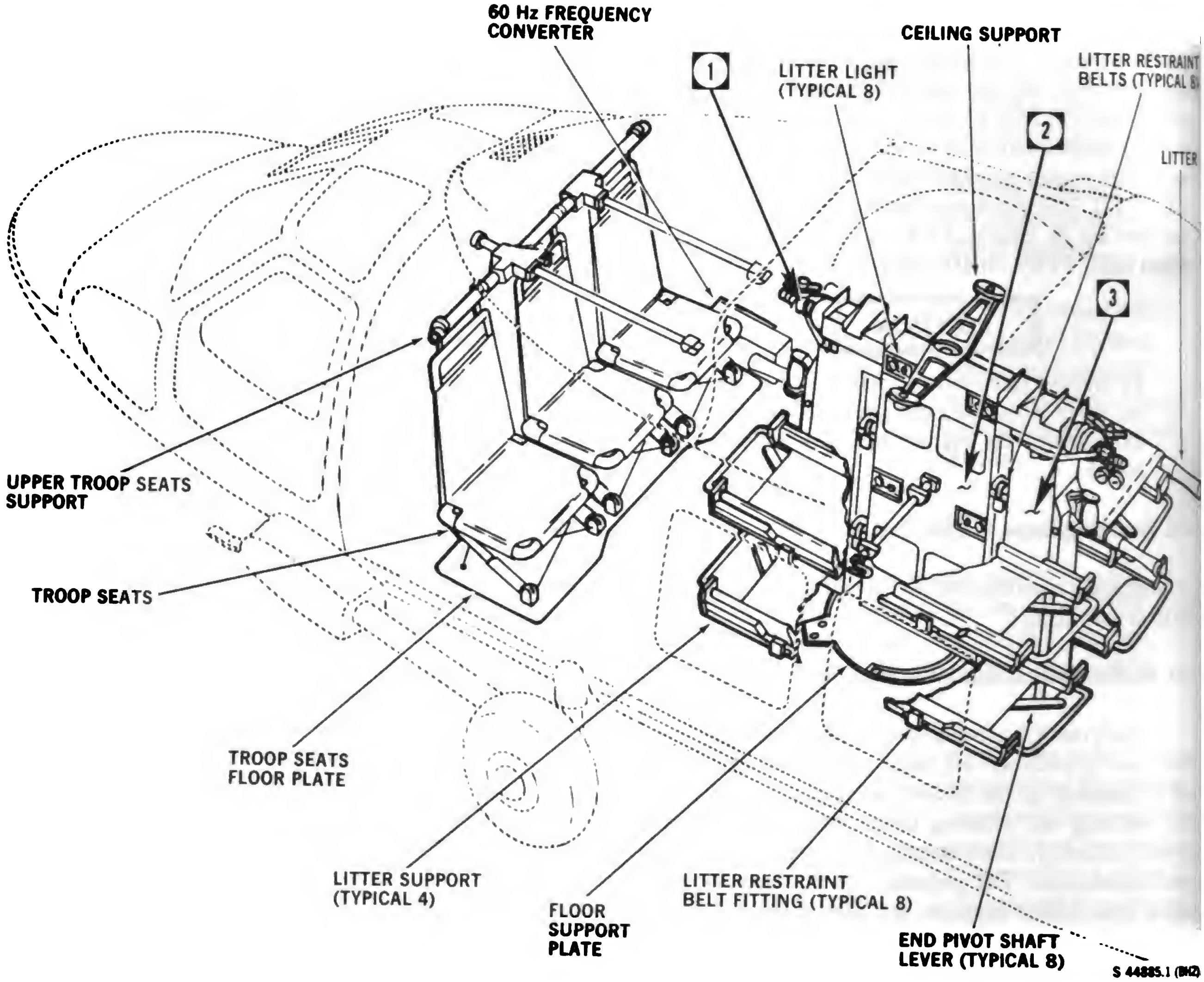
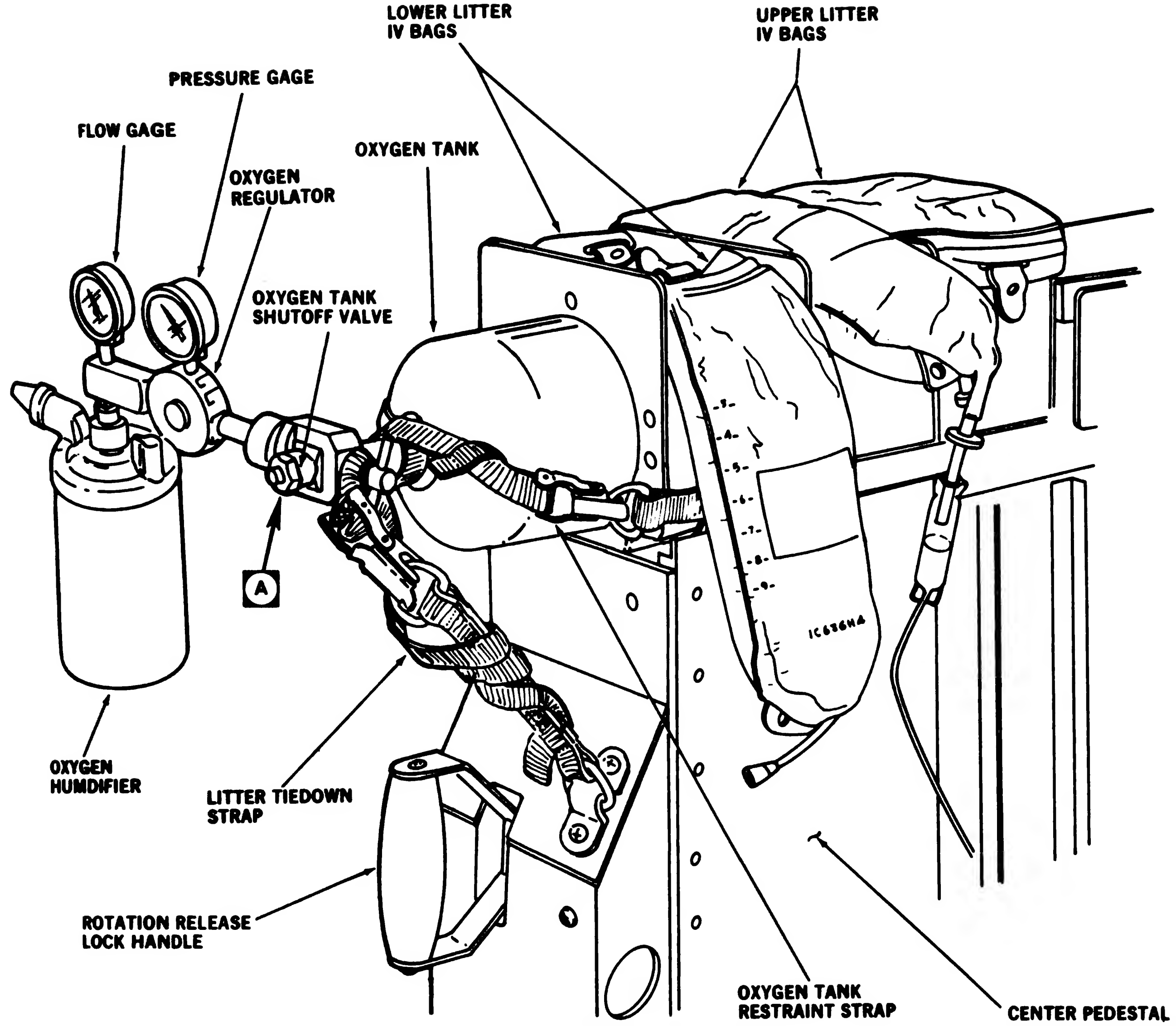
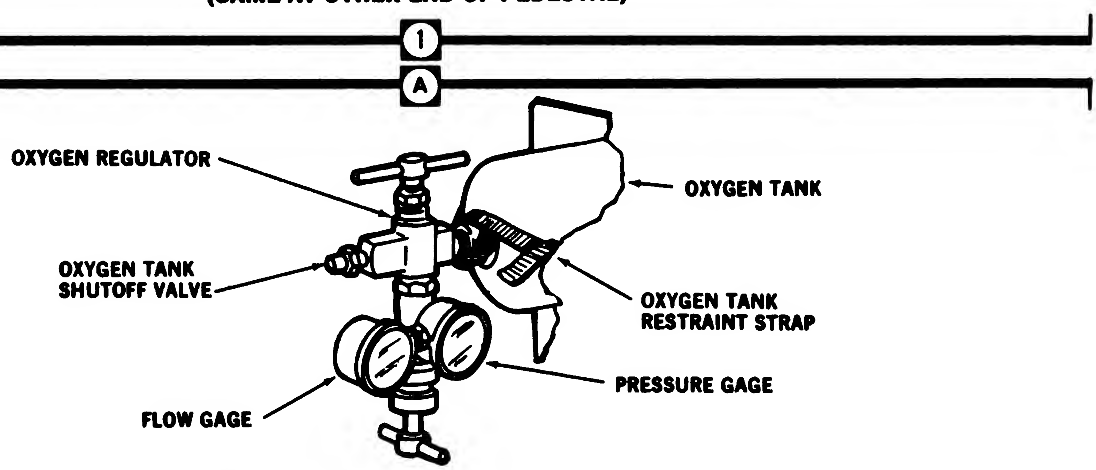


Figure 4-19. Medevac and Seat System (Sheet 1 of 5)



TYPICAL IV/OXYGEN TANK INSTALLATION
(SAME AT OTHER END OF PEDESTAL)



ALTERNATE OXYGEN REGULATOR INSTALLATION

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Figure 4-19. Medevac and Seat System (Sheet 2 of 5)

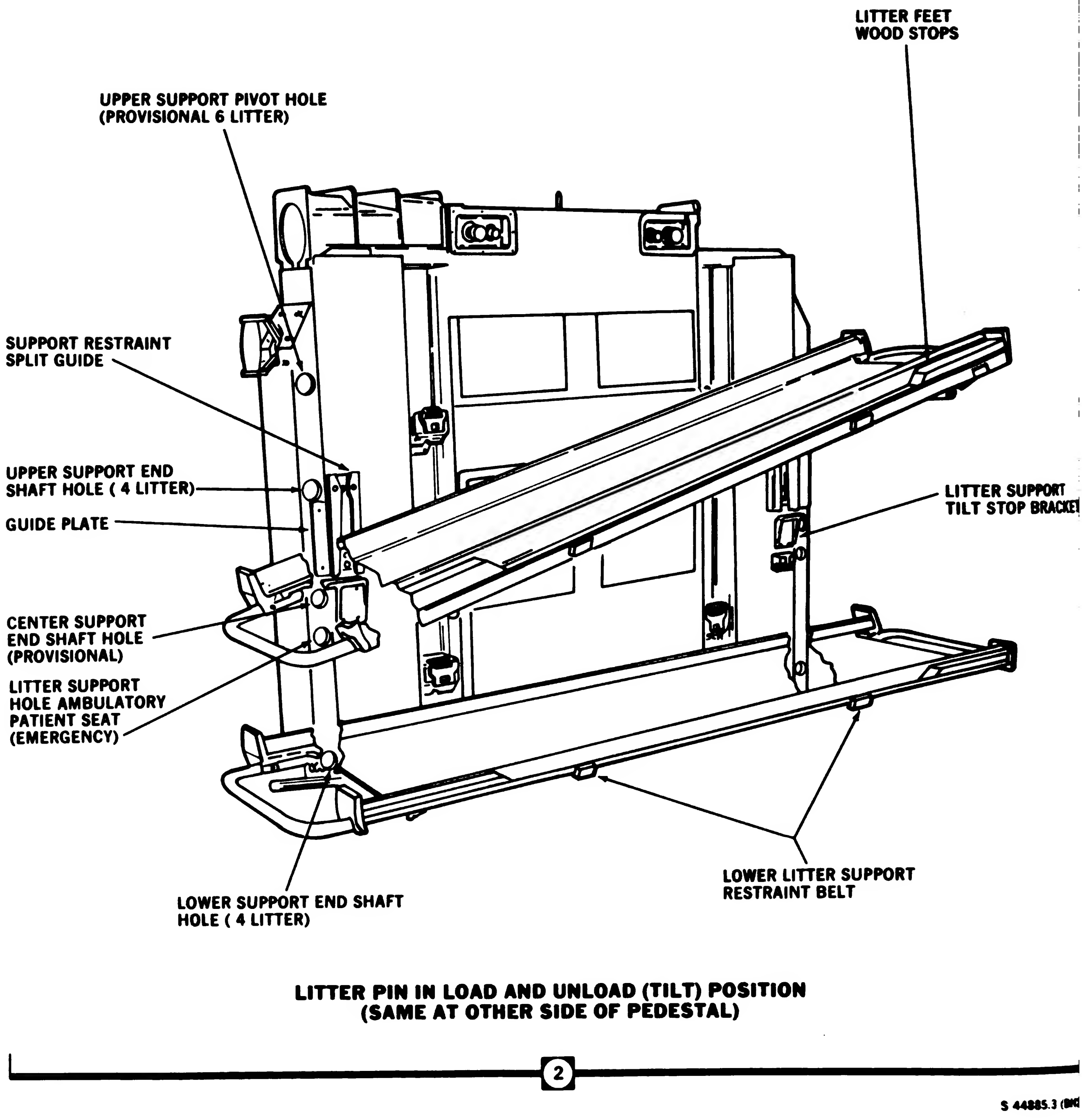


Figure 4-19. Medevac and Seat System (Sheet 3 of 5)

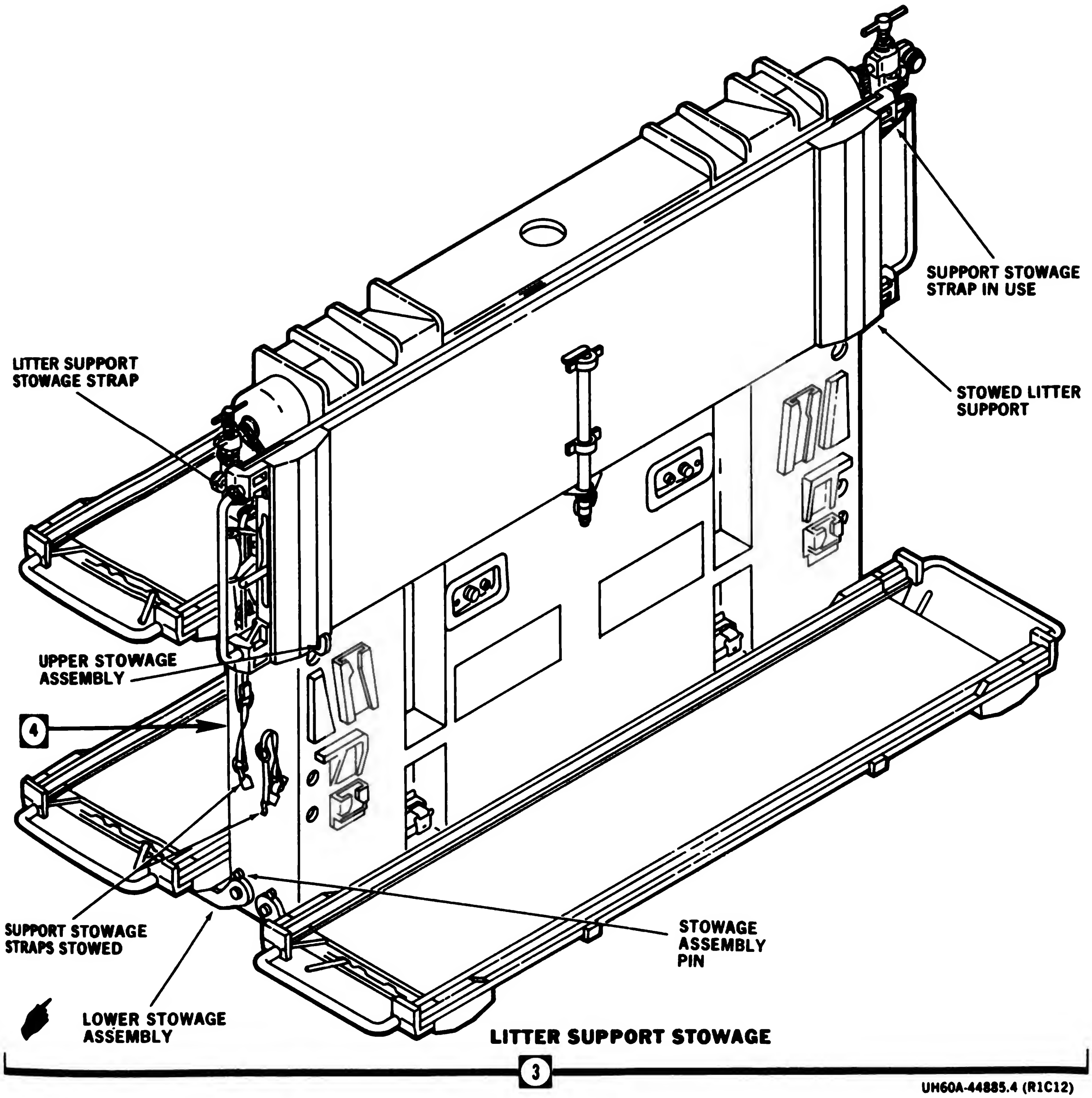
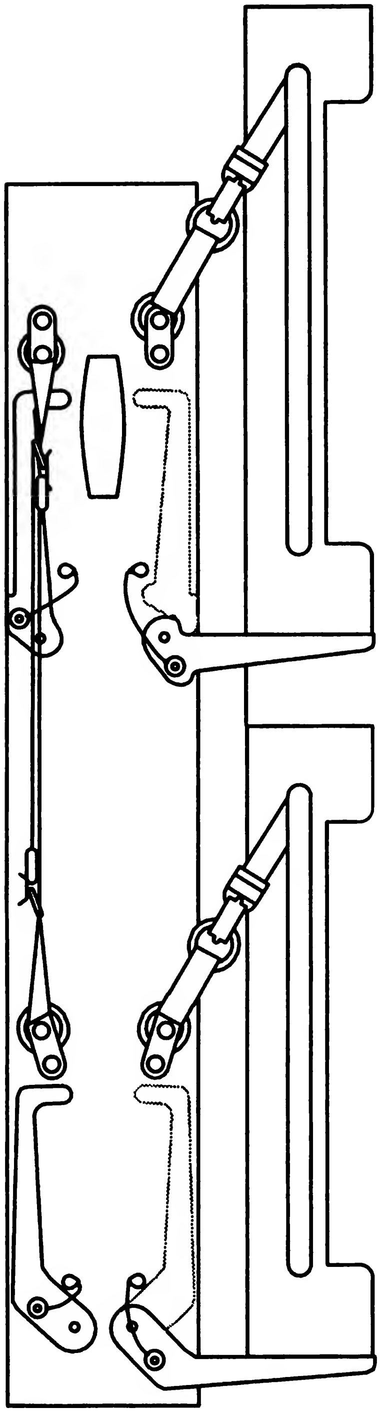


Figure 4-19. Medevac and Seat System (Sheet 4 of 5)



LEFT SIDE SHOWN
STOWAGE ASSEMBLY STOWED
AND STRAPS STOWED

RIGHT SIDE SHOWN
LITTER SUPPORTS STOWED
WITH STRAPS

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Figure 4-19. Medevac and Seat System (Sheet 5 of 5)

the center console at both ends. Behind the holes are support rollers for the pivot shafts. From top to bottom, the top hole is provisions for the upper litter in the six-litter configuration. The second hole is for the upper litter support of a four-litter configuration. These end holes line up with a central pivot shaft on the litter support. Only this litter position allows midposition pivoting for loading or unloading. The third hole is for the center litter of the provisional six-litter configuration. The fourth hole is used when installing the litter support in the four-litter configuration. The third, fourth, and fifth positions do not provide a tilt function.

4-93. Litter Lighting.

Two litter lights are installed in the pedestal at each litter (Figure 4-19). Each light contains a PUSH-ON, PUSH-OFF switch. The positioning of those lights is adjustable. Power to operate the litter lights is from the No. 1 and No. 2 dc primary buses through circuit breakers on the mission readiness circuit breaker panel, marked No. 1 LTR LTS and No. 2 LTR LTS. The lights are operated from a split bus to provide one light at each litter in case of a single dc primary bus failure.

4-94. Litter Support Installation.

The upper litter supports are supported by a center pivot shaft and two end pivot shafts, one at each end of the support (Figure 4-19). To tilt the upper end of the support only for loading or unloading of litter patients, the center shaft remains locked to the pedestal and the end shafts are disengaged for support pivoting. This system was designed to pivot about the center shaft. Although the supports may be pivoted at either end, more effort is required when the loaded litter is installed. To install the litter supports, do this:

a. Lower Litter Support Installation.

(1) Before installation, each center pivot shaft must be retracted and unlocked. The center pivot shaft handle must be secured in the handle retainer. End pivot handles must be in disengaged position.

(2) Engage T-bars on litter support with split retention fittings at bottom of pedestal.

(3) Line up end pivot shafts with holes. Disengage pivot shaft lever locks and move end pivot shaft lever toward pedestal, until pivot shaft is fully inserted into pivot shaft hole on pedestal and handle lock is engaged.

(4) Repeat step (3) for other end of litter support.

b. Upper Litter Support Installation.

(1) Prepare support. Before installation, each center pivot pin must be unlocked and retracted, and the handle disengaged from its retainer. End pivot handles must be in engaged position.

(2) Tilt outer edge of litter support slightly down and engage T-bars into split retention fittings at second support hole from top of pedestal.

(3) Raise outer edge of litter support until support is level.

(4) Insert end pivot shaft into pedestal by pulling on pivot shaft lever lock, and moving lever toward pedestal until end pivot shaft engages partway in end pivot support hole.

(5) Position center pivot shaft lock handle counterclockwise to horizontal.

(6) Push center pivot shaft toward pedestal until shaft is fully inserted into center pivot shaft hole. Opposite end of litter support should be raised or lowered to help line up center shaft on support with center hole on pedestal.

(7) Turn center pivot lock lever clockwise to horizontal.

(8) Repeat step (4) for other end of litter support. Now slide both end pivot shafts in fully by moving pivot lever lock handle to engage position.

WARNING

Use of the medevac pedestal ambulatory configuration for transport of personnel other than patients or essential medical personnel is prohibited.

c. Litter Support Installation for Ambulatory Patient Seating.

(1) Prepare support as in b.(1) above.

(2) Engage T-bar on litter pan with split retention brackets below support tilt stop brackets.

(3) Position litter support at second from bottom litter support end pivot hole on pedestal.

(4) Line up end pivot shafts with holes. Disengage pivot shaft lever lock and move pivot shaft lever toward pedestal, until pivot shaft is fully inserted into pivot shaft hole on pedestal and handle lock is engaged.

(5) Repeat step (3) for other end of litter support.

4-95. Litter Support Removal.

Removal of the litter support is the reverse of installation. Before removal, any litters on the support should be removed and belts unlocked. If IV or oxygen is installed, make certain hoses are not tangled with supports, then proceed as required.

4-96. Medevac Seats Installation.

The seat installation consists of three of the troop seats that were removed for medevac system installation. Install required number of seats at station 271.0.

4-97. Litter Loading and Unloading.

Litters can be loaded and unloaded laterally, directly onto the litter supports, from either side of the helicopter. Whenever rescue hoist and medevac kit are installed simultaneously, the upper, right litter support should be removed from the a/c. The lower, right support may be stowed if not actually in use. The lower right litter support shall be installed in the lowest position and used when transporting more than two litter patients or when conducting hoist operations with a stokes litter. Loading of a stokes litter patient may be facilitated by rotating the litter pedestal approximately 30 degrees from the fly position. When returning the pedestal to the fly position the aft right corner of the litter support must be lifted to prevent interference with the lower hoist mount bracket. To load and unload litter patients, assuming the medevac kit is in the flight position (litters along longitudinal axis), do this:

a. Both cabin doors - Open.

b. Pedestal rotation lock release handle - Pull handle and turn pedestal clockwise 90° (viewed from above). On helicopters with extended external range fuel tanks installed, the pedestal will rotate only 60° from center line for loading litter patients.

c. Release lock handle while turning pedestal. Pedestal will automatically lock in a lateral position for loading and unloading.

d. Release both litter support end pivot shaft on upper litters. Disengage pivot lever locks and move levers away from pedestal. Hold support with opposite hand. Release lever. End pivot shafts should rest on fitting at hole. Litter support is now ready to be loaded from either side. Select side desired. Move end pivot release lever about 1 inch more to compress the shaft springs, which allows the shaft to clear the end guide and the litter support to be lowered at the end. During the lowering, release pivot shaft lever to allow pivot shaft spring to push shaft onto lower stop fitting.

e. Using two persons (one each side or end) - Place litter with patient on end of upper support and push litter into position. Note that litter feet must be trapped between wood stops on litter support. If three or more patients are to be loaded, the upper supports must be loaded first. The reverse applies to unloading.

f. To tilt upper litter support end, pull shaft lever lock and move lever away from pedestal at support end which is being raised. Pivot litter support to level position until pivot shaft holes are lined up with pivot shafts. Move levers toward pedestal until shaft is fully inserted into shaft holes and handle locks are engaged.

g. Lower litters - Using two persons (one each side or end) place litter with patient on end of support and push litter into position. Note that litter feet must be trapped between wood stops on litter support.

h. Litter straps - Extend straps (on pedestal) and engage in buckle on litter supports. Pull straps out uniformly to engage; partial pulling will require complete retraction of the belt to disengage belt lock.

i. Pedestal rotation lock handle - Pull and turn pedestal counterclockwise 90° (viewed from above) into flight position (longitudinal axis), and release handle.

j. Cabin doors - Close.

k. Unloading is reverse of loading after litter straps are removed and oxygen and IV tubes are checked to make certain tangling will not occur with litter or support.

4-98. IV Bags and Oxygen Tanks Installation.

CAUTION

The pilot must be advised when oxygen is on board, its use must be per the Surgeon General's directives, and must have oxygen regulators attached.

Provisions for IV bags and oxygen tanks are on the top of the pedestal at each end. Four IV bags may be attached to each IV/oxygen assembly (Figure 4-19). IV bag hooks at the outer end of the assembly are used for the lower litters and the inner hooks are used for the upper litters. Eyelets at the top of the bag are placed on the IV hooks and the bags are hung downward. To prevent damage to IV bags, check clearance between transmission drip pan drain tube clamps and installed IV bags. Flow adjustment and replacement will be done by the medical attendant. Oxygen tanks are inserted into the assembly, bottom first. A restraint strap is provided to prevent the tank from falling out during normal maneuvering during flight. The strap is placed across the regulator in a manner and routed as shown in Figure 4-19, to prevent the restraint strap from slipping. The strap ends are attached and drawn tight to keep the tank secure.

4-99. Litter Support Stowage.

WARNING

Storage of the litter support in the upper level stowed position can be dangerous during a crash sequence due to the release of the litter support from the carousel. Advise storage in this manner be avoided. Maintain this litter support in the installed position or place in the back of the carousel in the ambulatory level if there are no occupants along the aft bulkhead (Row 5).

The litter supports may be stowed along the center pedestal on each side, one above the other (Figure 4-19). Stowage brackets at each end of the pedestal provide lower support of the supports, and prevent the supports from moving away from the pedestal. Web straps attached to rings are used to hold the upper ends of the supports to the pedestal. Pins are used to hold the stowage brackets in a stowed position against the pedestal end. Two brackets are provided for each litter support. The top support must be stowed first, then the lower support. For reinstallation the sequence is reversed.

1. Lower the stowage support arm to the horizontal position and insert the support arm stowage pin through the support arm and into the center pedestal.

NOTE

Improper positioning of the support arm stowage pin reduces the holding capability of the support arm, which may cause the support arm to shear its pivot bolt during a hard landing or aircraft mishap.

2. Place the litter pan in the stowed position, with the bottom of the litter pan against the center pedestal.

3. Secure the litter pan to the center pedestal by routing the opposite side web strap around the upper portion of the litter pan handle. Secure the metal clasp to the metal ring and tighten the web strap. (Use of the opposite side web strap will reduce excess movement of the litter pan while stowed).

4. If only one upper litter pan is to be stowed, as in step 3, additional security may be added by routing the same side web strap around the lower portion of the litter pan handle and fastening the web strap.

5. The lower litter pan will be stowed in the same manner as in steps 1 through 3. The same side web strap may be used to secure the lower portion of the litter pan as in step 4 if only one lower litter is to be stowed.

CAUTION

Do not store equipment between the stowed litter pan and the center pedestal.

6. Removal of stowed litter pans is accomplished in the reverse order of steps 1 through 4.

4-100. Range Extension Kit.

The range extension kit (Figure 4-20) provides a total usable additional fuel quantity of about 780 US gallons. The crashworthy tanks, when used, are in the cargo area, held in place by the tiedown fittings, and connected to the main fuel tank vent lines and pressure refueling lines. The range extension tanks are mission equipment and are included in useful load, when installed. The range extension fuel system consists of two crashworthy fuel tanks within a structural container, control panel, transfer/dump pumps, valves and lines. The structural containers have self-sealing breakaway valves and will withstand crash loads of 20 Gs forward and downward and 18 Gs sideward. Each tank contains a gravity refueling port and two fuel quantity probes. Refueling of the tanks is through the gravity refueling ports on the top left side. Defueling is by the fuel dump system or by transfer of fuel from the range extension tanks to the main tanks, using the transfer pump, and the suction defueling from the main tanks. Fuel sampling is done using the main tank kit sampling pump. When the range extension kit is installed, no cargo or seating space is available in the cabin.

4-101. Range Extension Control Panel.

The range extension control panel (Figure 4-20), when installed, is at the top rear of the lower console. Controls on the panel are: FUEL TRANSFER NO. 1 PUMP, OFF, and NO. 2 PUMP AUTO OFF MANUAL selector switch, NO. 1 TANK ON OFF and NO. 2 TANK ON and OFF transfer valve switches, NO. 1 and NO. 2 AUX EMPTY lights, FUEL DUMP control switch with guard cover, an AUX FUEL QUANTITY digital DIM control, a four-digit readout, in pounds TEST switch and a NO. 1 TANK, NO. 2 TANK, TOTAL quantity selector switch. Power to operate the systems are supplied by the No. 1 and No. 2 ac primary buses through circuit breakers on the mission readiness circuit breaker panel, in the cabin.

4-102. Fuel Transfer Operation.

Fuel transfer is done automatically or manually, as selected by the fuel transfer selector switch. Check valves in the transfer line prevent transferring fuel from one range extension (auxiliary) tank to the other, or pressure refueling the auxiliary tanks using the single-point refueling system. Fuel transfer flow rate is about 300 pounds per minute.

Normal transfer operation should be in the AUTO mode. Automatic transfer is controlled by the main fuel tank gaging system. Fuel transfer from the aux tanks is started when fuel level in either main tank drops to 600 pounds. Transfer is stopped when either main tank reaches the 1100-pound level. A fuel level below 600 pounds in one tank will not initiate transfer if the other tank is at or above 1100 pounds. Extensive crossfeed operation from one main tank may result in excessive short bursts of transfer; for example, one main tank going from 600 pounds to 650 pounds while the other tank goes from 1050 pounds to 1100 pounds.

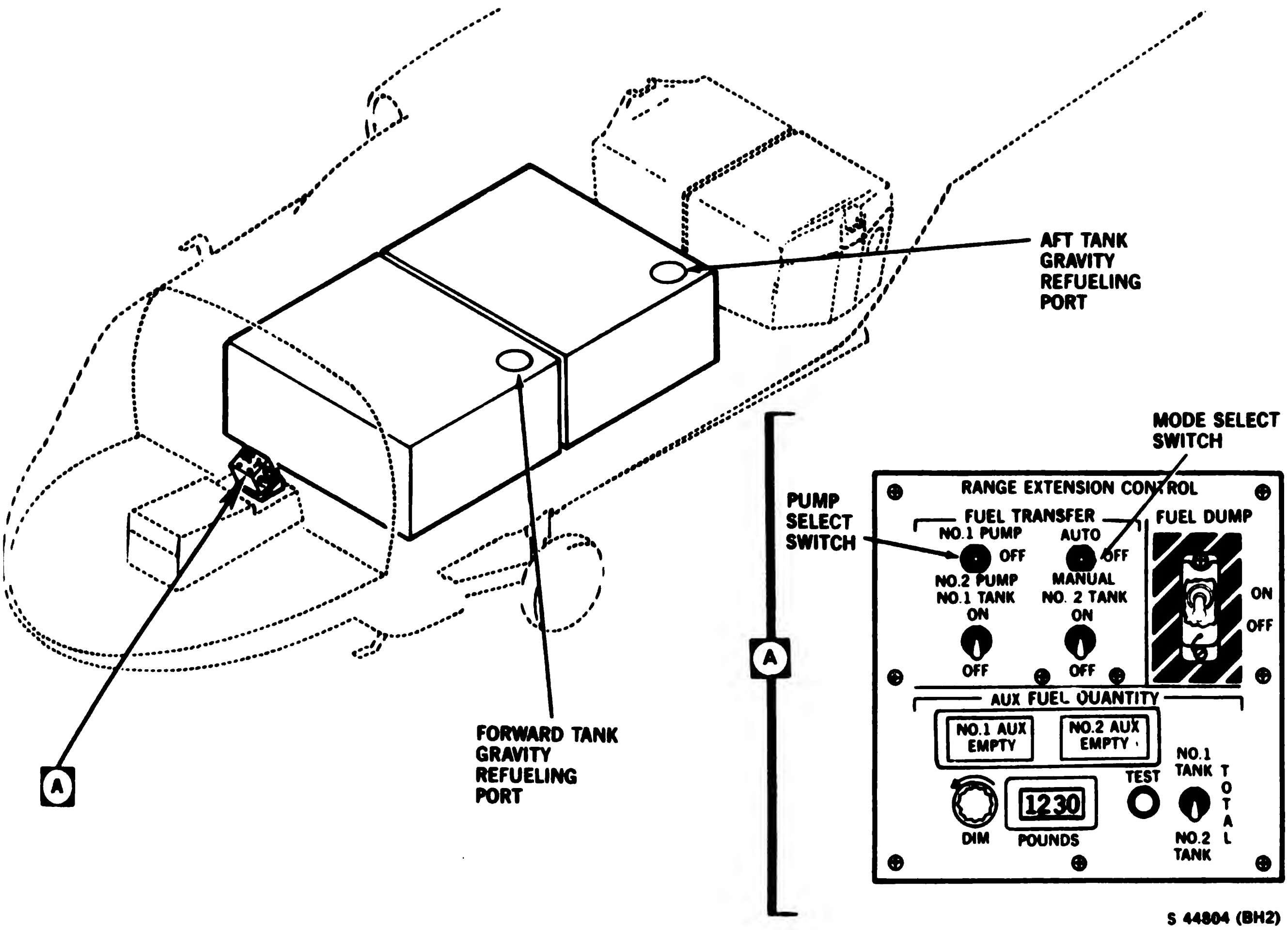


Figure 4-20. Range Extension Control Panel

Due to a different transfer rate to the two main tanks, crossfeed operation may be required to keep the main tanks at about the same level. To transfer fuel to the main fuel tanks, do this

CAUTION

Fuel transfer sequence must be carefully planned and executed in order to maintain CG within limits.

a. Auto Transfer.

(1) Mode select switch - AUTO.

(2) AUX FUEL QUANTITY switch - TOTAL.

(3) NO. 1 TANK and NO. 2 TANK switches - ON.

(4) Pump select switch - NO. 1 PUMP or NO. 2 PUMP.

(5) AUX FUEL QUANTITY POUNDS readout - Decreases when either main tank fuel level is below 600 pounds, and will continue until either main tank fuel level reaches 1100 pounds.

(6) Pump select switch - OFF.

(7) Repeat steps (3) through (6) for other pump.

b. Manual Transfer.

(1) Mode select switch - MANUAL.

(2) AUX FUEL QUANTITY switch - NO. 1 TANK.

(3) NO. 1 TANK switch - ON.

(4) Pump select switch - NO. 1 PUMP or NO. 2 PUMP.

(5) AUX FUEL QUANTITY POUNDS readout - Check for decrease.

(6) Pump select switch and TANK switch - OFF.

(7) Repeat steps (2) through (6) for other pump.

4-103. Fuel Dump Operation.

Fuel dump allows the pilot to remove fuel from the range extension tanks. The system uses the transfer pumps and dump valve to direct fuel to the overboard dump line on the right lower fuselage. Fuel flow rate during dumping is about 700-pounds-per-minute. To dump fuel, do this:

a. FUEL DUMP switch - ON.

b. When desired quantity of fuel is dumped - FUEL DUMP switch OFF.

4-104. Auxiliary Fuel Quantity Indicator.

The AUX FUEL QUANTITY system is independent of the main tank quantity system. A digital indicator and controls are at the lower part of the RANGE EXTENSION CONTROL panel. A four-place digital readout will indicate the quantity of fuel in NO. 1 TANK, or NO. 2 TANK or TOTAL of No. 1 and No. 2, by selection of the quantity switch. Single tank readout is 0-2600 pounds. Total fuel readout is 0-5200 pounds. When the TEST switch is pressed, the digital readout indication should be 8880.

NOTE

The fuel quantity indicator is inaccurate in the TOTAL position. For fuel quantity level check use individual tanks position.

4-105. Auxiliary Tank Empty Indicators.

A fuel low sensor on each fuel quantity probe provides signals to the range extension control panel. Those signals turn on caution lights on the control panel marked NO. 1 AUX TANK EMPTY or NO. 2 AUX TANK EMPTY, when fuel level in the respective tank reaches 20 pounds. The AUX TANK EMPTY lights will go on only when the respective tank selector switch is ON. When the NO. 1 or NO. 2 AUX TANK EMPTY light is on the switch must be placed OFF to turn the light off.

4-106. Unable to Transfer or Dump Internal Auxiliary Fuel with Tank Full and AUX EMPTY Light On.

When the situation requires that internal auxiliary fuel be transferred or dumped and the corresponding AUX EMPTY light is on, the fuel pump will not operate, therefore the applicable aux fuel quantity probe must be disconnected.

a. RANGE EXTENSION CONTROL panel switches - OFF.

CAUTION

Disconnecting either aux fuel tank probe invalidates the reading of the AUX FUEL QUANTITY POUNDS indication of the disconnected tank and TOTAL indication.

b. Crewmember - Disconnect applicable aux fuel quantity probe (plug 296 or 297 at about station 332, buttline 27.5 left).

If fuel transfer is required:

c. FUEL TRANSFER switch - MANUAL.

d. NO. 1 TANK or NO. 2 TANK switch - ON as applicable.

e. FUEL TRANSFER PUMP switch - NO. 1 PUMP or NO. 2 PUMP as applicable.

If fuel dump is required:

f. Do steps a and b.

g. FUEL DUMP switch - ON as required.

NOTE

The above procedures may cause the thermal protection in the transfer pump(s) to trip, requiring maintenance action to reset when the aux tank(s) become empty.

4-107. APU Inlet Particle Separator (IPS) Kit. (Helicopters With IPS Kit Installed).

The APU IPS Kit provides APU inlet air filtration via a centrifugal particle separator unit. The separator is attached to the APU radial inlet housing and provides for collection and overboard exhausting of scavenge particles. The passive separator operation employs APU bleed air to drive an ejector pump used for particle scavenging. The IPS kit is designed to be physically compatible with both HIRSS and non-HIRSS helicopters with the T-62T-40-1 series 200/300 APU installations only. The kit consists of three categories of removable components:

a. Air Particle Separator Assembly.

b. APU Modification Kit - Parts required to modify the APU to accept the separator assembly.

c. Airframe Provisions - Parts required to install the separator assembly and provide bleed air supply and scavenge exhaust provisions.

NOTE

When installed, the weight of the IPS Kit is included in Useful Load.

CHAPTER 5
OPERATING LIMITS AND RESTRICTIONS

Section I GENERAL

5-1. Purpose.

This chapter identifies or refers to all important operating limits and restrictions that shall be observed during ground and flight operations.

5-2. General.

The operating limitations set forth in this chapter are the direct results of design analysis, tests, and operating experiences. Compliance with these limits will allow the pilot to safely perform the assigned missions and to derive maximum use from the aircraft.

5-3. Exceeding Operational Limits.

Any time an operational limit is exceeded an appropriate entry shall be made on DA Form 2408-13. Entry shall state what limit or limits were exceeded, range, time beyond limits, and any additional data that would aid maintenance personnel in the maintenance action that may be required. The helicopter shall not be flown until corrective action is taken.

5-4. Minimum Crew Requirements.

The minimum crew required to fly the helicopter is two pilots. Additional crewmembers as required will be added at the discretion of the commander, in accordance with pertinent Department of the Army regulations.

Section II SYSTEM LIMITS

5-5. Instrument Markings.

5-6. Instrument Marking Color Codes.

NOTE

Instrument/color markings may differ from actual limits.

Operating limitations are shown as side arrows or colored strips on the instrument face plate of engine, flight and utility system instruments (Figure 5-1 and 5-1.1). Those readings are shown by ascending and descending columns of multicolor lights (red, yellow and green) measured against vertical scales. RED markings indicate the limit above or below which continued operation is likely to cause damage or shorten component life. GREEN markings indicate the safe or normal range of operation. YELLOW markings indicate the range when special attention should be given to the operation covered by the instrument.

5-7. Rotor Limitations.

It is not abnormal to observe a % RPM 1 and 2 speed split during autorotational descent when the engines are fully decoupled from the main rotor. A speed increase of one engine from 100% reference to 103% maximum can be expected. During power recovery, it is normal for the engine operating above 100% RPM to lead the other engine. Refer to Figure 5-1 for limitations.

5-8. Rotor Start and Stop Limits.

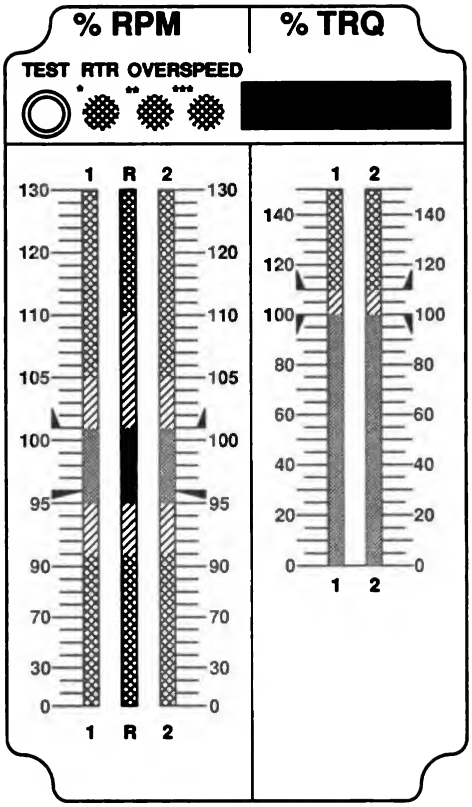
Maximum wind velocity for rotor start or stop is 45 knots from any direction.

5-9. Rotor Speed Limitations.

Refer to Figure 5-1 for rotor limitations.

MAIN ROTOR OVERSPEED

- * 127%
- ** 137%
- *** 142%



ENGINE % RPM 1-2

12-SECOND TRANSIENT	105%-107%
TRANSIENT	101%-105%
CONTINUOUS	95%-101%
TRANSIENT	91%-95%
MINIMUM EXCEPT FOR IDLE AND TRANSIENT	91%

AVOID OPERATION IN 20%-40% AND 60%-90% RANGE EXCEPT DURING START AND SHUTDOWN

ENGINE % TRQ

100

10-SECOND TRANSIENT	
DUAL-ENGINE	100%-125%
SINGLE-ENGINE	110%-135%
CONTINUOUS SINGLE-ENGINE ONLY	0%-110%
CONTINUOUS DUAL-ENGINE	0%-100%

MAIN ROTOR % RPM R

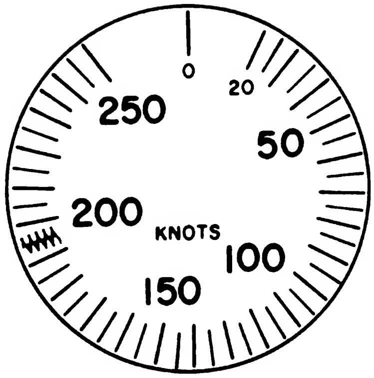
POWER ON		POWER OFF (AUTOROTATION)	
TRANSIENT	101%-107%	MAXIMUM	110%
CONTINUOUS	95%-101%	TRANSIENT	105%-110%
TRANSIENT	91%-95%	NORMAL	90%-105%
MINIMUM EXCEPT FOR IDLE AND TRANSIENT	91%		
TRANSIENT ONLY	0%-91%		

LEGEND

- RED
- YELLOW
- GREEN
- DIGITAL TORQUE

AA0373_1A

Figure 5-1. Instrument Markings (Sheet 1 of 4)



AIRSPEED

MAXIMUM	193 KNOTS

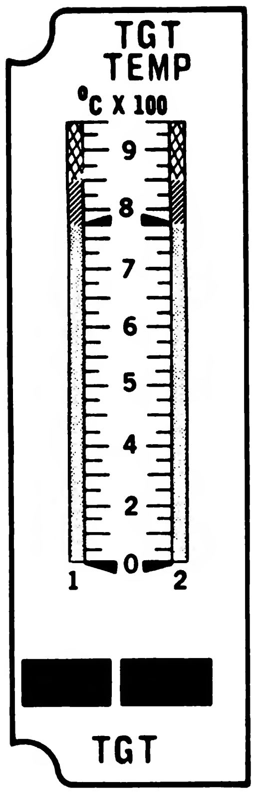
REFER TO SECTION V FOR ADDITIONAL AIRSPEED LIMITATIONS

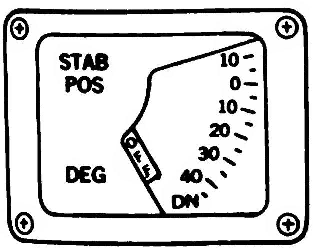
LEGEND

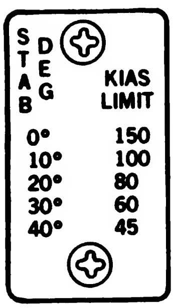
- RED
- YELLOW
- GREEN
- DIGITAL READOUT

TURBINE GAS TEMPERATURE -700

10-SECOND TRANSIENT	850-886°C
START ABORT LIMITS	850°C
30-MINUTE LIMIT	775-850°C
NORMAL	0-775°C

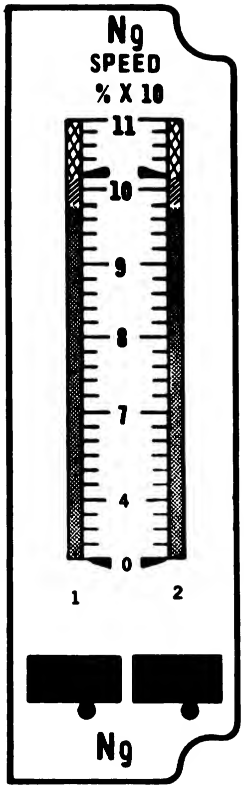






UH60A-44897.2 (R1C12)

Figure 5-1. Instrument Markings (Sheet 2 of 4)

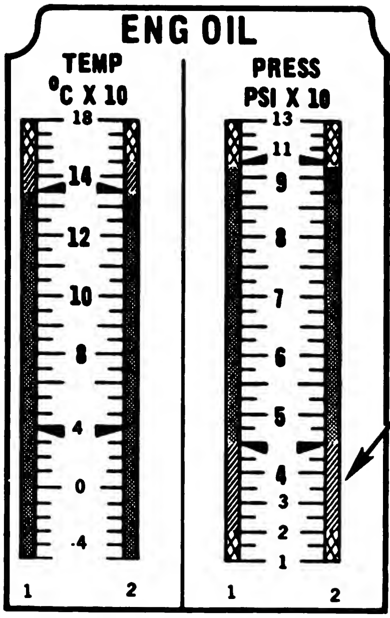


ENGINE Ng

10-SECOND TRANSIENT	102%-105%
30-MINUTE LIMIT	98-102%
CONTINUOUS	0-98%

ENGINE OIL PRESSURE

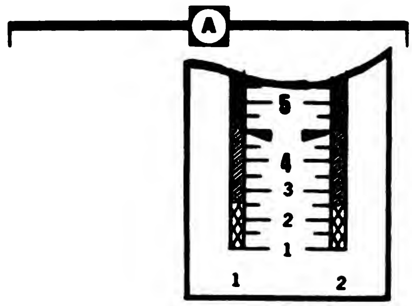
	GAGE MARKING	ACTUAL LIMITS
MAXIMUM		100 PSI
CONTINUOUS	40-100 PSI	20-100 PSI *
IDLE	20-40 PSI	
MINIMUM	20 PSI	



ON HELICOPTERS WITH MODIFIED INSTRUMENT FACE-PLATES

A

* 35 PSI MINIMUM AT 90% Ng



	GAGE MARKING	ACTUAL LIMITS
CONTINUOUS	45-100 PSI	20-100 PSI *
IDLE	25-45 PSI	20-40 PSI
MINIMUM	25 PSI	20 PSI

ON HELICOPTERS WITHOUT MODIFIED INSTRUMENT FACEPLATES

ENGINE OIL TEMPERATURE

MAXIMUM	150°C
30-MINUTE LIMIT	135-150°C
CONTINUOUS	-50-135°C

LEGEND	
	RED
	YELLOW
	GREEN
	DIGITAL READOUT

UH60A_44897_3 (R1C13)

Figure 5-1. Instrument Markings (Sheet 3 of 4)

MAIN TRANSMISSION OIL TEMPERATURE

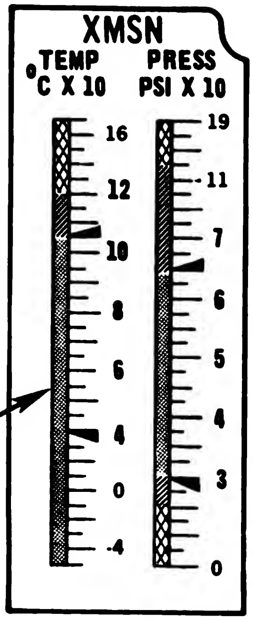
(ON HELICOPTERS WITH MODIFIED INSTRUMENT FACEPLATE)

UH60A EH

MAXIMUM	120°C
PRECAUTIONARY	105 - 120°C
CONTINUOUS	-50 - 105°C

LEGEND

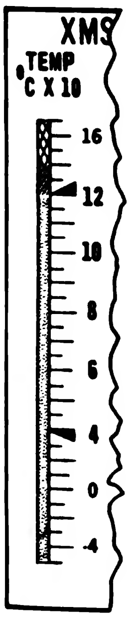
- RED
- YELLOW
- GREEN
- DIGITAL READOUT



MAIN TRANSMISSION OIL PRESSURE

MAXIMUM	130 PSI
PRECAUTIONARY	65-130 PSI
CONTINUOUS	30-65 PSI
IDLE AND TRANSIENT	20-30 PSI
MINIMUM	20 PSI

A



MAIN TRANSMISSION OIL TEMPERATURE

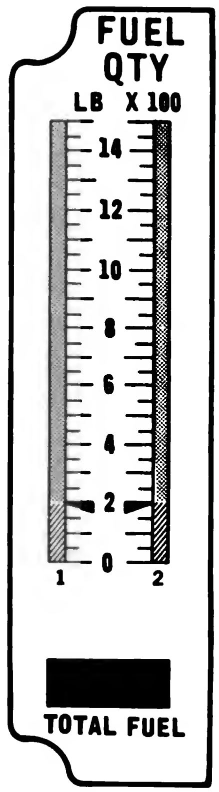
(ON HELICOPTERS WITHOUT MODIFIED INSTRUMENT FACEPLATE)

UH60A EH

	GAGE MARKING	ACTUAL LIMITS
MAXIMUM	140°C	120°C
PRECAUTIONARY	120 - 140°C	105 - 120°C
CONTINUOUS	-50 - 120°C	-50 - 105°C

FUEL QUANTITY UH60A EH

NORMAL	200-1500 LBS
PRECAUTIONARY	0-200 LBS
	TOTAL FUEL READOUT



UH60A_44897_4 (R1C13)

Figure 5-1. Instrument Markings (Sheet 4 of 4)

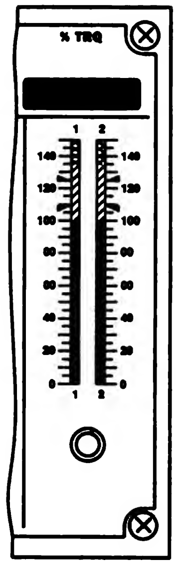
ENGINE % TRQ

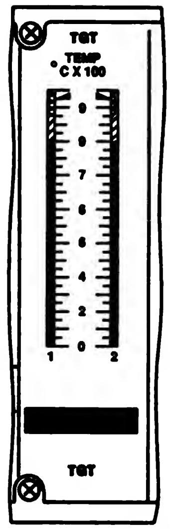
10-SECOND TRANSIENT

DUAL-ENGINE	100%-125%
SINGLE-ENGINE	135%-144%
CONTINUOUS SINGLE-ENGINE ONLY	0%-135%
CONTINUOUS DUAL-ENGINE	
ABOVE 80 KIAS	0%-100%
AT OR BELOW 80 KIAS	0%-120%

NOTE

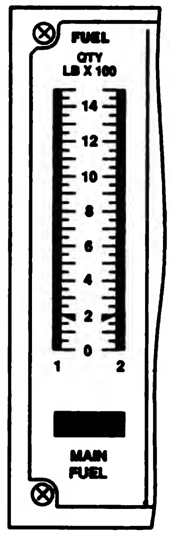
THE DUAL ENGINE CONTINUOUS TORQUE IS FURTHER RESTRICTED AS INDICATED BY A PLACARD ON THE INSTRUMENT PANEL. THE RESTRICTION IS APPLICABLE TO HELICOPTERS PRIOR TO S/N 91-26360 THAT ARE NOT EQUIPPED WITH IMPROVED MAIN ROTOR FLIGHT CONTROLS. SEE PLACARD FIGURE 5-1.2.





TURBINE GAS TEMPERATURE

10-SECOND TRANSIENT	903°-949° C
2.5-MINUTES TRANSIENT (CONTINGENCY POWER)	878°-903° C
START ABORT LIMIT	851° C
10-MINUTE LIMIT	851°-878° C
30-MINUTE LIMIT	810°-851° C
NORMAL	0°-810° C

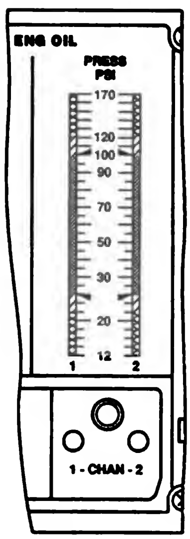


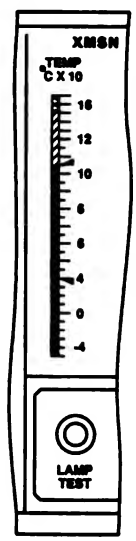
FUEL QUANTITY

NORMAL	200-1500 LBS
PRECAUTIONARY	0-200 LBS

ENGINE OIL PRESSURE

MAXIMUM	120 PSI
5-MINUTE LIMIT	100-120 PSI
NORMAL OPERATION	26-100 PSI
IDLE	22-26 PSI
MINIMUM	22 PSI





MAIN TRANSMISSION OIL TEMPERATURE

MAXIMUM	140° C
PRECAUTIONARY	105-140° C
CONTINUOUS	-50-105° C

LEGEND

(crosshatch)	RED
(diagonal)	YELLOW
(solid)	GREEN
(solid)	DIGITAL READOUT

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SA

Figure 5-1.1. Instrument Markings UH 60L

5-10. Main Transmission Module Limitations.

a. Oil pressure fluctuations should not occur during steady state forward flight or in level hover. Momentary fluctuations in oil press may occur during transient maneuvers (i.e., pitch pulse during AFCS Hover checks, in gusty wind condition, autorotation, or steady nose up hover. Pitch attitude changes above +6° will cause pressure fluctuations. Those fluctuations including momentary drops into the yellow range (below 30 psi) are acceptable. Oil pressure should remain in the 50-55 psi range for the UH-60A/EH-60A, and 50-60 psi for the UH-60L for most conditions. If fluctuations occur in steady state or main gearbox pressure remains below 50 psi, make an entry on Form 2408-13.

b. A demand for maximum power from engines with different engine torque factors (ETF) will cause a torque split when the low ETF engine reaches TGT limiting. This torque split is normal. Under these circumstances, the high power engine may exceed 100% torque up to 110% (−700) or 135% (−701C) continuous as long as the average of % TRQ 1 and 2 is 100% or less. (Example: #1 TRQ = 96% at TGT limiting, #2 TRQ is allowed to go up to 104%. Total aircraft torque = (96% + 104%/2) = 100%.

Section III POWER LIMITS

5-11. Engine Power Limitations. 700

The limitations which are presented in Figure 5-1, present absolute limitations, regardless of atmospheric conditions. For variations in power available with temperature and pressure altitude, refer to the TORQUE AVAILABLE charts in Chapter 7.

5-12. Engine Power Limitations. 701C

The limitations which are presented in Figure 5-1.2 are absolute limitations regardless of atmospheric conditions. For variations in power available with temperature and pressure altitude, refer to TORQUE AVAILABLE charts in Chapter 7.1. As indicated by a placard on the instrument panel, the dual engine torque is further restricted on those helicopters prior to S/N 91-26360 that are not equipped with improved main rotor flight controls. See placard on Figure 5-1.2.

5-13. Engine RPM (N_p SPEED and % RPM 1 and 2) Limitations.

Transient % RPM 1 or 2 operation in yellow range (101% - 105%) is not recommended as good operating practice. However no damage to either engine or drive train is incurred by operation within this range.

5-14. Engine Starter Limits.

The pneumatic starter is capable of making the number of consecutive start cycles listed below, when exposed to the environmental conditions specified, with an interval of at least 60 seconds between the completion of one cycle and the beginning of the next cycle. A starting cycle is the interval from start initiation and acceleration of the compressor, from zero rpm, to starter dropout. The 60-second delay between start attempts applies when the first attempt is aborted for any reason, and it applies regardless of the duration of the first attempt. If motoring is required for an emergency, the 60-second delay does not apply.

a. At ambient temperatures of +16°C (+61°F) and below, two consecutive start cycles may be made, followed by a 3-minute rest period, followed by two additional consecutive start cycles. A 30-minute rest period is then required before any additional starts.

b. At ambient temperatures of +16° to +52°C (+61° to +126°F), two consecutive start cycles may be made. A 30-minute rest period is then required before any additional start cycles.

5-15. Pneumatic Source Inlet Limits.

The minimum ground-air source (pneumatic) required to start the helicopter engines is 40 psig and 30 ppm at +149°C (+300°F). The maximum ground-air source to be applied to the helicopter is 50 psig at +249°C (+480°F), measured at the external air connector on the fuselage.

5-16. Engine Start Limits.

CAUTION

Engine start attempts at or above a pressure altitude of 18,000 feet 701C, or 20,000 feet 700 could result in a Hot Start.

Crossbleed starts shall not be attempted unless the anti-ice light is off, and operating engine must be at 90% Ng SPEED and rotor speed at 100% RPM R. When attempting single-engine starts at pressure altitudes above 14,000 feet, press the start switch with the ENG POWER CONT lever OFF, until the maximum motoring speed (about 24%) is reached, before going to IDLE. Engine starts using APU source may be attempted when within the range of FAT and pressure altitude of Figure 5-2.

5-17. Engine Overspeed Check Limitations.

Engine overspeed check in flight is prohibited. Engine overspeed checks, on the ground, are authorized by designated maintenance personnel only.

5-18. Hot Fuel Limitations.

When an aircraft operating on JP-4 is restarted within 2 hours of an engine shutdown and air temperature is above 21°C (70°F), a minimum of 2 minutes of two engine ground operation at 100% RPM R is required prior to takeoff to purge possible hot fuel from engine nacelle area. When using JP-4, both fuel boost pumps shall be on and operational. Otherwise engine flameout may result.

UH-60L DUAL ENGINE TORQUE LIMITS - % TORQUE

PRESSURE ALT. 1000 FT / FAT, °C	-20	-10	0	10	20	30	40	50	FAT, °C / PRESSURE ALT. 1000 FT
20	60	58	56	53	51	49	48	46	20
18	66	63	61	59	56	54	52	50	18
16	72	69	66	64	61	59	57	55	16
14	79	75	73	70	67	65	62	60	14
12	86	82	79	76	73	70	68	66	12
10	93	89	85	83	80	77	74	71	10
8		97	93	90	86	83	81	77	8
6				97	93	90	87	83	6
5		100			97	93	90	87	5
4						97	94	91	4
3	100% TORQUE 2000 FT. & BELOW						97	95	3
FAT, °C	-20	-10	0	10	20	30	40	50	FAT, °C

HELICOPTERS PRIOR TO S/N 91-26360 NOT EQUIPPED WITH IMPROVED MAIN ROTOR FLIGHT CONTROLS.

AL0044

Figure 5-1.2. Dual Engine Torque Limitations 701C

EXAMPLE

WANTED

IF TWO-ENGINE START CAN BE DONE AT 2900 FEET PRESSURE ALTITUDE AND 16°C

KNOWN

PRESSURE ALTITUDE=2900 FEET
FREE-AIR TEMPERATURE = 16°C

METHOD

ENTER CHART AT PRESSURE ALTITUDE 2900 FEET → MOVE RIGHT TO INTERSECT VERTICAL TEMPERATURE LINE. IF LINES INTERSECT WITHIN DARK SHADED AREA, TWO-ENGINE START CAN BE DONE.

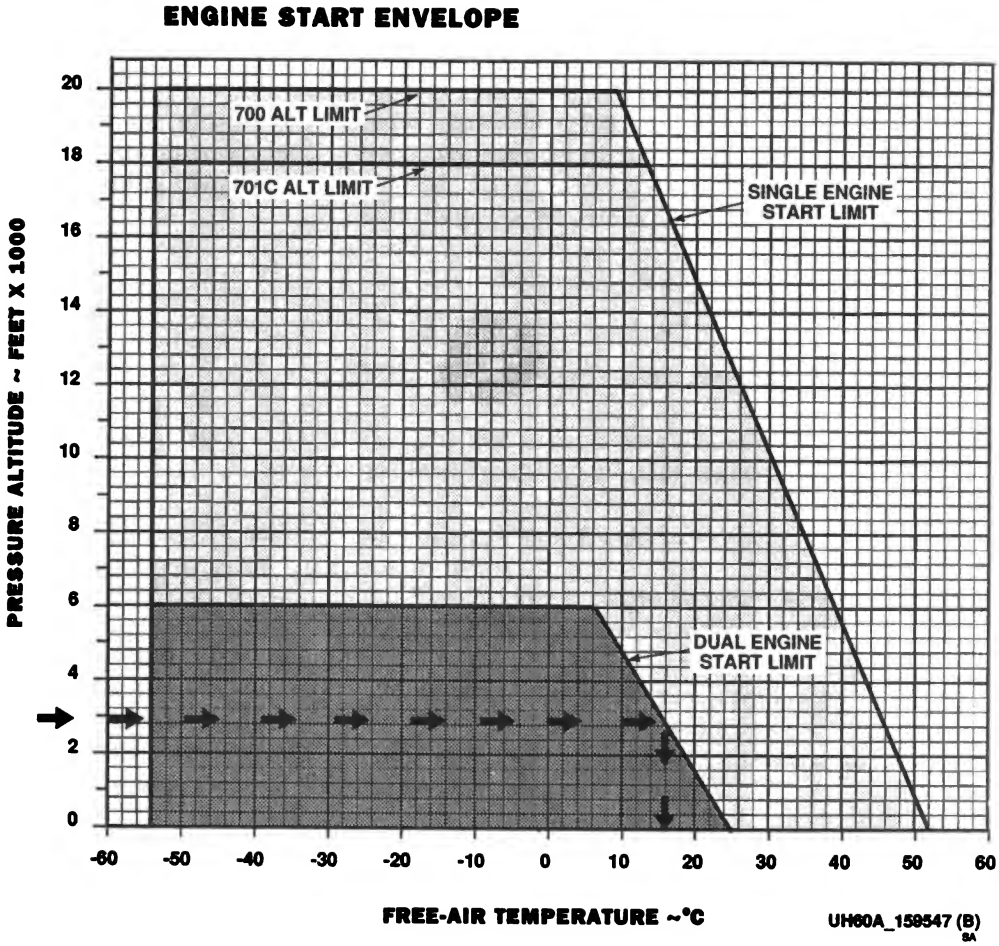


Figure 5-2. Engine Start Envelope

Section IV LOADING LIMITS

5-19. Center of Gravity Limitations.

a. Center of gravity limits for the aircraft to which this manual applies and instructions for computation of the center of gravity are contained in Chapter 6.

5-20. Weight Limitations.

WARNING

Four (4) ERFS 230 gallon tanks may be flown providing the aircraft maximum gross weight is not exceeded.

The maximum gross weight for UH/EH-60A helicopters without provisions for Engine Output Shaft - STUD BALANCE (MWO 55-1520-237-50-58 not incorporated) or without the wedge mounted pitot static probes (paragraph 7-32) provides for use with ESSS is 20,250 pounds. The maximum gross weight for UH-60L helicopters and UH/EH-60A helicopters with provisions for Engine Output Shaft - STUD BALANCE (MWO 55-1520-237-50-58 incorporated) and with wedge mounted pitot static probe (reference paragraph 7-32) provides for use with ESSS is 22,000 pounds. In addition to the above limits maximum weight are further limited by cargo floor maximum capacity of 300 pounds per square foot.

5-21. Stowage Provisions.

Maximum capacity for each storage compartment is 125 pounds.

5-22. Cabin Ceiling Tiedown Fittings.

The four cabin ceiling tiedown fittings have a limited load capability of 4,000 pounds.

5-23. Cargo Hook Weight Limitation.

The maximum weight that may be suspended from the cargo hook is limited to 8,000 pounds.

5-24. Rescue Hoist Weight Limitations.

The maximum weight that may be suspended from the rescue hoist is 600 pounds.

Figure 5-3 Deleted

Section V AIRSPEED LIMITS

5-25. Airspeed Operating Limits.

The airspeed operating limits charts (Figures 5-4 and 5-4.1) defines maximum permitted airspeed (VNE) as a function of altitude, temperature, and gross weight. Additional airspeed limits not shown on the chart are:

a. Maximum airspeed for one engine inoperative is 130 KIAS.

b. Maximum airspeed for autorotation at a gross weight of 16,825 pounds or less is 150 KIAS.

c. Maximum airspeed for autorotation at a gross weight of greater than 16,825 pounds is 130 KIAS.

d. Sideward/rearward fight limits:

(1) For aircraft with a biased tail rotor the maximum sideward/rearward flight is 45 knots (35 knots with ESSS) in a no wind condition. Hovering in winds greater than 45 knots (35 knots with ESSS) from the sides or rear is prohibited. Sideward/rearward flight into the wind, when combined with windspeed, shall not exceed 45 knots (35 knots with ESSS). Refer to Chapter 8, Subparagraph 8-62 for additional information regarding crosswind/side flight operations during high altitude/heavy weight operating conditions.

(2) For aircraft with unbiased tail rotors refer to Figure 5-5 for sideward/rearward flight limits.

e. When external stores are attached, helicopter forward air speed is limited to 178 KIAS.

f. SAS inoperative airspeed limits:

(1) One SAS inoperative - 170 KIAS.

(2) Two SAS inoperative - 150 KIAS.

(3) Two SAS inoperative in IMC - 140 KIAS.

g. Hydraulic system inoperative limits:

(1) One hydraulic system inoperative - 170 KIAS.

(2) Two hydraulic systems inoperative - 150 KIAS.

(3) Two hydraulic systems inoperative in IMC - 140 KIAS.

h. Searchlight and landing light airspeed limits.

(1) Landing light. If use is required, the landing light must be extended prior to reaching a maximum forward airspeed of 130 KIAS. With landing light extended, airspeed is limited to 180 KIAS.

(2) Searchlight. If use is required, the searchlight must be extended prior to reaching a maximum forward airspeed of 100 KIAS. With searchlight extended, airspeed is limited to 180 KIAS.

AIRSPEED OPERATING LIMITATIONS

AIRCRAFT WITHOUT ESSS INSTALLED 100% RPM R

EXAMPLE

WANTED

MAX IAS FOR VARIOUS TEMPS, PRESSURE ALTITUDE AND GROSS WEIGHTS

KNOWN

FAT = - 20°C
PRESSURE ALTITUDE = 4,000 FEET.
GROSS WEIGHT = 18,000 POUNDS.

METHOD

ENTER FAT AT -20°C. MOVE RIGHT TO PRESSURE ALTITUDE 4,000 FEET. MOVE DOWN TO 18,000 POUNDS GROSS WEIGHT. MOVE LEFT TO READ 186 KNOTS.

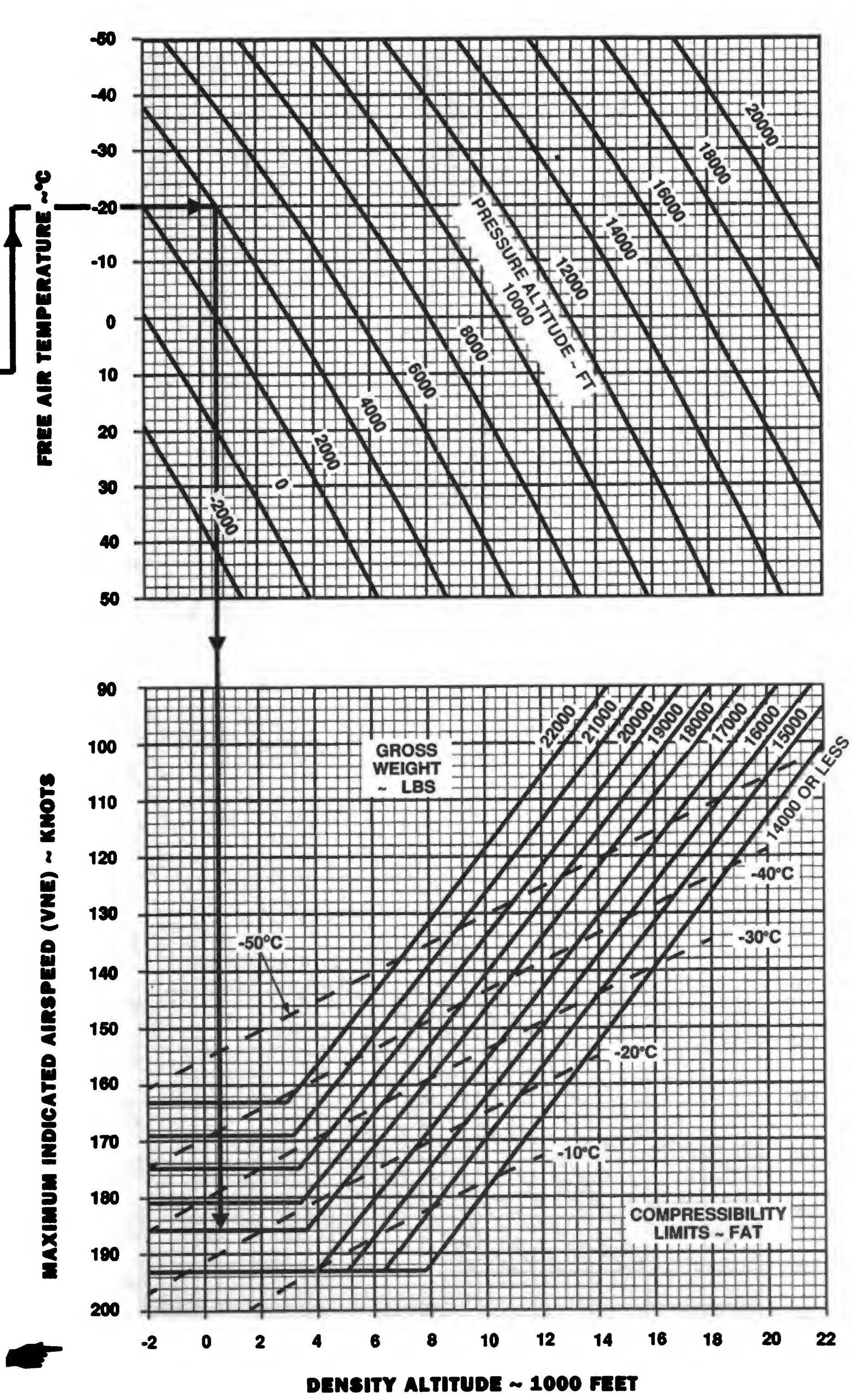


Figure 5-4. Airspeed Operating Limits

AIRSPEED OPERATING LIMITATIONS

AIRCRAFT WITH EXTERNAL STORES SUPPORT SYSTEM INSTALLED

100% RPM R

AIRSPEED OPERATING LIMITS ESSS

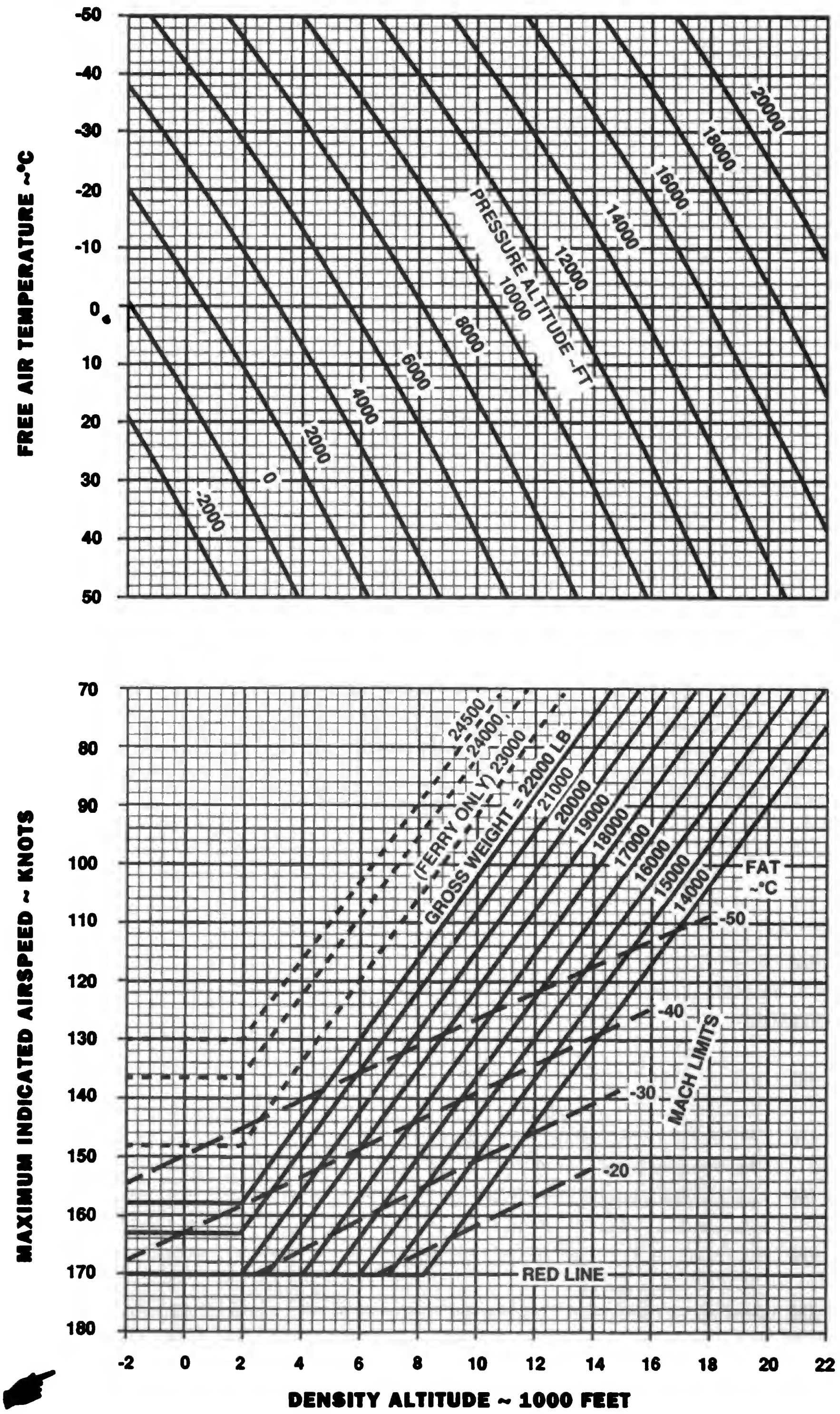
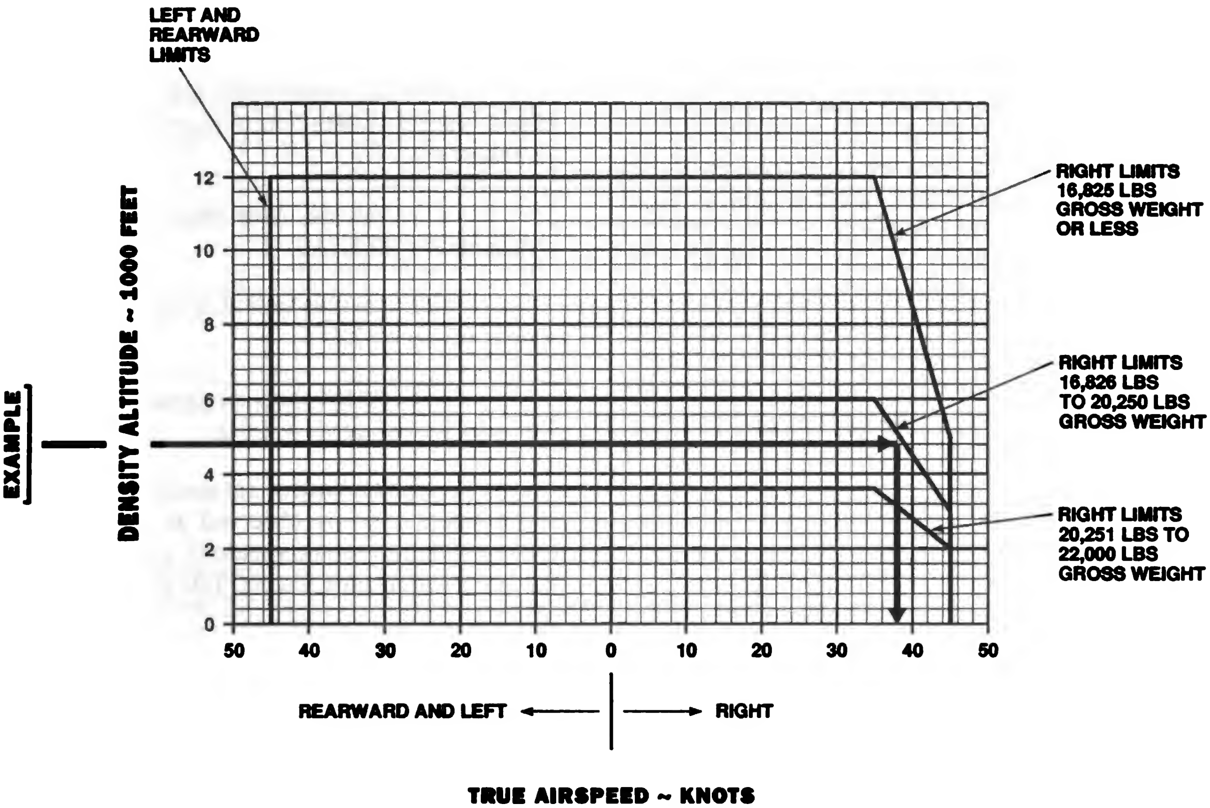


Figure 5-4.1. Airspeed Operating Limits

SIDEWARD/REARWARD FLIGHT SPEED LIMITS



EXAMPLE

WANTED

MAXIMUM TRUE AIRSPEED RIGHT SIDEWARD FLIGHT LIMIT AT MISSION GROSS WEIGHT

KNOWN

DENSITY ALTITUDE = 4,800 FEET
GROSS WEIGHT = 19,500 POUNDS

METHOD

ENTER DENSITY ALTITUDE AT 4,800 FEET. MOVE RIGHT TO INTERSECTION 20,250 POUNDS GROSS WEIGHT LINE. MOVE DOWN. READ MAXIMUM TRUE AIRSPEED TO RIGHT = 39 KNOTS.

NOTE

FOR AIRCRAFT WITH TAIL ROTOR BIAS. CROSSWIND, SIDEWARD OR REARWARD FLIGHT IS LIMITED TO 45 IN A CLEAN CONFIGURATION AND 35 KNOTS IN THE HIGH DRAG CONFIGURATION AT ANY ALTITUDE WHERE HOVER CAPABILITY EXISTS. THIS LIMITATION COVERS GROSS WEIGHTS UP TO 22,000 POUNDS IN CLEAN CONFIGURATION AND 24,500 POUNDS IN HIGH DRAG CONFIGURATION.

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SA

Figure 5-5. Sideward/Rearward Flight Limits

5-26. Flight with Cabin Door(s)/Window(s) Open.

The following airspeed limitations are for operating the helicopter in forward flight with the cabin doors/window open:

a. Cabin doors

(1) Cabin doors may be fully open up to 100 KIAS with soundproofing installed after station 379.

(2) Cabin doors may be fully open up to 145 KIAS with soundproofing removed aft of station 379 or with soundproofing secured properly.

(3) The doors will not be intentionally moved from the fully open or closed position in flight. The cabin doors may be opened or closed during hovering flight. The cabin doors must be closed or fully opened and latched before forward flight. Should the door inadvertantly open in flight, it may be secured fully open or closed.

b. Gunner's window(s) may be fully open up to 170 KIAS.

c. Cockpit doors sliding windows will not be opened or closed during flight at any airspeeds.

d. Flight with cockpit door(s) removed is prohibited.

5-27. Airspeed Limitations Following Failure of the Automatic Stabilator Control System.

a. Manual control available. If the automatic stabilator control system fails in flight and operation cannot be restored:

(1) The stabilator shall be set full down at speeds below 40 KIAS.

(2) The stabilator shall be set at zero degrees at speeds above 40 KIAS.

(3) Autorotation airspeed shall be limited to 120 KIAS at all gross weights.

b. Manual control not available. The placard airspeed limits shall be observed as not-to-exceed speed (powered flight and autorotation), except in no case shall the autorotation limit exceed 120 KIAS.

Section VI MANEUVERING LIMITS

5-28. Prohibited Maneuvers.

a. Hovering turns greater than 30° per second are prohibited. Intentional maneuvers beyond attitudes of ±30° in pitch or ±60° in roll are prohibited.

b. Simultaneous moving of both ENG POWER CONT levers to IDLE or OFF (throttle chop) in flight is prohibited.

c. Rearward ground taxi is prohibited.

5-29. Restricted Maneuvers.

5-30. Manual Operation of the Stabilator.

Manual operation of the stabilator in flight is prohibited except as required by formal training requirements, or as alternate stabilator control in case the AUTO mode malfunctions.

5-31. Downwind Hovering.

Prolonged rearward flight and downwind hovering are to be avoided to prevent accumulation of exhaust fumes in the helicopter and heat damage to windows on open cargo doors.

5-32. Maneuvering Limitations.

The maneuvering limits of the helicopter, other than as limited by other paragraphs within this section, are always defined by main rotor blade stall. Stall has not been encountered in one G flight up to the airspeeds shown in chart Figure 5-4. In maneuvering flight, stall will be accompanied by an increase in 4-per-rev vibration levels, which increase proportionately with the degree of stall. Maneuvering flight which results in heavy stall and thus significant increases in 4-per-rev vibration levels is prohibited.

5-32.1. High Speed Yaw Maneuver Limitation.

Above 80 KIAS avoid abrupt, full pedal inputs to prevent excess tail rotor system loading.

5-33. Limitations for Maneuvering With Sling Loads.

Maneuvering limitations with a sling load is limited to a maximum of 30° angle of bank in forward flight (Figure 5-6). Side flight is limited by bank angle and is decreased as airspeed increases. Rearward flight with sling load is limited to 35 knots.

5-34. Limitations for Maneuvering With Rescue Hoist Loads.

Maneuvering limitations with a rescue hoist load is limited to maximum of 30° angle of bank in forward flight (Figure 5-6). Side flight is limited by bank angle and is decreased as airspeed is increased. Rearward flight with hoist load is limited to 35 knots. Rate of descent is limited to 1000 feet-per-minute.

5-35. Bank Angle Limitation.

Bank angles shall be limited to 30° when a PRI SERVO PRESS caution light is on.

5-36. Landing Gear Limitations.

Do not exceed a touchdown sink rate of 540 feet-per-minute on level terrain and 360 feet-per-minute on slopes with gross weights of up to 16,825 pounds; above 16,825 pounds gross weight 300-feet-per-minute on level terrain and 180 feet-per-minute on slopes.

5-37. Landing Speed Limitations.

Maximum forward touchdown speed is limited to 60 knots ground speed on level terrain.

5-38. Slope Landing Limitations.

The following slope limitations apply regardless of gross weight or CG:

NOTE

Because of the flat profile of the main transmission and forward location of both transmission oil pumps, transmission oil pressure will drop during nose-up slope operations. At slope angle of 10° an indicated oil pressure of 30-35 psi is normal, and at a 15° slope angle a pressure in the range of 10-15 psi is normal, due to pitching of the helicopter.

a. 15° nose-up, right wheel up or left wheel upslope. The slope limitations shall be further reduced by 4° for every 10 knots of wind.

b. 6° nose downslope. Landing in downslope conditions with tail winds greater than 15 knots shall not be conducted. A low-frequency oscillation may occur when landing nose-down on a slope with the cyclic near the aft stop.

c. The main gearbox may be operated up to 30 minutes at a time with pressure fluctuations when the helicopter is known to be at a nose-up attitude (i.e., slope landings or hover with extreme aft CG).

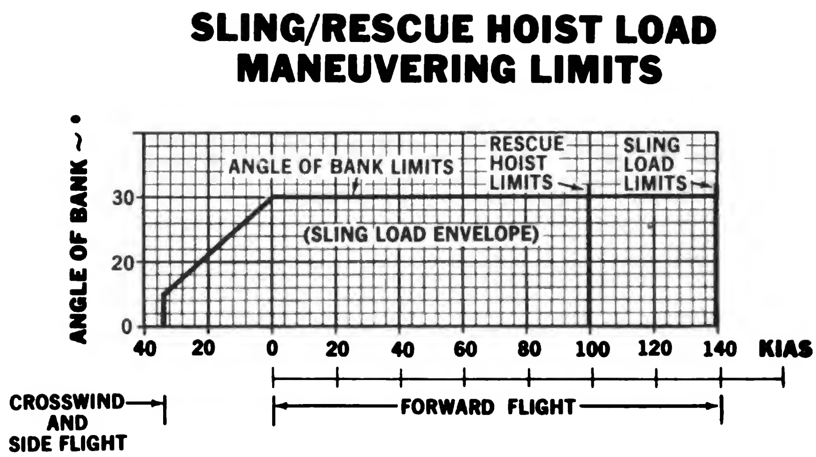


Figure 5-6. Sling/Hoist Load Maneuvering Limitations

Section VII ENVIRONMENTAL RESTRICTIONS

5-39. Flight in Instrument Meteorological Conditions (IMC).

1. This aircraft is qualified for operation in instrument meteorological conditions. Normal configuration for IMC flight includes all components of the AFCS installed and properly operating. If the roll trim actuator has been removed and a serviceable replacement is not available, the helicopter may be launched into IMC, providing a placard is placed on the instrument panel noting the removal of the roll trim actuator, and that the following AFCS equipment is installed and functional:

a. Stabilator.

b. SAS 1 and SAS 2 (all axes).

2. The helicopter shall not enter IMC flight if any component of either vertical gyro is inoperative. Should both systems fail during flight, a landing should be made as soon as practicable.

5-40. Flight in Icing Conditions.

a. When the ambient air temperature is + 4°C (39°F) or below and visible liquid moisture is present, icing may occur. Icing severity is defined by the liquid water content (LWC) of the outside air and measured in grams per cubic meter (g/m3).

a. Trace :LWC 0 to 0.25 g/m3
b. Light :LWC 0.25 to 0.5 g/m3
c. Moderate :LWC 0.5 to 1.0 g/m3
d. Heavy :LWC greater than 1.0 g/m3

b. Helicopters not equipped with engine inlet anti-ice modulating valve, insulated ambient air sensing tube, and blade deice kit are prohibited from flight into icing conditions (ambient temperature of +4°C (+39°F) or below in visible liquid moisture e.g. rain, clouds, or wet snow).

c. Helicopters equipped with operational engine inlet anti-ice modulating valve and insulated ambient air sensing tube but not equipped with blade deice kit are permitted flight into trace icing conditions. Flight into light icing conditions is not recommended. Flight into moderate or more severe icing conditions is prohibited.

d. Helicopters equipped with operational engine inlet anti-ice modulating valve, insulated ambient air sensing tube, and operational blade deice kit are permitted flight into forecast or known moderate icing conditions.

e. Helicopters equipped with operational engine inlet anti-ice modulating valve, and insulated ambient air sensing tube, but equipped with an inoperative blade de-ice kit, are permitted flight in the conditions as described in paragraph 5-40c.

f. All other anti-ice equipment (i.e., windshield anti-ice, pitot heat, engine anti-ice) shall be installed and operational before flight into known or forecasted icing conditions.

5-41. Engine and Engine Inlet Anti-Ice Limitations.

At engine power levels of 10% TRQ per engine and below, full anti-ice capability cannot be provided, due to engine bleed limitations. Avoid operation under conditions of extreme low power requirements such as high rate of descent (1900 fpm or greater), or ground operation below 100% RPM R, during icing conditions. The cabin heating system should be turned off before initiating a high rate of descent.

5-42. Backup Hydraulic Pump Hot Weather Limitations.

During prolonged ground operation of the backup pump using MIL-H-83282 or MIL-H-5606 with the rotor system static, the backup pump is limited to the following temperature/time/cooldown limits because of hydraulic fluid overheating.

FAT°C (°F)	Operating Time (Minutes)	Cooldown Time (Pump Off) (Minutes)
−54° - +32° (−65° - 90°)	Unlimited	— —
+33° - +38° (+91° - +100°)	24	72
+39° - +52° (+102° - 126°)	16	48

5-43. APU Operating Limitations.

To prevent APU overheating, APU operation at ambient temperature of +43°C (+109°F) and above with engine and rotor operating, is limited to 30 minutes. With engine and rotor not operating, the APU may be operated continuously up to an ambient temperature of +51°C (+124°F).

5-44. Windshield Anti-ice Limitations.

Windshield anti-ice check shall not be done when FAT is over +21°C (+70°F). Refer to TM 55-1520-237-T.

5-45. Turbulence and Thunderstorm Operation.

a. Intentional flight into severe turbulence is prohibited.

b. Intentional flight into thunderstorms is prohibited.

c. Intentional flight into turbulence with a sling load attached and an inoperative collective pitch control friction is prohibited.

Section VIII OTHER LIMITATIONS

NOTE

EH

Until completion of airworthiness qualification of EH-60A flight of aircraft in EH-60A configuration is prohibited unless operating under an Airworthiness Release from U.S. Army Aviation Systems Command.

5-46. Lockout Operation Limitations.

(a) Lockout operation for practice, training, or maintenance is permitted in flight at minimum altitude of 4,000 feet AGL.

(b) Lockout operation is permitted on the ground.

(c) Emergency lockout procedures prescribed in Chapter 9 remain in effect for actual in-flight emergencies.

CHAPTER 6
WEIGHT/BALANCE AND LOADING

Section I GENERAL

6-1. Introduction.

This chapter contains instructions and data to compute any combination of weight and balance for this helicopter, if basic weight and moment are known.

6-2. Class.

All Army helicopters defined in this manual are in Class 2. Additional directives governing weight and balance of Class 2 aircraft forms and records are contained in AR 95 series, TM 55-1500-342-23, and DA PAM 738-751.

6-3. Helicopter Compartment and Station Diagram.

Figure 6-1 shows the reference datum line, that is 341.2 inches forward of the centroid of the main rotor, the fuselage stations, waterlines and buttlines. The fuselage is divided into compartments A through F. The equipment in each compartment is listed on DD Form 365-1 (Chart A) in the Weight and Balance Handbook.

Section II WEIGHT AND BALANCE

6-4. Scope.

This section provides appropriate information required for the computation of weight and balance for loading an individual helicopter. The forms currently in use are the DD Form 365 series. The crewmember has available the current basic weight and moment which is obtained from DD Form 365-3 (Chart C) for the individual helicopter. This chapter contains weight and balance definitions; explanation of, and samples of Basic Weight and Balance Record, DD Form 365-3 (Chart C) (the source of the basic weight and moment); figures showing weights and moments of variable load items; and a practical example of a loading problem using DD Form 365-3 (Chart C) and clearance form DD Form 365-4 (Form F).

6-5. Weight Definitions.

a. *Basic Weight.* Basic weight of an aircraft is that weight which includes all hydraulic systems and oil systems full, trapped and unusable fuel, and all fixed equipment, to which it is only necessary to add the crew, fuel, cargo, and ammunition (if carried) to determine the gross weight for the aircraft. The basic weight varies with structural modifications and changes of fixed aircraft equipment.

b. *Operating Weight.* Operating weight includes the basic weight plus aircrew, the aircrew's baggage, and emergency and other equipment that may be required. Operating weight does not include the weight of fuel, ammunition, cargo, or external auxiliary fuel tanks if such tanks are to be disposed of during flight.

c. *Gross Weight.* Gross weight is the total weight of an aircraft and its contents.

6-6. Balance Definitions.

6-7. Horizontal Reference Datum.

The horizontal reference datum line is an imaginary vertical plane at or forward of the nose of the helicopter from which all horizontal distances are measured for balance purposes. Diagrams of each helicopter show this reference datum line as balance station zero.

6-8. Arm.

Arm, for balance purposes, is the horizontal distance in inches from the reference datum line to the CG of the item. Arm may be determined from the helicopter diagram in Figure 6-1.

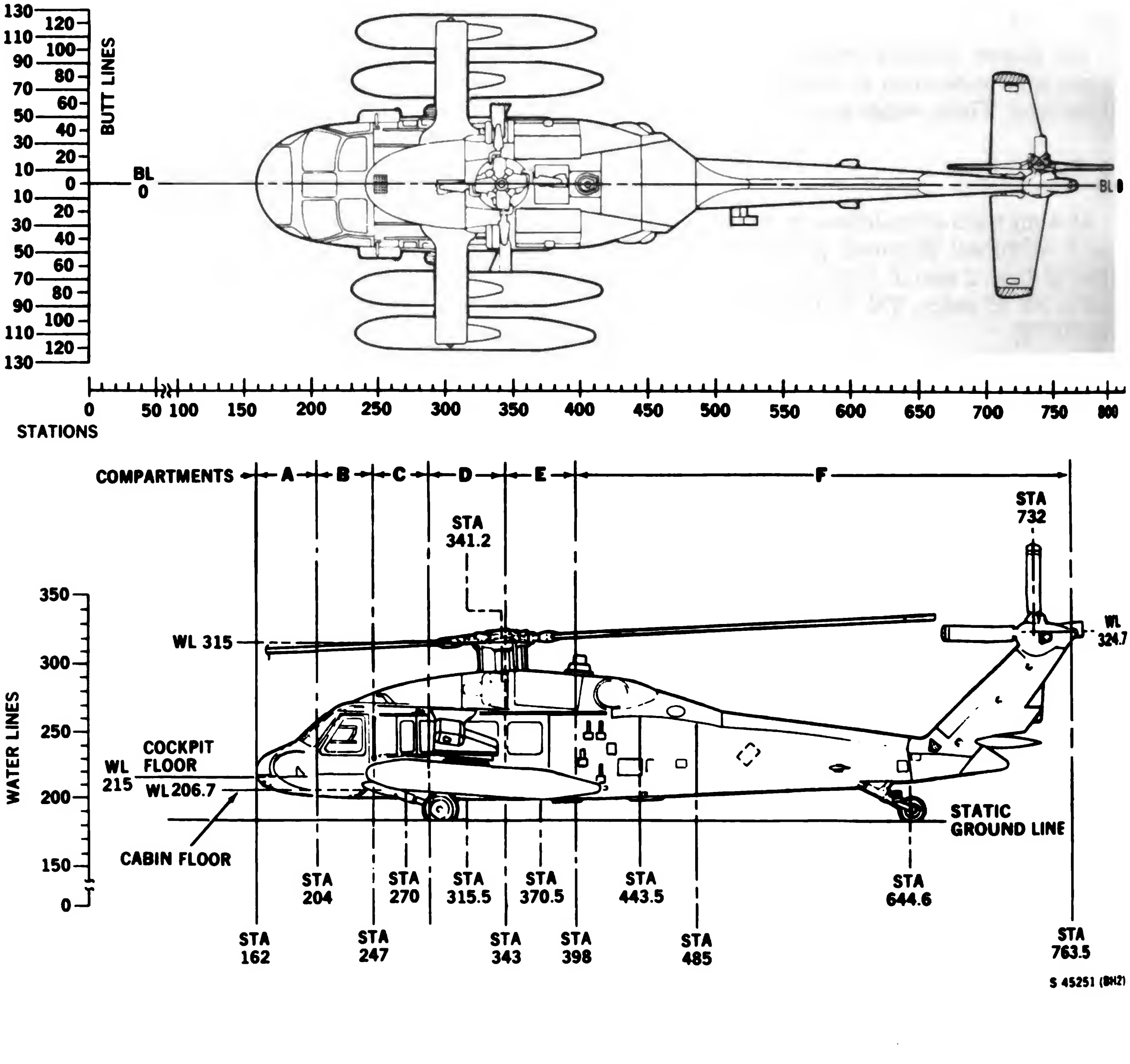


Figure 6-1. Helicopter Compartment and Station Diagram

6-9. Moment.

Moment is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits. For this helicopter, moment/1000 has been used.

6-10. Average Arm.

Average arm is the arm obtained by adding the weights and moments of a number of items, and dividing the total moment by the total weight.

6-11. Basic Moment.

Basic moment is the sum of the moments for all items making up the basic weight. When using data from an actual weighing of a helicopter, the basic moment is the total of the basic helicopter with respect to the reference datum. Basic moment used for computing DD Form 365-4 is the last entry on DD Form 365-3 for the specific helicopter.

6-12. Center of Gravity (CG).

Center of gravity is the point about which a helicopter would balance if suspended. Its distance from the reference datum line is found by dividing the total moment by the gross weight of the helicopter.

6-13. CG Limits.

CG limits (Figures 6-2 and 6-2.1) defines the permissible range for CG stations. The CG of the loaded helicopter must be within these limits at takeoff, in the air, and on landing.

6-14. DD Form 365-3 (Chart C) Weight and Balance Records.

DD Form 365-3 (Chart C) is a continuous history of the basic weight, moment, and balance, resulting from structural and equipment changes in service. At all times the last weight, moment/constant, is considered the current weight and balance status of the basic helicopter.

6-15. Loading Data.

The loading data in this chapter is intended to provide information necessary to work a loading problem for the helicopter. From the figures, weight and moment are obtained for all variable load items and are added arithmetically to the current basic weight and moment from DD Form 365-3 (Chart C) to obtain the gross weight and moment. If the helicopter is loaded within the forward and aft CG limits, the moment figure will fall numerically between the limiting moments. The effect on the CG of the expenditures in flight of such items as fuel and cargo may be checked by subtracting the weights and moments of such items from the takeoff gross weight and moment, and checking the new moment, with the CG limits chart. This check should be made to determine whether or not the CG will remain within limits during the entire flight.

6-16. DD Form 365-4 (Form F).

There are two versions of DD Form 365-4. Refer to TM 55-1500-342-23 for completing the form.

6-17. Center of Gravity Limits Chart.

The CG limit charts (Figures 6-2 and 6-2.1) allows the center of gravity (inches) to be determined when the total weight and total moment are known.

CENTER OF GRAVITY

WITHOUT EXTERNAL STORES SUPPORT SYSTEM INSTALLED
11,500 TO 16,500 POUNDS GROSS WEIGHT
CENTER OF GRAVITY LIMITS

EXAMPLE

WANTED

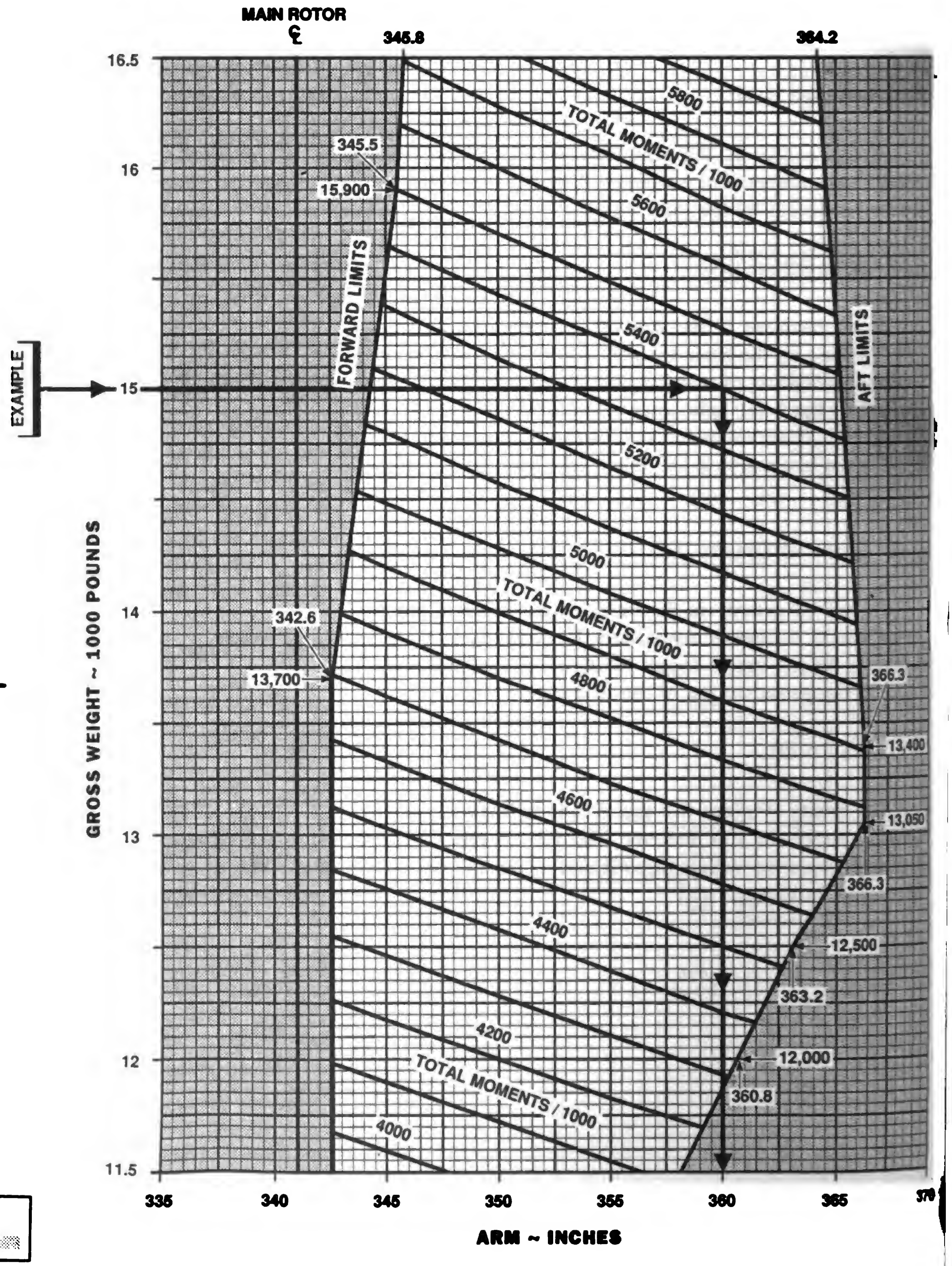
DETERMINE IF LOADING LIMITS ARE EXCEEDED

KNOWN

GROSS WEIGHT = 15,000 POUNDS
MOMENT / 1000 =5,400

METHOD

ENTER GROSS WEIGHT AT 15,000 POUNDS. MOVE RIGHT TOTAL MOMENT / 1,000 = 5,400 CG IS WITHIN LIMITS MOVE DOWN TO ARM = 360



LEGEND
BEYOND LIMITS

DATA BASIS: CALCULATED

AA0347_1

Figure 6-2. Center of Gravity Limits Chart (Sheet 1 of 2)

CENTER OF GRAVITY
WITHOUT EXTERNAL STORES SUPPORT SYSTEM INSTALLED
16,500 TO 22,000 POUNDS GROSS WEIGHT
CENTER OF GRAVITY LIMITS

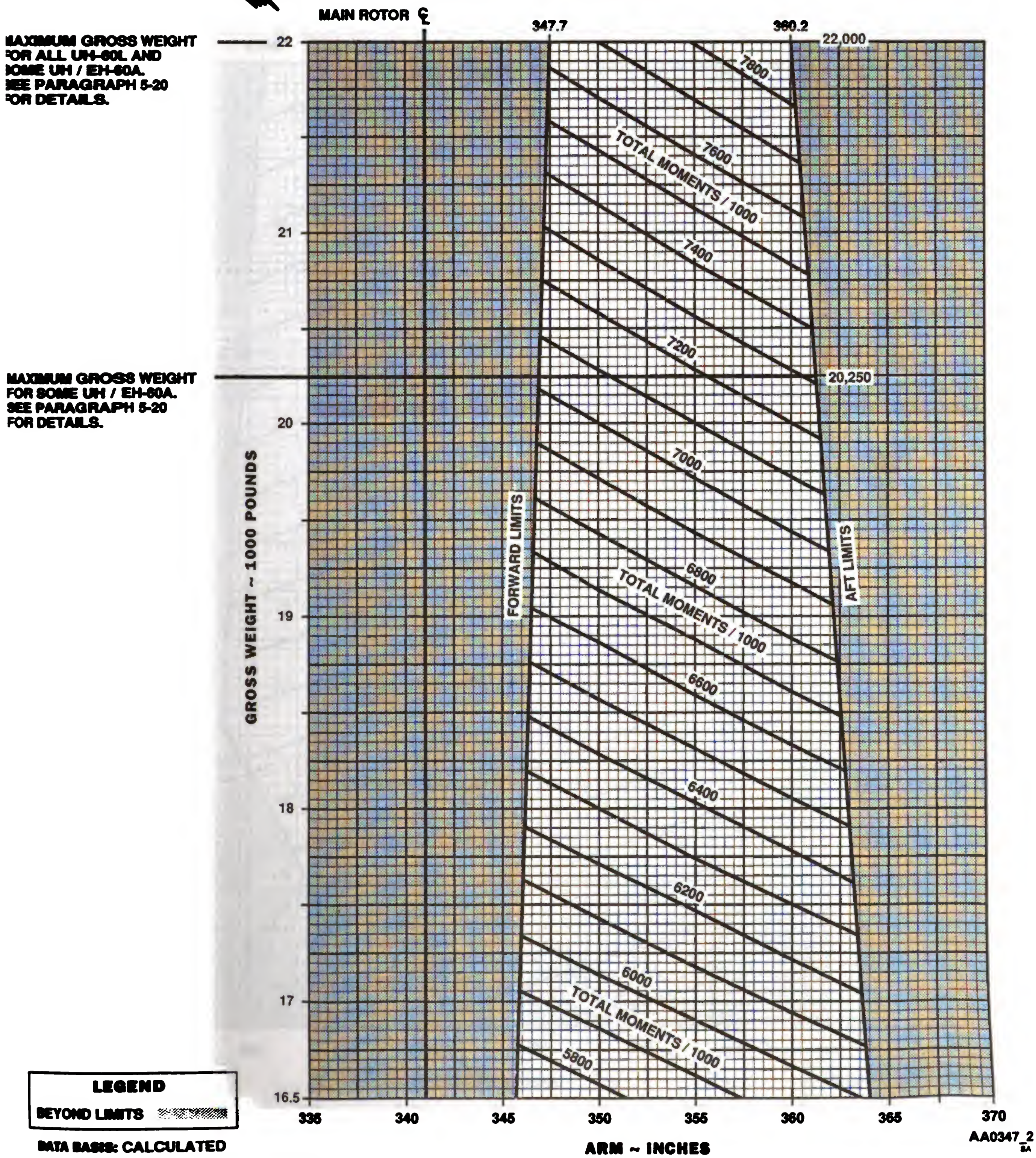


Figure 6-2. Center of Gravity Limits Chart (Sheet 2 of 2)

CENTER OF GRAVITY

WITH EXTERNAL STORES SUPPORT SYSTEM INSTALLED
11,500 TO 16,500 POUNDS GROSS WEIGHT
CENTER OF GRAVITY LIMITS

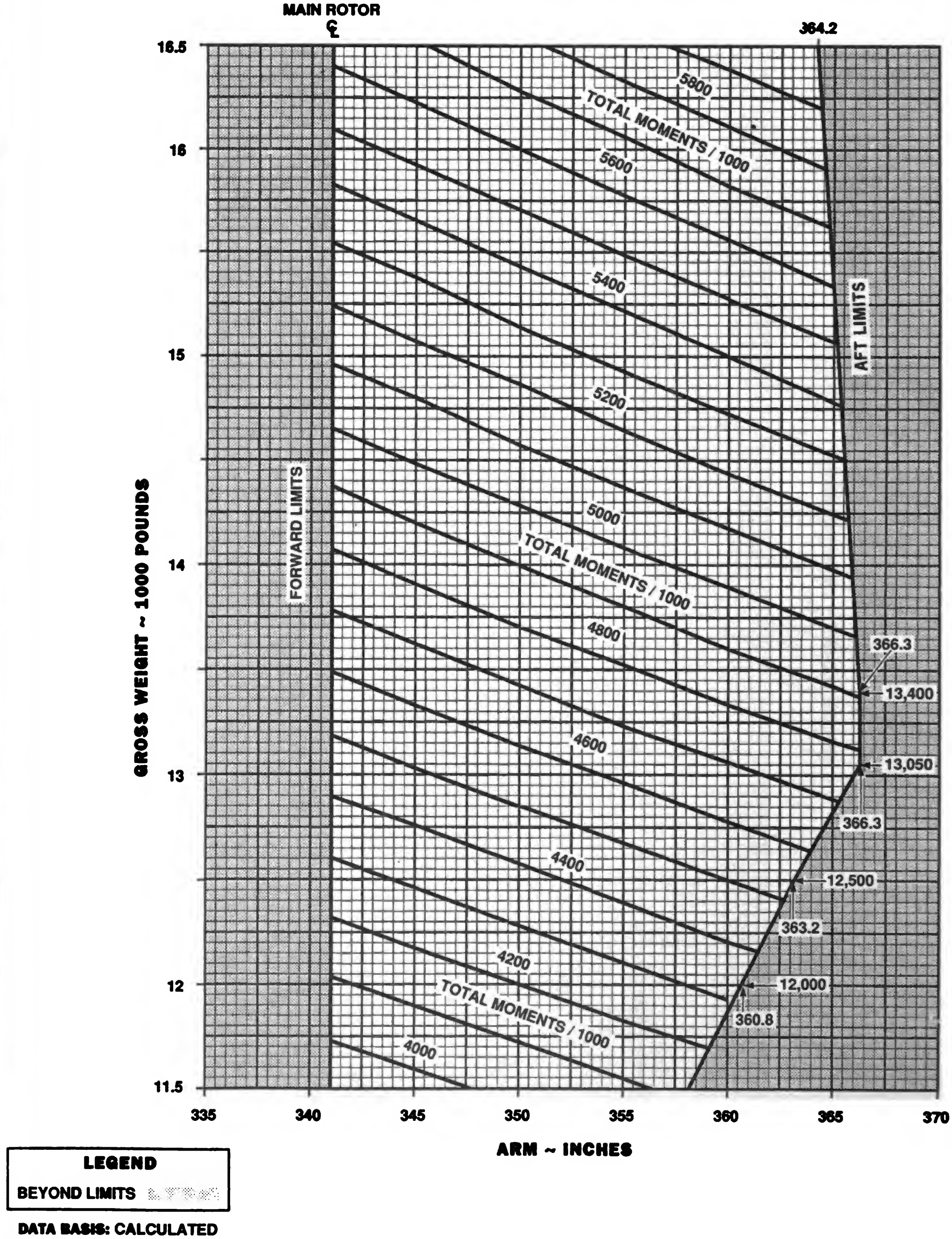


Figure 6-2.1. Center of Gravity Limits Chart (Sheet 1 of 3)

CENTER OF GRAVITY
WITH EXTERNAL STORES SUPPORT SYSTEM INSTALLED
16,500 TO 22,000 POUNDS GROSS WEIGHT
CENTER OF GRAVITY LIMITS

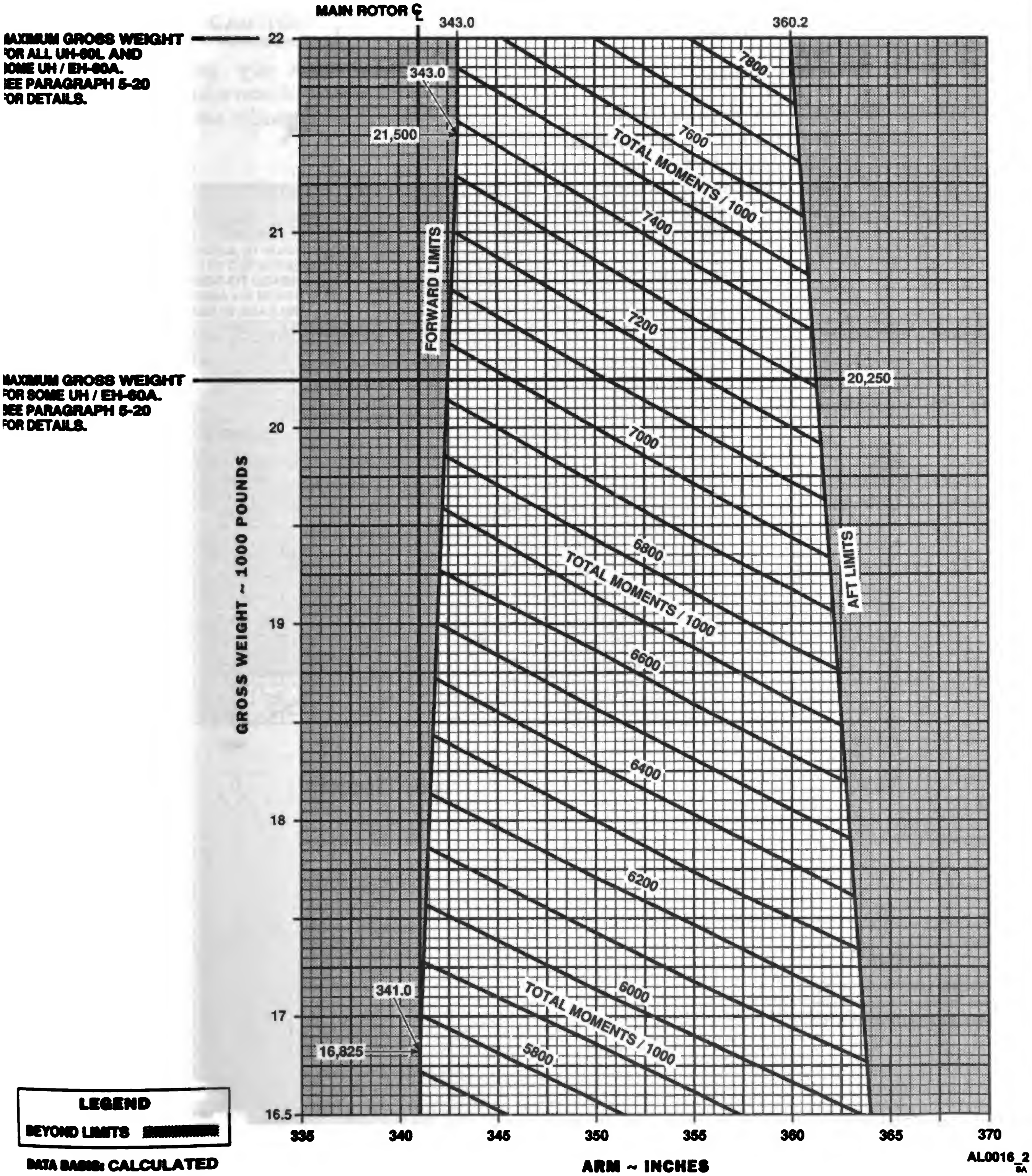
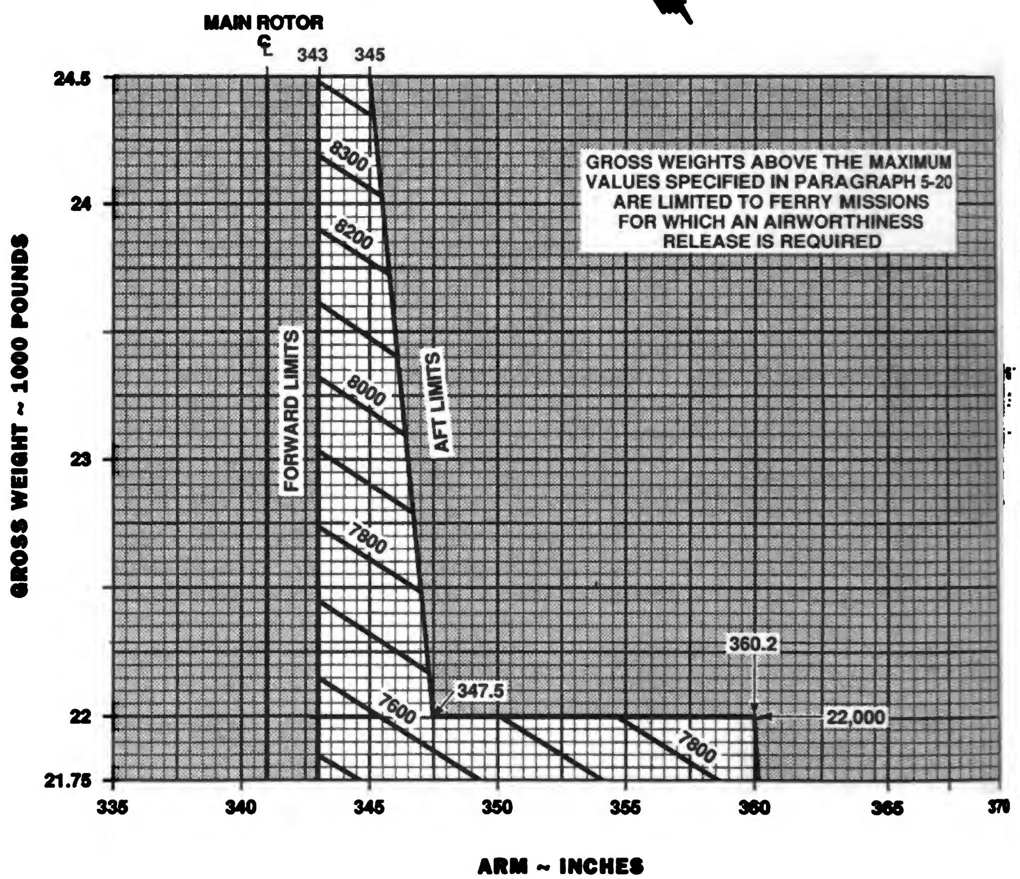


Figure 6-2.1. Center of Gravity Limits Chart (Sheet 2 of 3)

CENTER OF GRAVITY
WITH EXTERNAL STORES SUPPORT SYSTEM INSTALLED
21,750 TO 24,500 POUNDS GROSS WEIGHT
CENTER OF GRAVITY LIMITS



LEGEND
BEYOND LIMITS

DATA BASIS: CALCULATED

AL001

Figure 6-2.1. Center of Gravity Limits Chart (Sheet 3 of 3)

Section III FUEL/OIL

6-18. Fuel Moments.

CAUTION

When operating with range extension tanks, fuel transfer must be made in a manner to prevent the helicopter from exceeding CG limits.

Fuel moments for the main and range extension fuel tanks are shown on Figure 6-3. Approximate weight of JP4 is 6.5 lb/gal. JP5 is 6.8 lb/gal, Jet A is 6.8 lb/gal, and JP8 is 6.7 lb/gal.

CAUTION

When operating with a light cabin load or no load, it may be necessary to adjust fuel load to remain within Aft C.G. limits. Fuel loading is likely to be more restricted on those aircrafts with the HIRSS installed.

Section IV PERSONNEL

6-19. Personnel Moments.

When aircraft are operated at critical gross weights, the exact weight of each individual occupant plus equipment should be used. Personnel moments data is shown on Figure 6-4. If weighing facilities are not available, or if the tactical situation dictates otherwise, loads shall be computed as follows:

a. Combat equipped soldiers: 240 pounds per individual.

b. Combat equipped paratroopers: 260 pounds per individual.

c. Crew and passengers with no equipment: compute weight according to each individual's estimate.

FUEL MOMENTS

EXAMPLE

WANTED:

FUEL MOMENT

KNOWN:

FUEL QUANTITY
MAIN 1700 POUNDS

METHOD:

FOR MAIN TANK ENTER AT 1700 POUNDS AND MOVE RIGHT TO MAIN LINE. MOVE DOWN. READ MOMENT / 1000 = 710

ITEM	STA	WEIGHT IN LBS
230 GALLON TANK	315.6	150
450 GALLON TANK	314.6	234

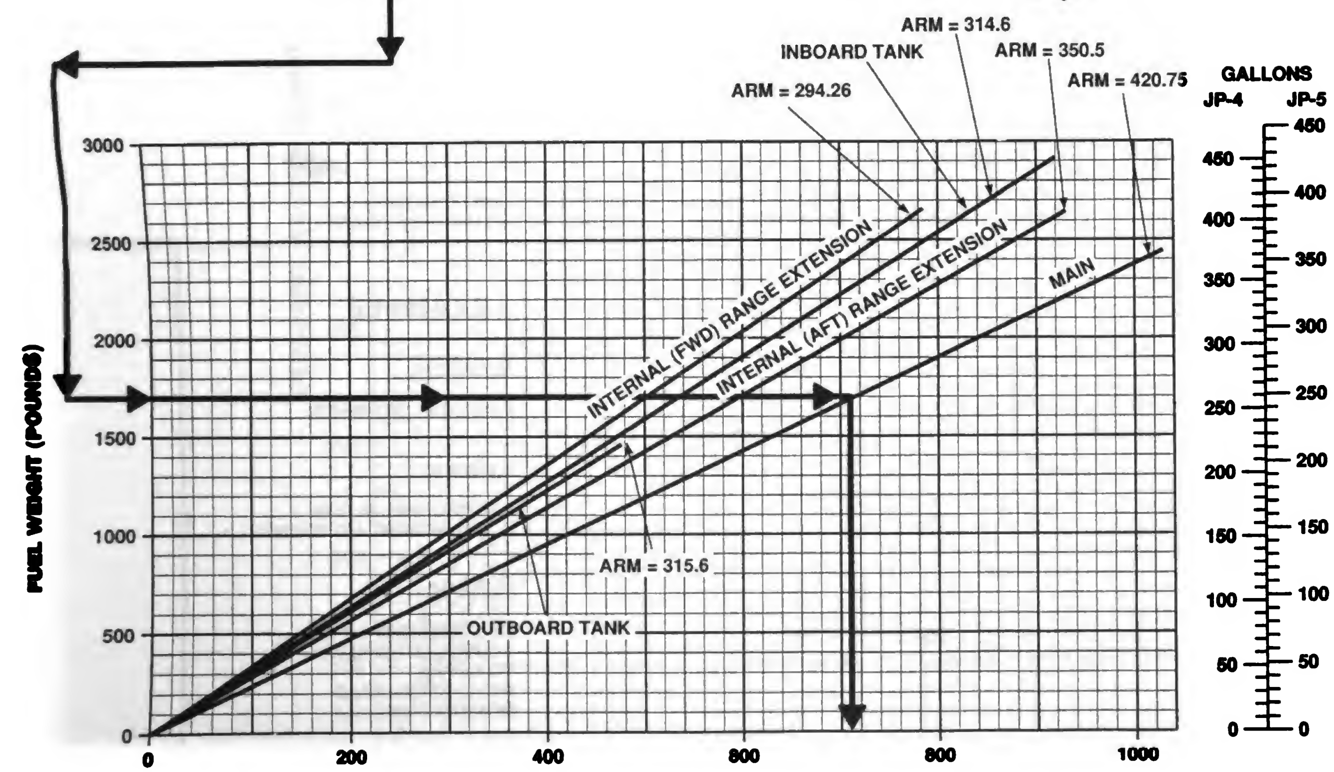


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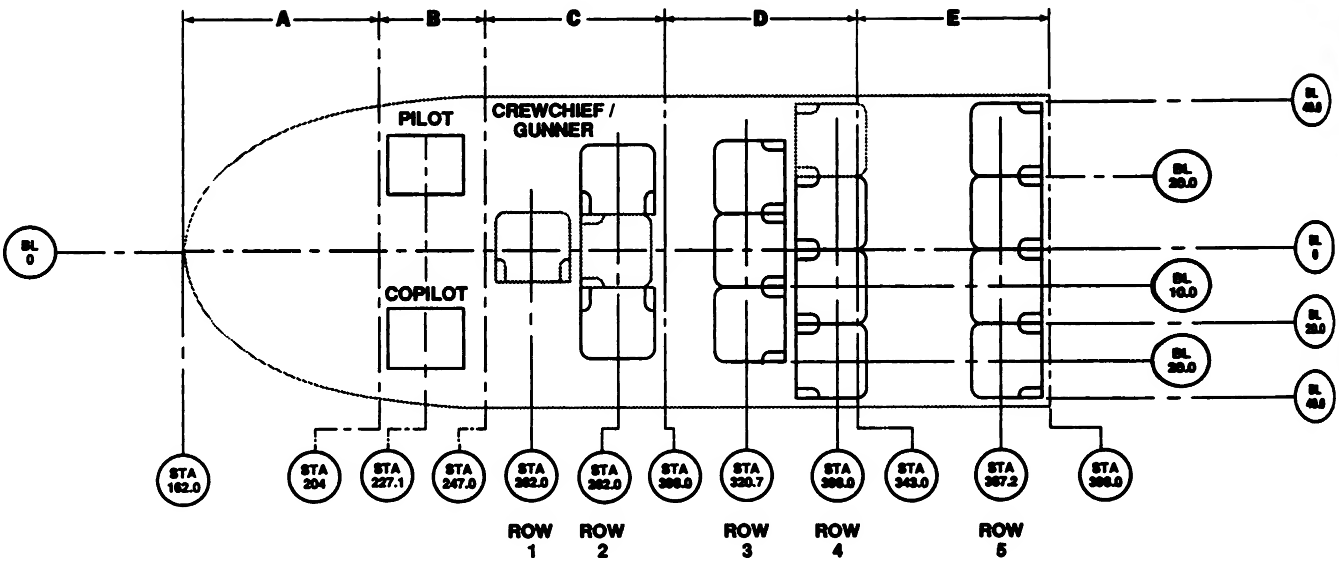
Figure 6-3. Fuel Moments

PERSONNEL MOMENTS



SEAT WEIGHT - AND MOMENT TABLE*

ITEM	ROW	WEIGHT	MOM / 1000
CREWCHIEF / GUNNER (2) TROOPS (3) TROOPS (3) TROOPS (4)	2 3 4 5	43 48 48 63	12 15 16 25
TOTAL-12 SEATS		202	68
ALTERNATE SEATING (BROKEN LINES)			
FORWARD TROOP SEAT (1)	1	16	4
REAR FACING TROOP SEAT (1)	2	16	5
REAR FACING TROOP SEAT (1)	4	16	6
TOTAL-15 SEATS		250	83

*SEAT WEIGHT AND MOMENTS SHOULD BE INCLUDED ON CHART C

EXAMPLE

WANTED:

PESONNEL MOMENTS

KNOWN:

2 PERSONNEL IN ROW 3
TOTAL WEIGHT 480 POUNDS

METHOD:

ENTER WEIGHT AT 480 POUNDS-MOVE RIGHT TO ROW 3.
MOVE DOWN. READ MOMENT / 1000=154

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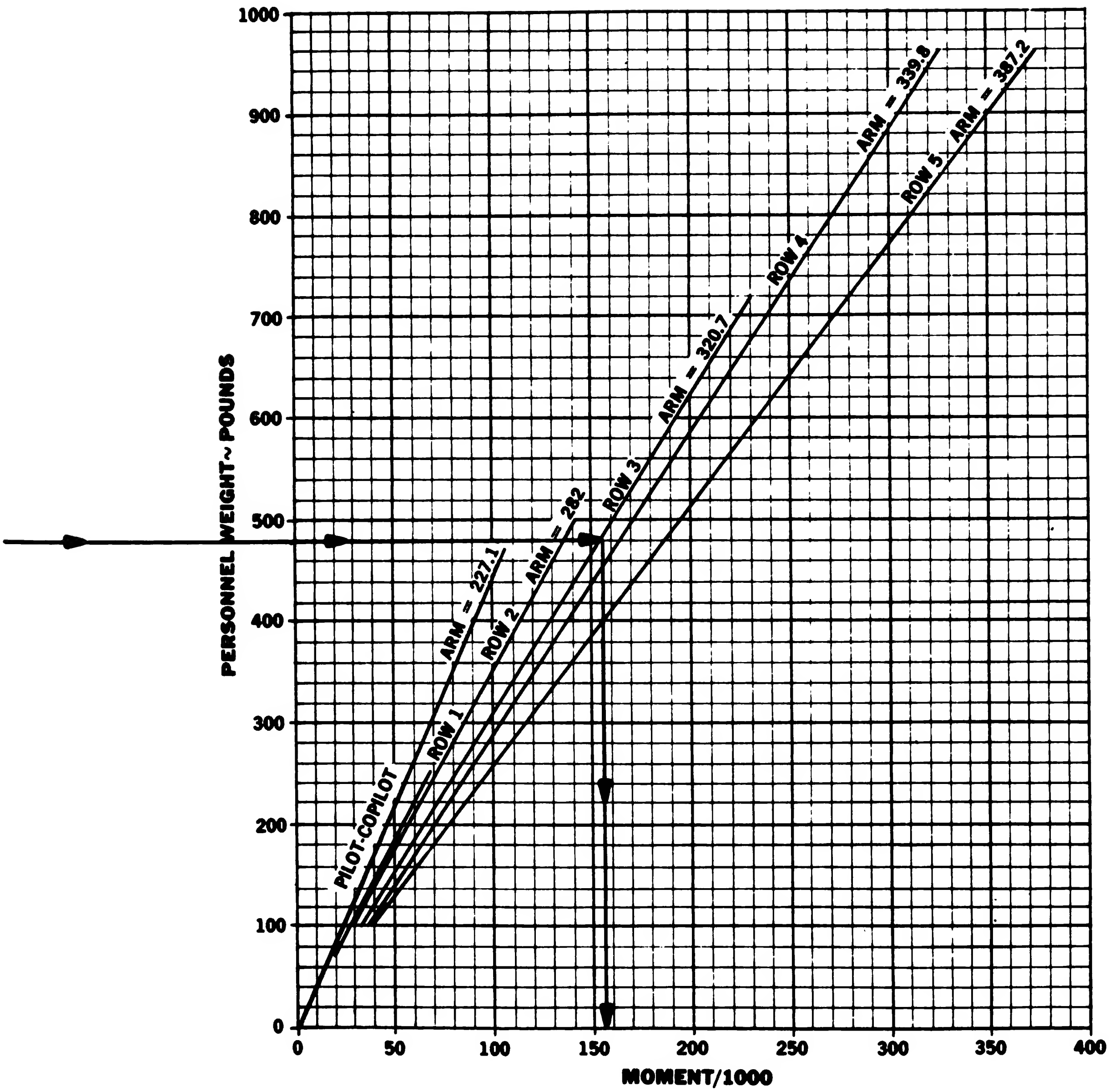
Figure 6-4. Personnel Moments (Sheet 1 of 3) UH

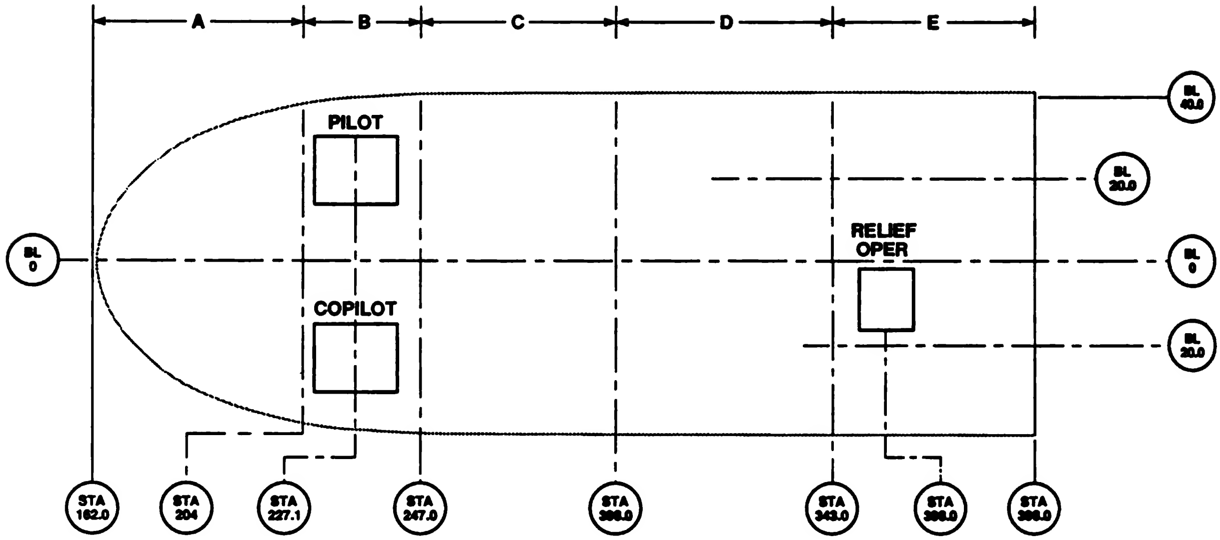
PERSONNEL MOMENTS



DATA BASIS: CALCULATED

S 45259.2 (BH2)

Figure 6-4. Personnel Moments (Sheet 2 of 3) UH



ITEM	STA	WEIGHT	MOM / 1000
SEAT RELIEF OPERATOR	356.0	18	6
TOTAL - 1 SEAT	–	18	6

EXAMPLE

WANTED

PERSONNEL MOMENTS

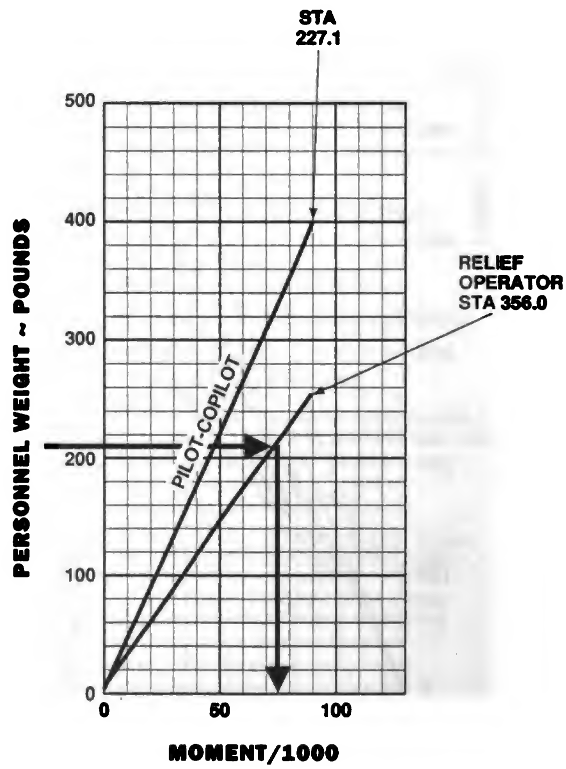
KNOWN

PERSONNEL AT STA 356

OBSERVER - 210 POUNDS

METHOD

ENTER WEIGHT AT 210
POUNDS - MOVE RIGHT
TO OBSERVER ARC (STA 356.0)
MOVE DOWN READ
MOMENT / 1000 = 75



DATA BASIS: CALCULATED

AA0069_3

Figure 6-4. Personnel Moments (Sheet 3 of 3) EH

Section V MISSION EQUIPMENT

6-20. Armament Loading Data Moments.

Armament consists of two M60D machineguns, ammunition, and grenades. Various loads of ammunition are presented in Figure 6-10. When determining the moments for a given ammo load not shown on the chart, go to the nearest load shown.

6-21. EH-60A Helicopters Without Mission Equipment.

When operating without EH-60 mission equipment or with a light cabin load or no cabin load, it may be necessary to limit fuel load to remain within aft cg limits.

6-22. Litter Moments.

a. Litter moments are in Figure 6-8.

b. Medevac system (excluding litters) weight and moments are included in the helicopter basic weight and moments Form 365-3 when installed.

c. Litter weight is estimated to 25 pounds which includes litter, splints, and blankets.

d. Medical attendant's average weight is 200 pounds.

e. Medical equipment and supplies should be stored per unit loading plan and considered in weight and balance computations.

ARMAMENT LOADING DATA

AMMUNITION TABLE

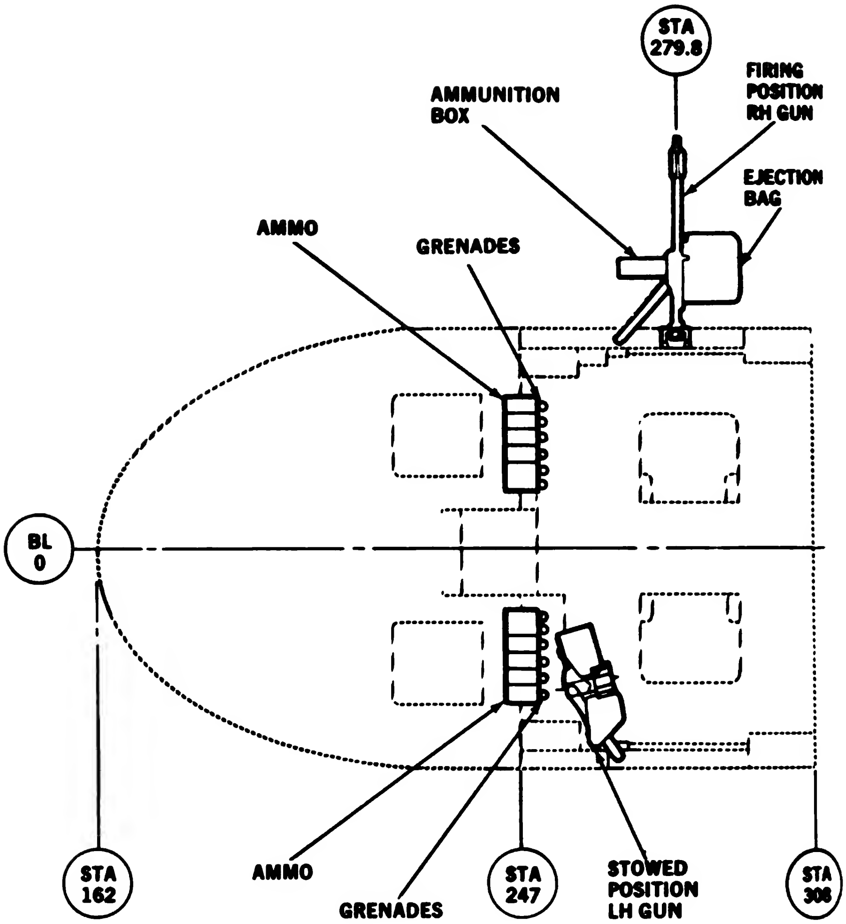
LIVE ROUNDS	LIVE AMMO (7.62 MM) ARM - 247.0	
	WEIGHT - LB	MOM/1000
100	7	2
200	13	3
300	20	5
400	26	6
500	32	8
600	39	10
700	46	11
800	52	13
ARM - 279.8		
100	7	2
200	13	4
300	20	5
400	26	7

CHAFF

CHAFF CARTRIDGE MI. 30 RDS ARM - 505.0 (SINGLE CHAFF WEIGHT 0.33 LB)	
WEIGHT - LB	MOM/1000
10	5

FLARE EH

FLARE DISPENSED XM-130, 30 RDS ARM-548.5 (SINGLE FLARE WEIGHT 0.43 LB.)	
WEIGHT-LB	MOM/1000
13	7



(GUN STOWED AND FIRING POSITIONS ARE SAME EACH SIDE)

GRENADE TABLE

QUANTITY	STOWED			
	GRENADE AN-M8 ARM - 251.0		GRENADE M18 ARM - 251.0	
	WEIGHT - LB	MOM/1000	WEIGHT - LB	MOM/1000
2	3	1	2	1
4	6	2	5	1
6	9	2	7	2
8	12	3	10	2
10	15	4	12	3
12	18	5	14	4

M60D TABLE

ITEM	WEIGHT	MOM/1000	
		STOWED	FIRING POSITION
M60D (2)	45.4	12	13
EJECTION BAG (2)	9.0	2	3
AMMO BOX (2)	3.4	1	-
STORAGE BOX (2)	2.6	1	1
SUPPORT (2)	20.2	5	6
BIPOD (2)	4.0	1	1
TOTAL	84.6	22	25

DATA BASIS: CALCULATED

S 45200 (BH2)

Figure 6-5. Armament Loading Data Moments

CARGO MOMENTS — CARGO HOOK

EXAMPLE

WANTED

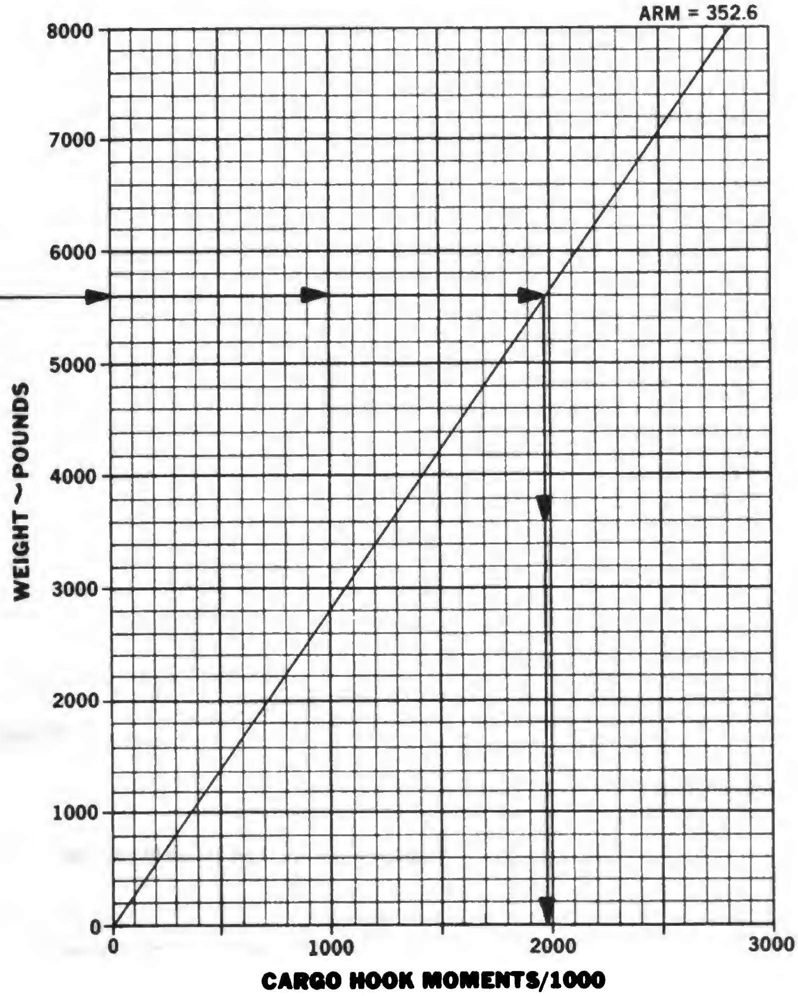
MOMENT OF CARGO ON CARGO HOOK

KNOWN

CARGO = 5600 POUNDS

METHOD

ENTER WEIGHT AT 5600 POUNDS. MOVE RIGHT TO LINE. MOVE DOWN AND READ MOMENT/1000 = 1975



S 45261 (BH2)

Figure 6-6. Cargo Hook Moments

RESCUE HOIST MOMENTS

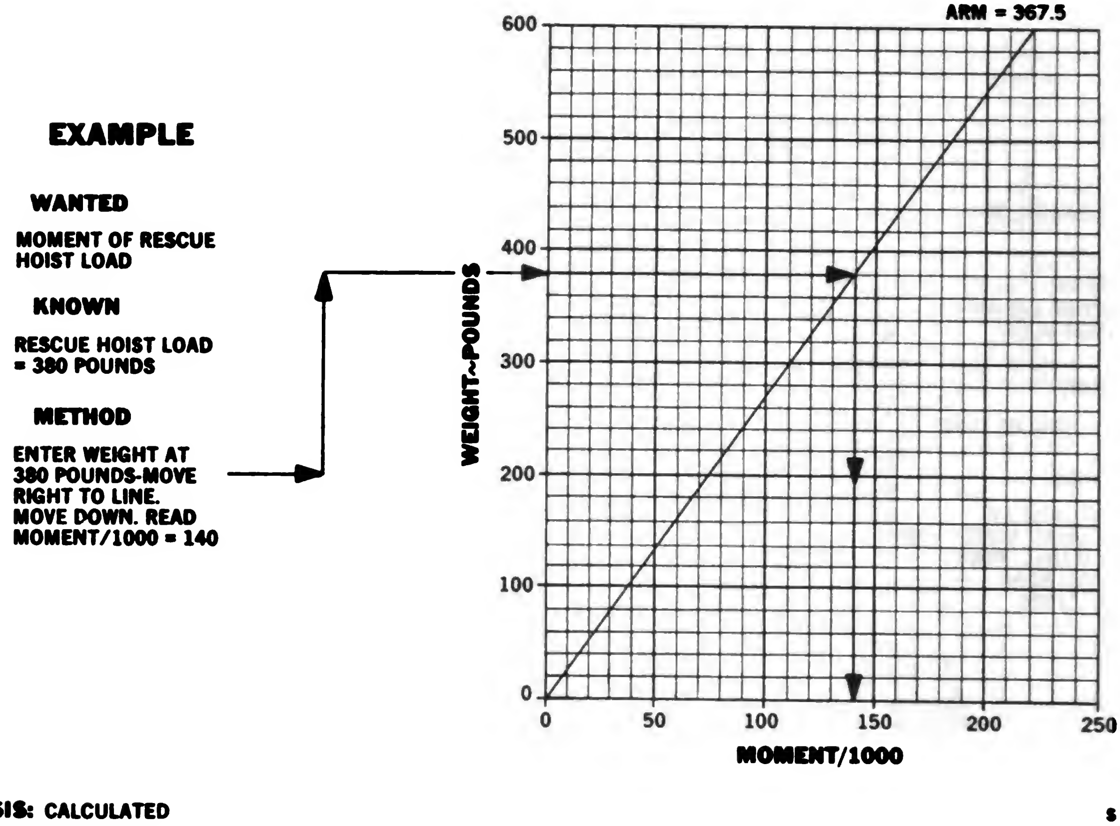


Figure 6-7. Rescue Hoist Moments

Section VI CARGO LOADING

6-23. Cabin Dimensions.

Refer to Figure 6-9 for dimensions. For loading, and weight and balance purposes, the helicopter fuselage is divided into six compartments, A through F, three of which are in the cabin, C, D, and E. There are 17 tiedown fittings rated at 5,000 pounds each. Cargo carrier restraint rings are at stations 308 and 379, to cover the 71 inches of longitudinal space. Cargo tiedown devices are stored in the equipment stowage space of compartment F.

6-24. Cabin Doors.

Cabin doors are at the rear end of the cargo compartment on each side of the fuselage. The door openings are 54.5 inches high and 69 inches wide; maximum package sizes accommodated by the openings are 54 inches high by 68 inches wide and are shown on Figure 6-10.

6-25. Maximum Cargo Size Diagram for Loading Through Cabin Doors.

Figure 6-10 shows the largest size of cargo of various shapes that can be loaded into the cabin through the cabin doors.

6-26. Tiedown Fittings and Restraint Rings.

The 17 tiedown fittings (Figure 6-11) installed on the cargo floor can restrain a 5,000-pound load in any direction. All tiedown fittings incorporate studs that are used to install the troop seats. Eight net restraint rings in the cargo compartment prevent cargo from hitting the bulkhead at station 398, or entering the crew area. Each restraint ring is rated at 3500-pound capacity in any direction.

6-27. Equipment Storage Compartments.

Weight and moments for equipment stowage compartment are shown in Figure 6-12.

6-28. Equipment Loading and Unloading.

6-29. Data Prior to Loading.

The following data should be assembled or gathered by the loading crew before loading (Refer to FM 55-450-2, Army Helicopter Internal Load Operations):

a. Weight of the individual items of cargo.

b. Overall dimensions of each item of cargo (in inches).

c. The helicopter's center of gravity.

d. Floor loads for each item of cargo.

e. Any shoring that may be required.

f. When required, the location of the center of gravity of an individual item of cargo.

6-30. Cargo Center of Gravity Planning.

The detail planning procedure consists of four steps, as follows:

a. Determine ALLOWABLE LOAD from LIMITATIONS section of DD Form 365-4.

b. Plan the location in the helicopter for the individual items of cargo. Since the CG of the load is determined by the station method, then specific locations must be assigned to each item of cargo.

c. Determine the CG of the cargo load as planned. Regardless of the quantity, type, or size of cargo, use the station method.

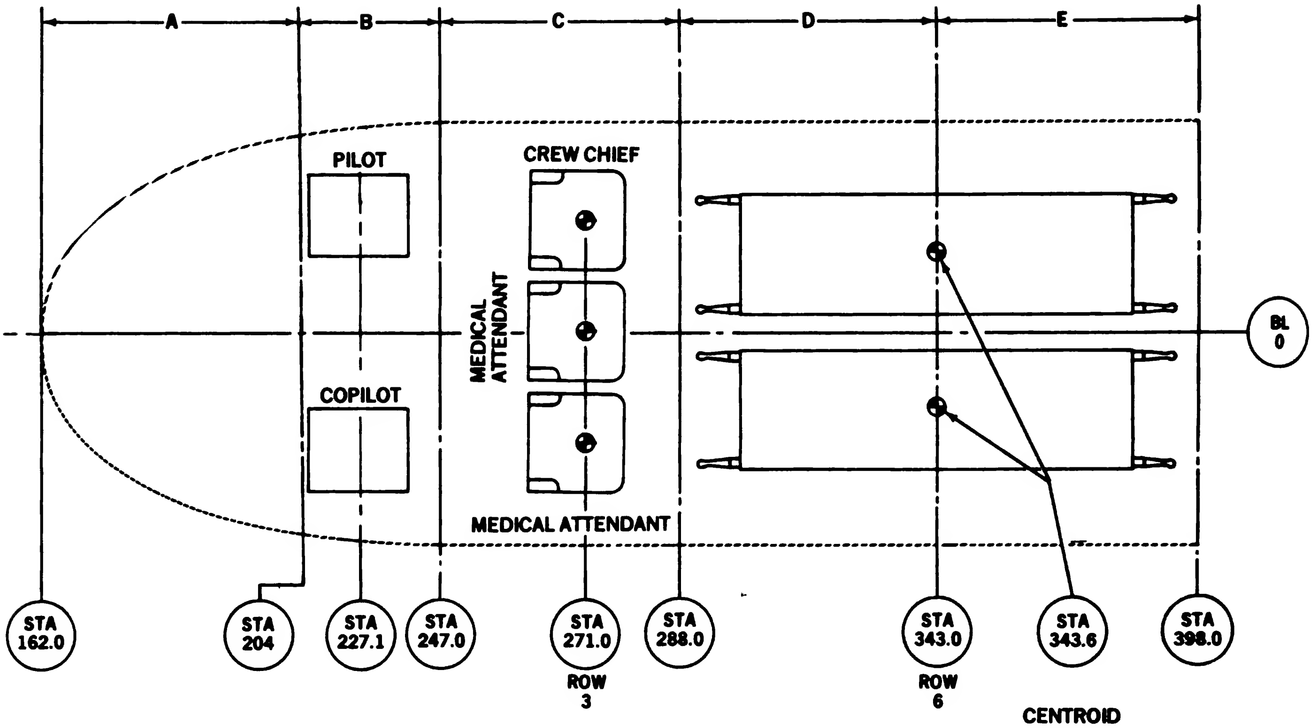
d. Determine the CG of the fully-loaded helicopter from Figure 6-4, and if the CG of the helicopter fails within allowable limits. If it does, the cargo can be loaded. If not, the planned location of the individual items must be changed until an acceptable loading plan is obtained. The results obtained using the Cargo Planning Placement Charts are normally satisfactory for final cargo placement. When cargo loads consists of more than one item, the heavier items of cargo should be placed so that their CG is about in the center of the cabin, and the lighter items of cargo are forward and rear of them.

6-31. Restraint Criteria.

The amount of restraint that must be used to keep the cargo from moving in any direction is called the "restraint criteria" and is usually expressed in units of the force of gravity, of Gs. Following are the units of the force of gravity or Gs needed to restrain cargo in four directions:

	Cargo
Forward	12 Gs
Rear	3 Gs
Lateral	8 Gs
Vertical	3 Gs (Up)
	3 Gs (Down)

LITTER MOMENTS



EXAMPLE

WANTED

LITTER MOMENTS

KNOWN

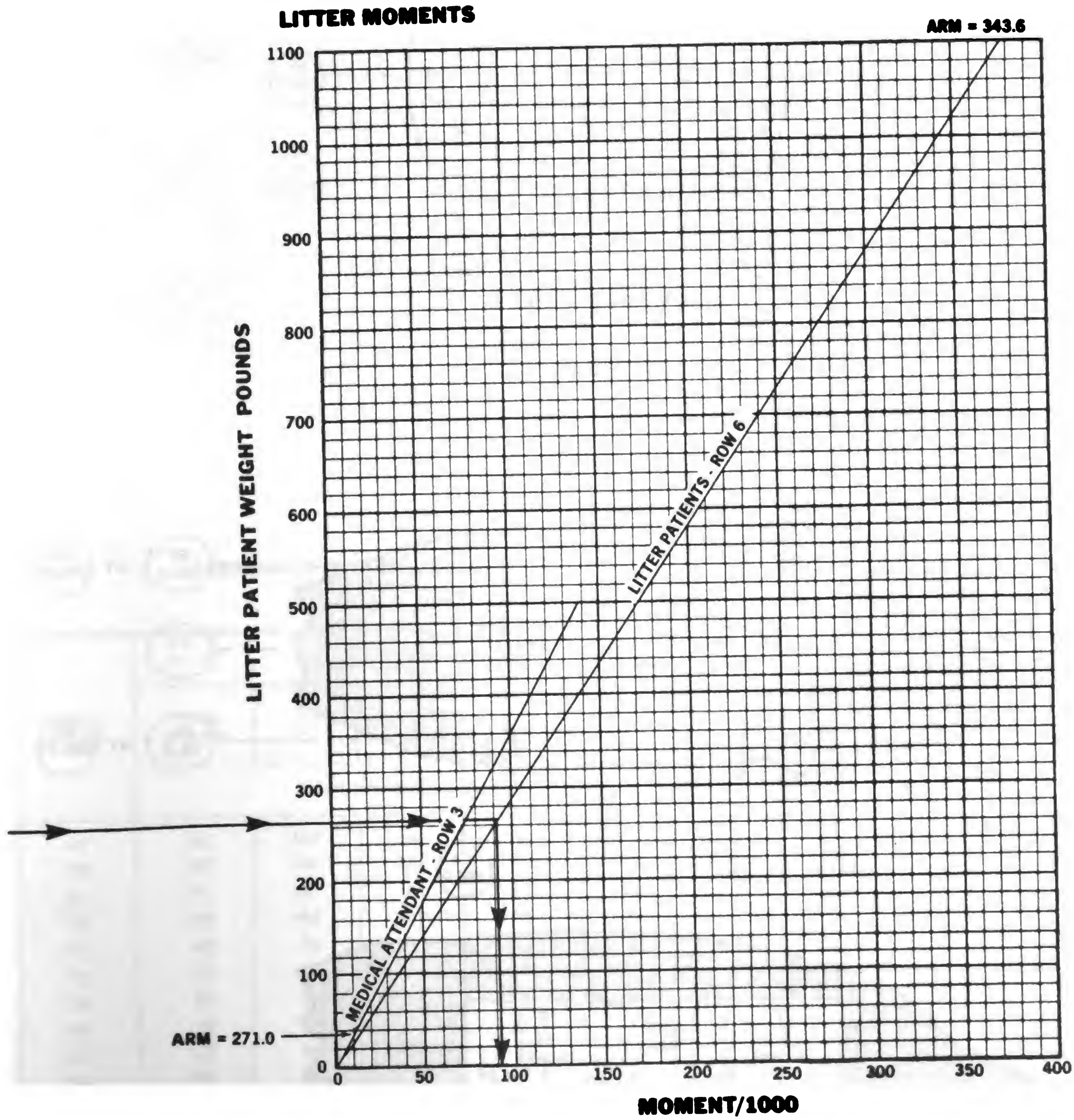
LITTER WEIGHT
= 265 POUNDS

METHOD

ENTER WEIGHT AT
265 POUNDS - MOVE
RIGHT TO LITTER
ROW 6
MOVE DOWN. READ
MOMENT/1000 = 91

S 45263.1 (BH2)

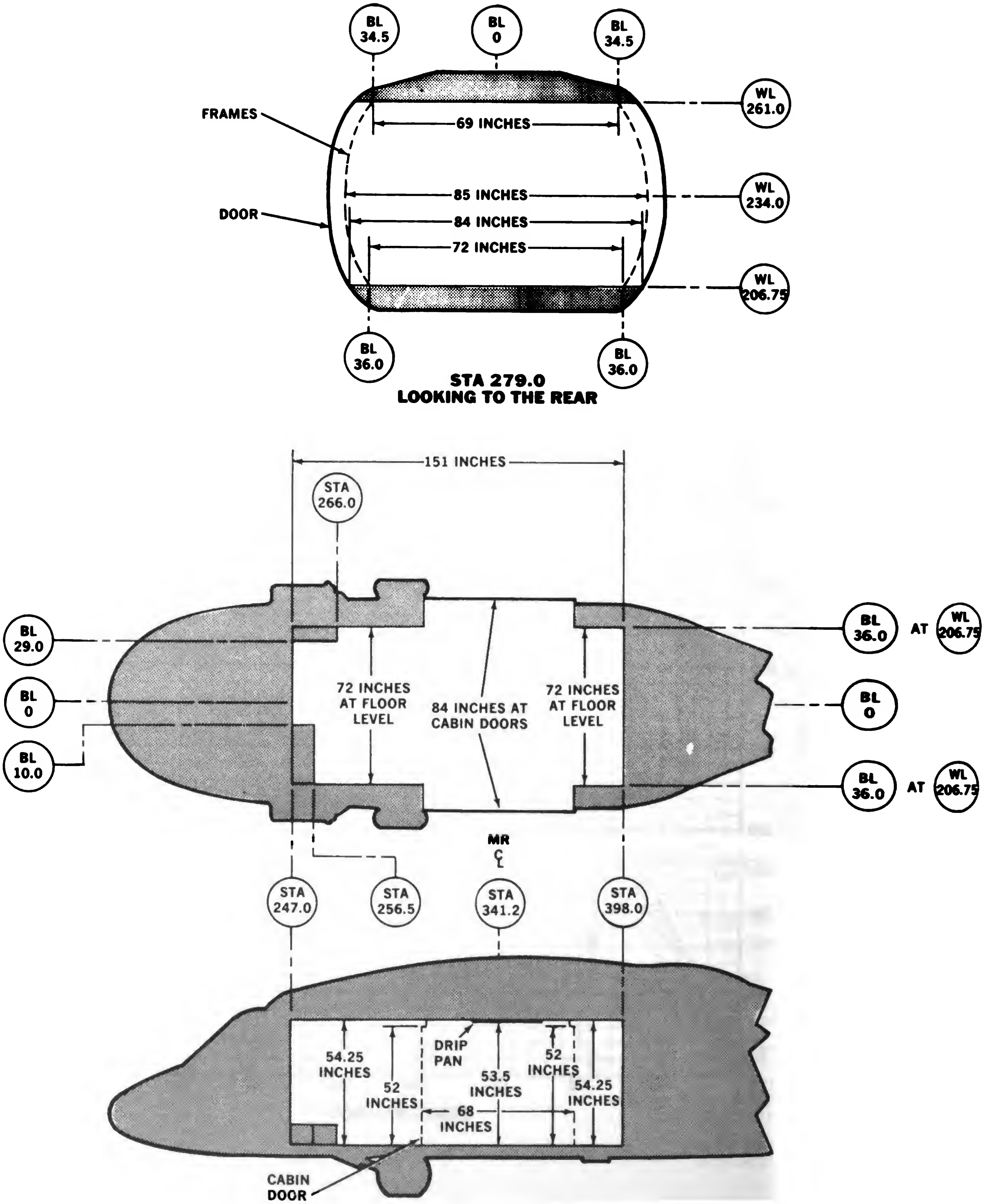
Figure 6-8. Litter Moments (Sheet 1 of 2)



DATA BASIS: CALCULATED

S 45623.2 (BH2)

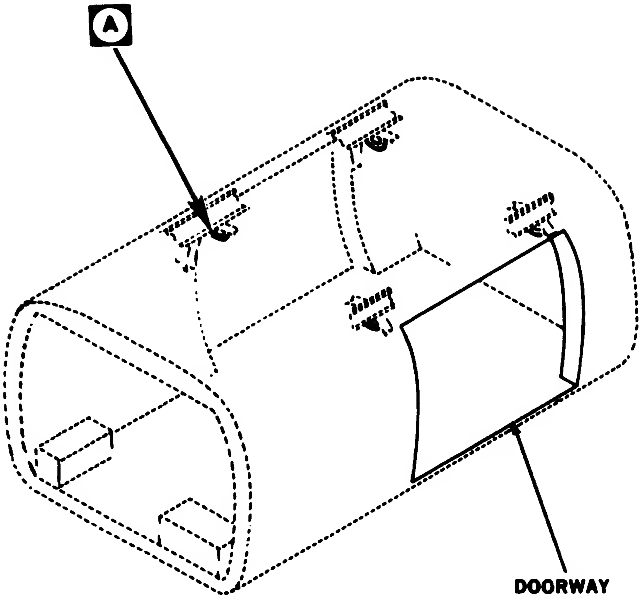
Figure 6-8. Litter Moments (Sheet 2 of 2)

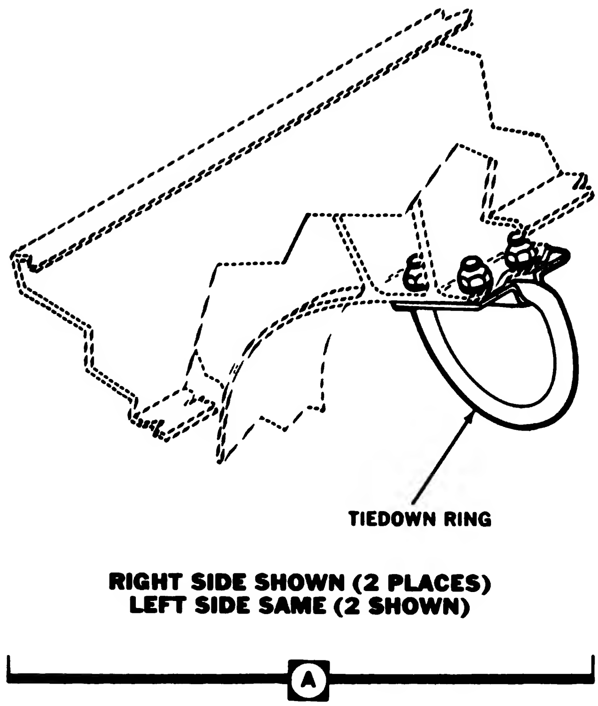


CABIN AND DOOR DIMENSIONS

S 45264 (BHZ)

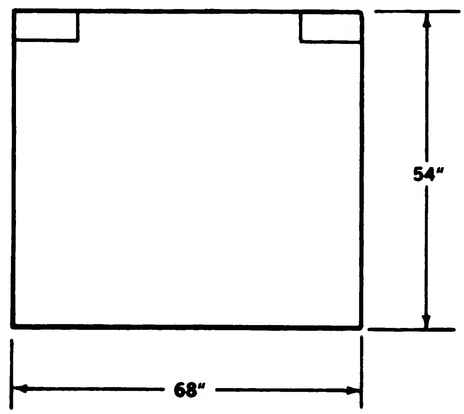
Figure 6-9. Cabin Dimensions





MAXIMUM PACKAGE SIZE TABLE
CABIN DOORS

WIDTH INCHES	HEIGHT - INCHES				
	50 & UNDER	51	52	53	54
	MAXIMUM LENGTH - INCHES				
46	102	102	102	96	93
48	102	102	102	96	93
50	101	101	101	95	92
52	100	100	100	94	92
54	99	99	99	93	91
56	98	98	98	93	91
58	97	97	97	93	91
60	96	96	96	91	90
62	93	93	93	89	87
64	91	91	91	87	
66	86	86	86	80	
68	80	80	80	77	

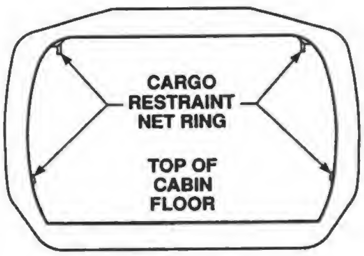


CABIN DOOR - BOTH SIDES

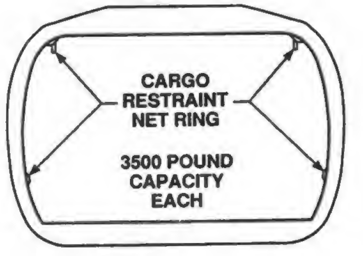
NOTE
IF GUNNERS AREA NOT USED, LENGTHS ARE APPROXIMATELY 90% OF TABLE VALVES

S 45265 (BH2)

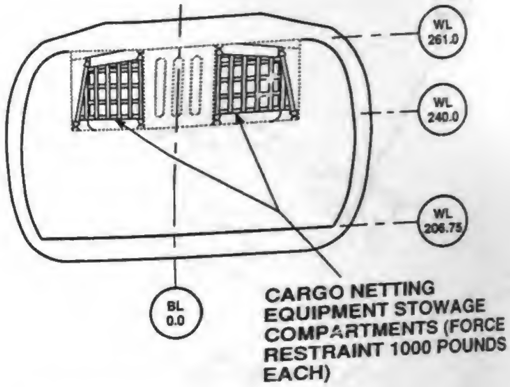
Figure 6-10. Maximum Package Size for Cargo Door



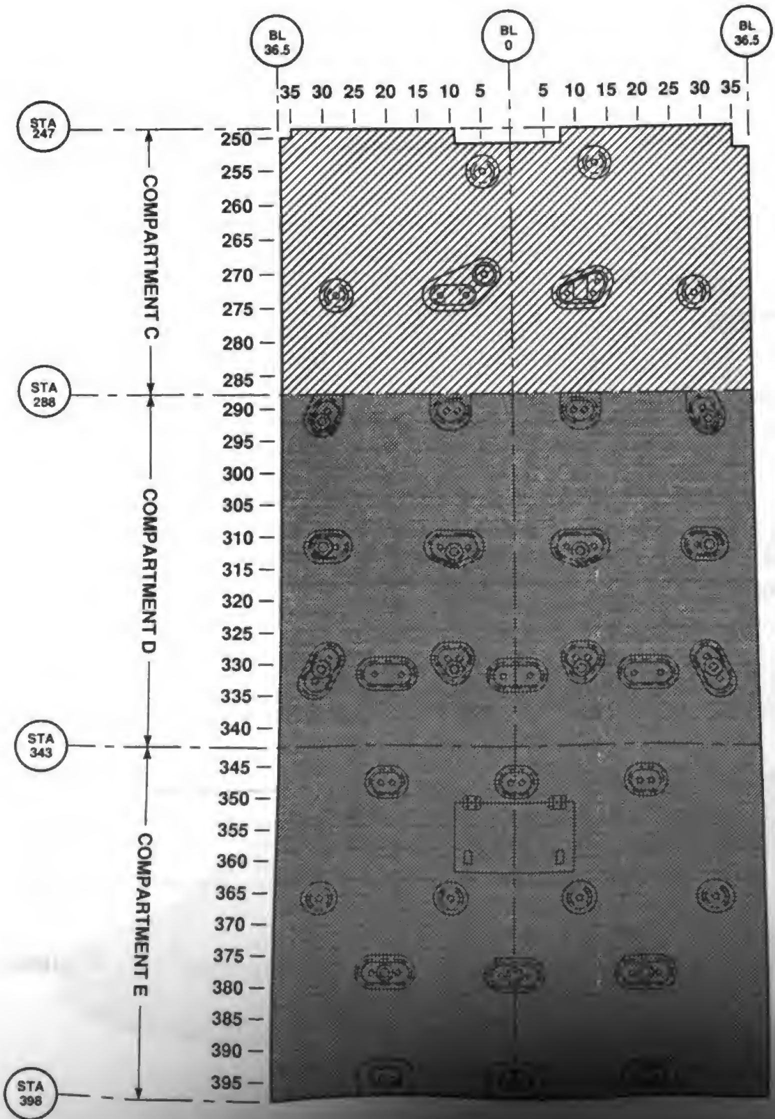
STA 308.0
LOOKING TO THE FRONT



STA 379.0
LOOKING TO THE FRONT



STA 402.19 - LOOKING TO THE REAR



◎ TIEDOWN FITTING
5000 POUNDS CAPACITY

	MAXIMUM COMPARTMENT CAPACITY IN POUNDS	FLOOR CAPACITY POUNDS PER SQUARE FOOT
	5460	300
	8370	300

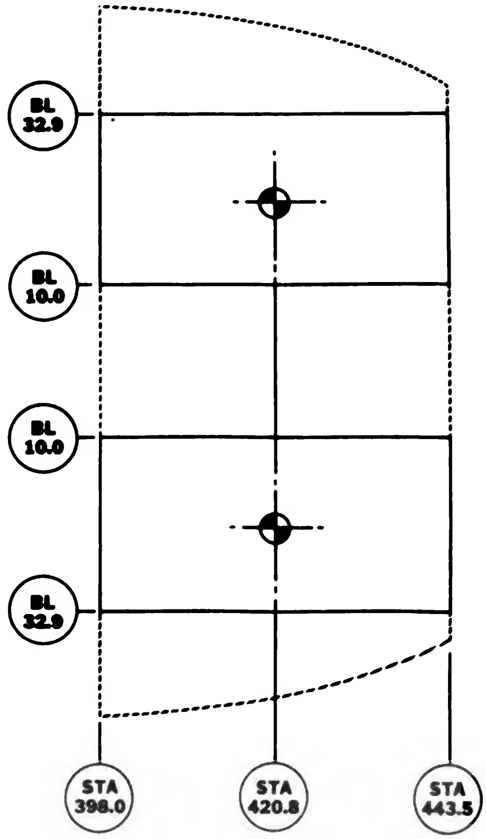
AA0671_1A

...e 6-11. C... ...angement

STOWAGE COMPARTMENT MOMENTS

STOWED SEAT TABLE

ITEM	ROW	WEIGHT	MOMENT/1000
CREWCHIEF/GUNNER (2)	2	43	18
TROOPS (3)	3	48	20
TROOPS (3)	4	48	20
TROOPS (4)	5	63	27
TOTAL-12 SEATS		202	85
ALTERNATE (1)	1	16	7
ALTERNATE (1)	2	16	7
ALTERNATE (1)	4	16	7
TOTAL-15 SEATS		250	106



EXAMPLE

WANTED

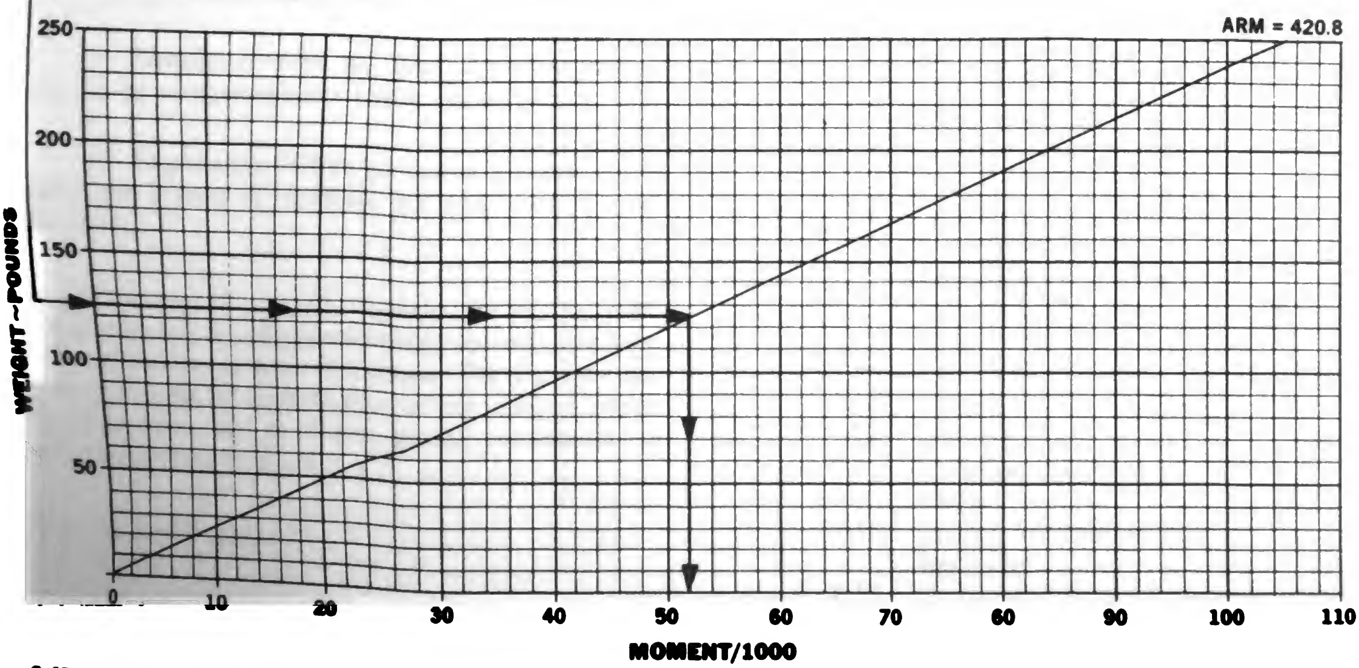
MOMENT OF STOWED EQUIPMENT

KNOWN

EQUIPMENT WEIGHT = 125 POUNDS

METHOD

ENTER WEIGHT AT 125 POUNDS - MOVE RIGHT TO LINE MOVE DOWN READ MOMENT/1000 = 52



DATA BASIS: CALCULATED

S 45340 (SH2)

Figure 6-12. Stowage Compartment Moments

CHAPTER 7
PERFORMANCE DATA

Section I INTRODUCTION

NOTE

Chapter 7 contains performance data for aircraft equipped with T700-GE-700 engines. Performance data for other models are contained in Chapter 7.1. Users are authorized to remove whichever chapter is not applicable to their model aircraft, and are not required to carry both chapters on board.

7-1. Purpose.

The purpose of this chapter is to provide the best available performance data available. Regular use of this information will enable you to receive maximum safe utilization of the helicopter. Although maximum performance is not always required, regular use of this chapter is recommended for these reasons:

a. Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.

b. Situations requiring maximum performance will be more readily recognized.

c. Familiarity with the data will allow performance to be computed more easily and quickly.

d. Experience will be gained in accurately estimating the effects of variables for which data are not presented.

The information is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used in flight, to establish unit or area standard operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7-2. Chapter 7 Index.

The following index contains a list of the sections, titles, figure numbers, subjects and page numbers of each performance data chart contained in this chapter.

7-3. General.

The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgment and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However, NO GENERAL CONSERVATISM HAS BEEN APPLIED. All performance data presented are within the applicable limits of the helicopter.

Pages 7-2.1/7-2.2 Deleted

NOTE

EH Until completion of airworthiness qualification of EH-60A, flight of aircraft in EH-60A configuration is prohibited unless operating under an Airworthiness Release from U.S. Army Aviation Systems Command.

CAUTION

Exceeding operating limits can cause permanent damage to critical components. Overlimit operation can decrease performance, cause early failure, or failure on a subsequent flight.

7-4. Limits.

Applicable limits are shown on the charts. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13, so proper maintenance action can be taken.

7-5. Use of Charts.

7-6. Dashed Line Data.

Weights above 22,000 lbs are limited to ferry missions for which an Airworthiness Release is required.

7-7. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The data provided generally is based on one of three categories:

a. Flight test data. Data obtained by flight test of the helicopter by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. Calculated data. Data based on tests, but not on flight test of the complete helicopter.

c. Estimated data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7-8. Specific Conditions.

The data presented is accurate only for specific conditions listed under the title of each chart. Variables for which data is not presented, but which may affect that phase of performance, are discussed in the text. Where data is available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7-9. Performance Discrepancies.

Regular use of this chapter will allow you to monitor instrument and other helicopter systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data is not provided, thereby increasing the accuracy of performance predictions.

7-10. Free Air Temperatures.

A temperature conversion chart (Figure 7-1) is included for the purpose of converting Fahrenheit temperature to Celsius.

7-11. Performance Data Basis.

The data presented in the performance charts are primarily derived for a clean UH-60A aircraft and are based on U. S. Army test data. The clean configuration assumes all doors and windows are closed and includes the following external configuration:

a. Fixed provisions for the External Stores Support System (ESSS).

b. Main rotor de-ice system

c. Mounting brackets for IR jammer and chaff dispenser.

d. The Hover Infrared Suppressor System (HIRSS) with baffles installed.

e. Includes wire strike protection system.

NOTE

Aircraft which have an external configuration which differs from the clean configuration may be corrected for drag differences on cruise performance as discussed in Section VII DRAG.

TEMPERATURE CONVERSION

EXAMPLE

WANTED:

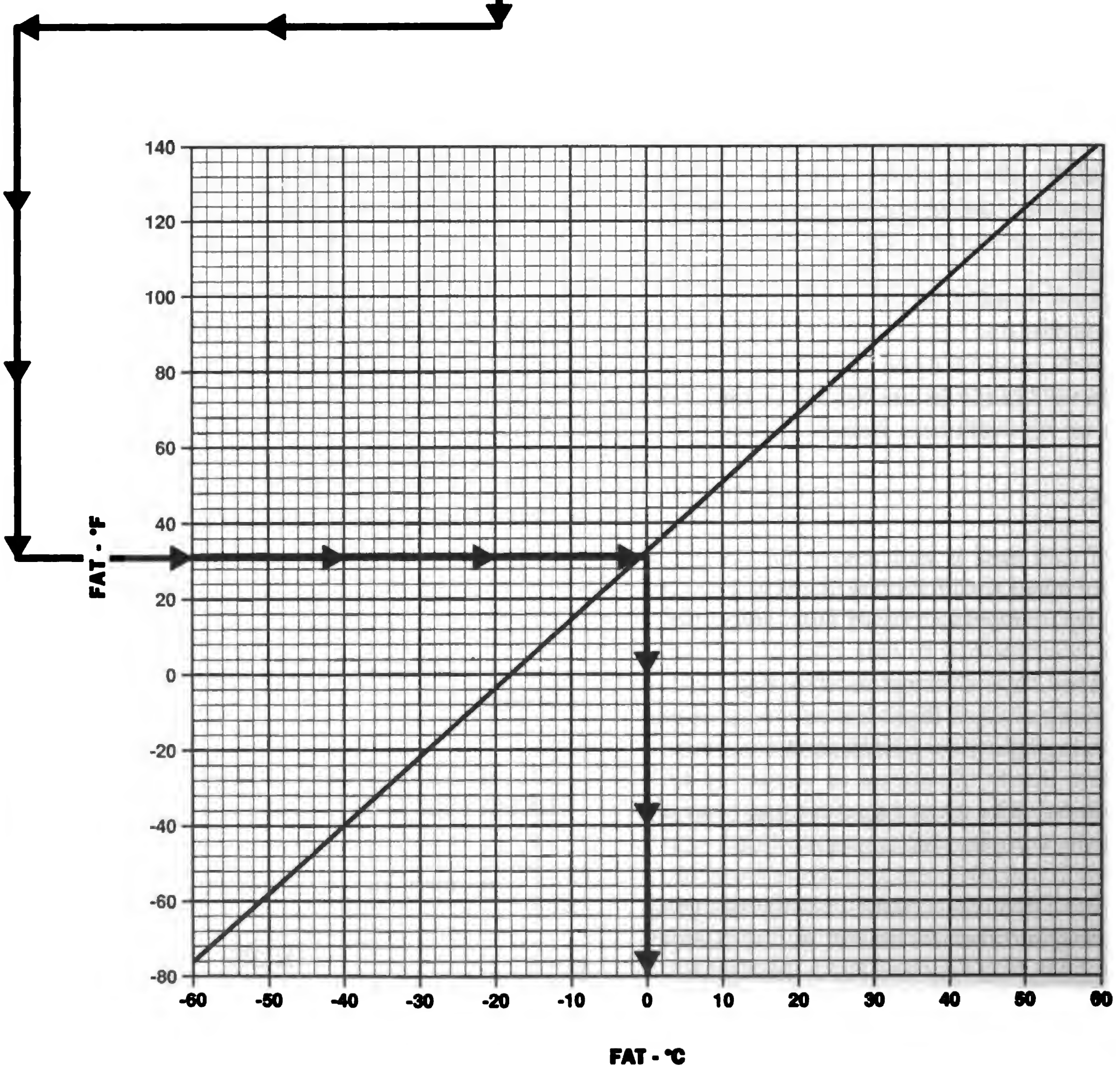
FREE AIR TEMPERATURE IN DEGREES CELSIUS

KNOWN:

FREE AIR TEMPERATURE = +32°F

METHOD:

ENTER FREE AIR TEMPERATURE HERE
MOVE RIGHT TO DIAGONAL LINE
MOVE DOWN TO DEGREES CELSIUS SCALE
READ FREE AIR TEMPERATURE = 0°C



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SA

Figure 7-1. Temperature Conversion Chart

7-11.1. Performance Data Basis - High Drag.

The data presented in the high drag performance charts are primarily derived for the UH-60A with the ESSS system installed and two 230 gallon tanks mounted on the outboard pylons, and are based on U.S. Army test data. The high drag configuration assumes all doors and windows are closed and includes the following external configuration:

a. External stores support system installed.

b. Two 230 gallon tanks mounted on the outboard pylons.

c. Inboard vertical pylons empty.

Section II MAXIMUM TORQUE AVAILABLE

7-12. Torque Factor Method.

The torque factor method provides an accurate indication of available power by incorporating ambient temperature effects on degraded engine performance. This section presents the procedure to determine the maximum dual- or single-engine torque available for the T700-GE-700 engine as installed in each individual aircraft. Specification power is defined for a newly delivered low time engine. The aircraft HIT log forms for each engine provide the engine and aircraft torque factors which are obtained from the maximum power check and recorded to be used in calculating maximum torque available.

7-13. Torque Factor Terms.

The following terms are used when determining the maximum torque available for an individual aircraft:

a. Torque Ratio (TR). The ratio of torque available to specification torque at the desired ambient temperature.

b. Engine Torque Factor (ETF). The ratio of an individual engine torque available to specification torque at reference temperature of 35°C. The ETF is allowed to range from 0.85 to 1.0.

c. Aircraft Torque Factor (ATF). The ratio of an individual aircrafts power available to specification power at a reference temperature of 35°C. The ATF is the average of the ETF's of both engines and its value is allowed to range from 0.9 to 1.0.

7-14. Torque Factor Procedure.

The use of the ATF or ETF to obtain the TR from Figure 7-2 for ambient temperatures between −15°C and 35°C is shown by the example. The ATF and ETF values for an individual aircraft are found on the engine HIT Log. The TR always equals 1.0 for ambient temperatures of −15°C and below, and the TR equals the ATF or ETF for temperatures of 35°C and above. For these cases, and for an ATF or ETF value of 1.0, Figure 7-2 need not be used.

7-15. Maximum Torque Available Chart.

This chart (Figure 7-3) presents the maximum specification torque available at zero airspeed and 100% RPMR for the operational range of pressure altitude and FAT. The single- and dual-engine transmission limits for continuous operation are shown and should not be exceeded. The engine torque available data above the single-engine transmission limit is presented as dashed lines and is required for determining torque available when TR values are below 1.0. When the TR equals 1.0, the maximum torque available may be read from the horizontal specification torque available per engine scale. When the TR value is less than 1.0, the maximum torque available is determined by multiplying the TR by the specification torque available. The lower portion of Figure 7-3 presents TR correction lines which may be used in place of multiplication to read torque available per engine directly from the vertical scale.

7-16. Engine Bleed Air.

With engine bleed air turned on, the maximum available torque is reduced as follows:

a. Engine Anti-Ice On: Reduce torque determined from Figure 7-2 by a constant 16% TRQ. Example: (90% TRQ − 16% TRQ) = 74% TRQ.

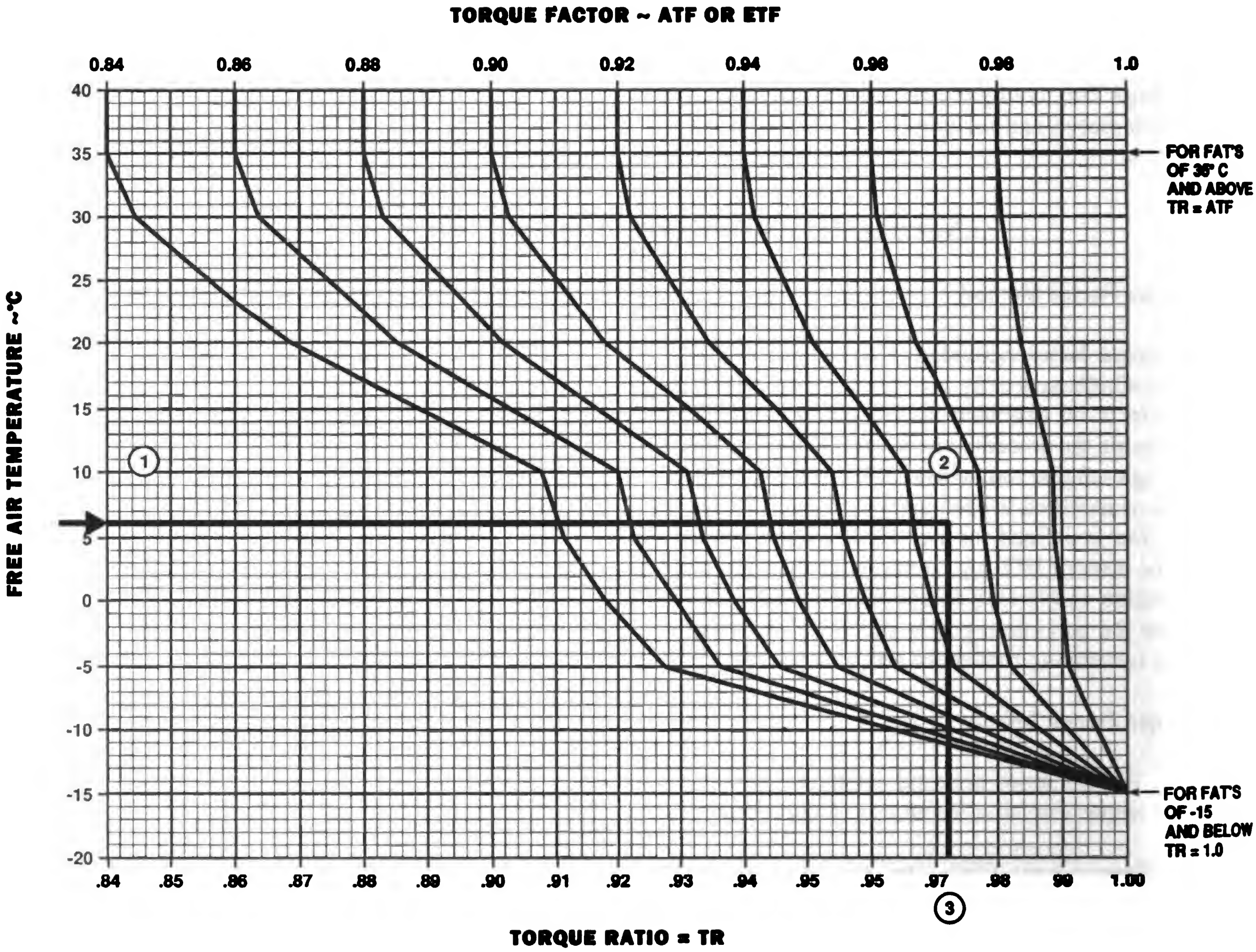
b. Cockpit Heater On: Reduce torque available by 4% TRQ.

c. Both On: Reduce torque available by 20% TRQ.

7-17. Infrared Suppressor Systems.

When the hover IR suppressor system is installed and operating in the benign mode exhaust (baffles removed) the maximum torque available is increased about 1% TRQ. When an IR suppressor system is not installed, maximum torque available is also increased about 1%.

TORQUE FACTOR



EXAMPLE

WANTED:

TORQUE RATIO AND MAXIMUM TORQUE AVAILABLE

KNOWN:

ATF = 0.95
PRESSURE ALTITUDE = 6000 FT
FAT = 6° C

METHOD:

TO OBTAIN TORQUE RATIO:

1. ENTER TORQUE FACTOR CHART AT KNOWN FAT
2. MOVE RIGHT TO THE ATF VALUE
3. MOVE DOWN, READ TORQUE RATIO = 0.972

TO CALCULATE MAXIMUM TORQUE AVAILABLE:

4. ENTER MAXIMUM TORQUE AVAILABLE CHART AT KNOWN FAT (FIGURE 7-2)
5. MOVE RIGHT TO KNOWN PRESSURE ALTITUDE
6. MOVE DOWN, READ SPECIFICATION TORQUE = 97.2%

TO OBTAIN VALUE FROM CHART:

7. MOVE DOWN TO TORQUE RATIO OBTAINED FROM FIGURE 7-1
8. MOVE LEFT, READ MAXIMUM TORQUE AVAILABLE = 93.0%

DATA BASIS: CALCULATED

AA0675
9A

Figure 7-2. Aircraft Torque Factor (ATF)

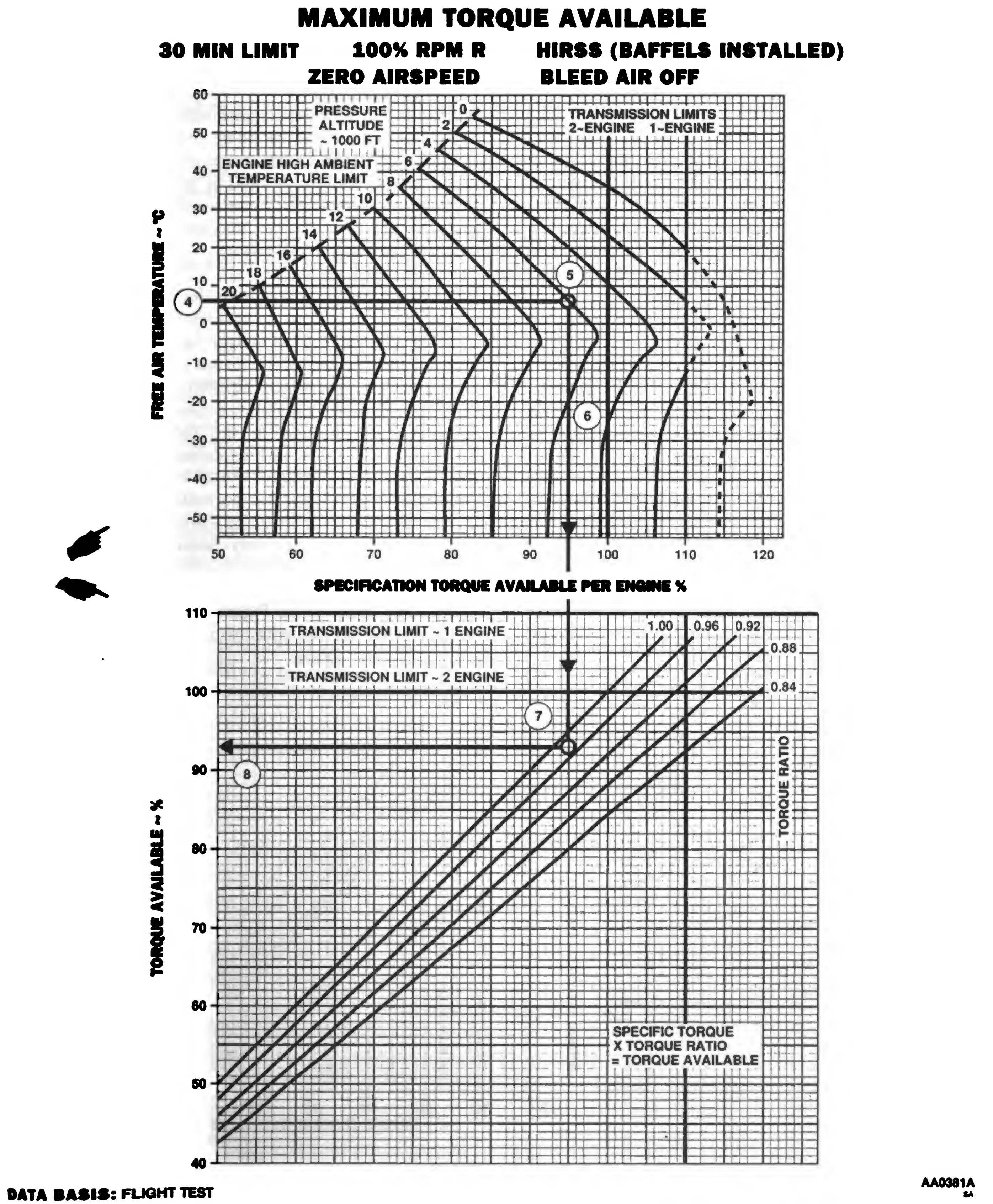


Figure 7-3. Maximum Torque Available - 30-Minute Limit

Section III HOVER

7-18. HOVER CHART.

a. The primary use of the chart (Figures 7-4 through 7-9) is illustrated by part A of the example. To determine the torque required to hover, it is necessary to know pressure altitude, free air temperature, gross weight, and desired wheel height. Enter the upper right grid at the known pressure altitude, move right to the temperature, move down to gross weight. Move left to desired wheel height, deflect down and read torque required for dual engine or single engine operation.

b. In addition to the primary use, the hover chart (Figure 7-4) may be used to predict maximum hover height. This information is necessary for use of the take-off chart found in Figure 7-7. To determine maximum hover height, it is necessary to know pressure altitude, free air temperature, gross weight, and maximum torque available. Enter the known pressure altitude, move right to the temperature, move down to gross weight, move left to intersection with maximum torque available and read wheel height. This wheel height is the maximum hover height.

c. The hover chart may also be used to determine maximum gross weight for hover at a given wheel height, pressure altitude, and temperature as illustrated in part B of the example (Figure 7-4). Enter at known pressure altitude, move right to the temperature, then move down and establish a vertical line on the lower grid. Now enter lower left grid at maximum torque available. Move up to wheel height, then move right to intersect vertical line from pressure altitude/FAT intersection. Interpolate from gross weight lines to read maximum gross weight at which the helicopter will hover.

7-19. Maximum Gross Weight to Hover Chart.

The maximum gross weight for hover charts (Figures 7-6 and 7-7) provides a means of finding the maximum gross weight at which the helicopter can be hovered OGE in zero wind for combinations of pressure altitude with FAT at ATF values of 0.9 and 1.0 respectively. FATs of −15°C and below provide the same gross weight capability. Figures 7-8 and 7-9 may be used to determine the maximum gross weight to hover IGE at various wheel heights once the OGE weight is known for clean or high drag configuration respectively. Maximum gross weight to hover may be approximated by interpolation/extrapolation when ATF values are other than 1.0 and 0.9. The user has the option to use Figure 7-4 or the combination of Figures 7-6 and 7-7 with interpolation/extrapolation.

HOVER

100% RPM R
ZERO WIND LEVEL SURFACE
COLD DAY CLEAN CONFIGURATION

EXAMPLE

WANTED:

A. TORQUE REQUIRED TO HOVER OGE AND AT A 10 FOOT WHEEL HEIGHT
B. MAXIMUM GROSS WEIGHT TO HOVER OGE

KNOWN:

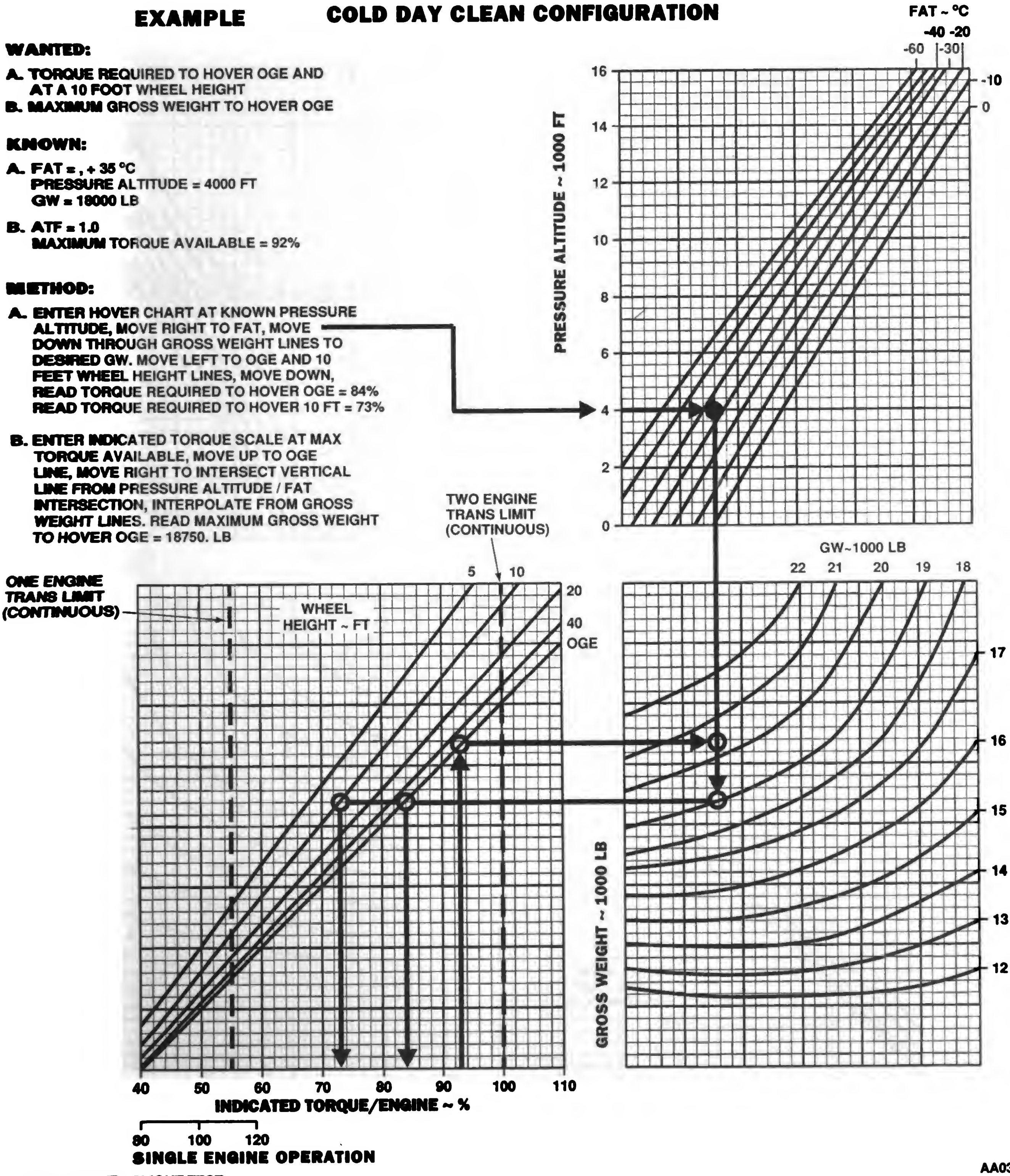
A. FAT = , + 35 °C
PRESSURE ALTITUDE = 4000 FT
GW = 18000 LB

B. ATF = 1.0
MAXIMUM TORQUE AVAILABLE = 92%

METHOD:

A. ENTER HOVER CHART AT KNOWN PRESSURE ALTITUDE, MOVE RIGHT TO FAT, MOVE DOWN THROUGH GROSS WEIGHT LINES TO DESIRED GW. MOVE LEFT TO OGE AND 10 FEET WHEEL HEIGHT LINES, MOVE DOWN, READ TORQUE REQUIRED TO HOVER OGE = 84%
READ TORQUE REQUIRED TO HOVER 10 FT = 73%

B. ENTER INDICATED TORQUE SCALE AT MAX TORQUE AVAILABLE, MOVE UP TO OGE LINE, MOVE RIGHT TO INTERSECT VERTICAL LINE FROM PRESSURE ALTITUDE / FAT INTERSECTION, INTERPOLATE FROM GROSS WEIGHT LINES. READ MAXIMUM GROSS WEIGHT TO HOVER OGE = 18750. LB



DATA BASE: FLIGHT TEST

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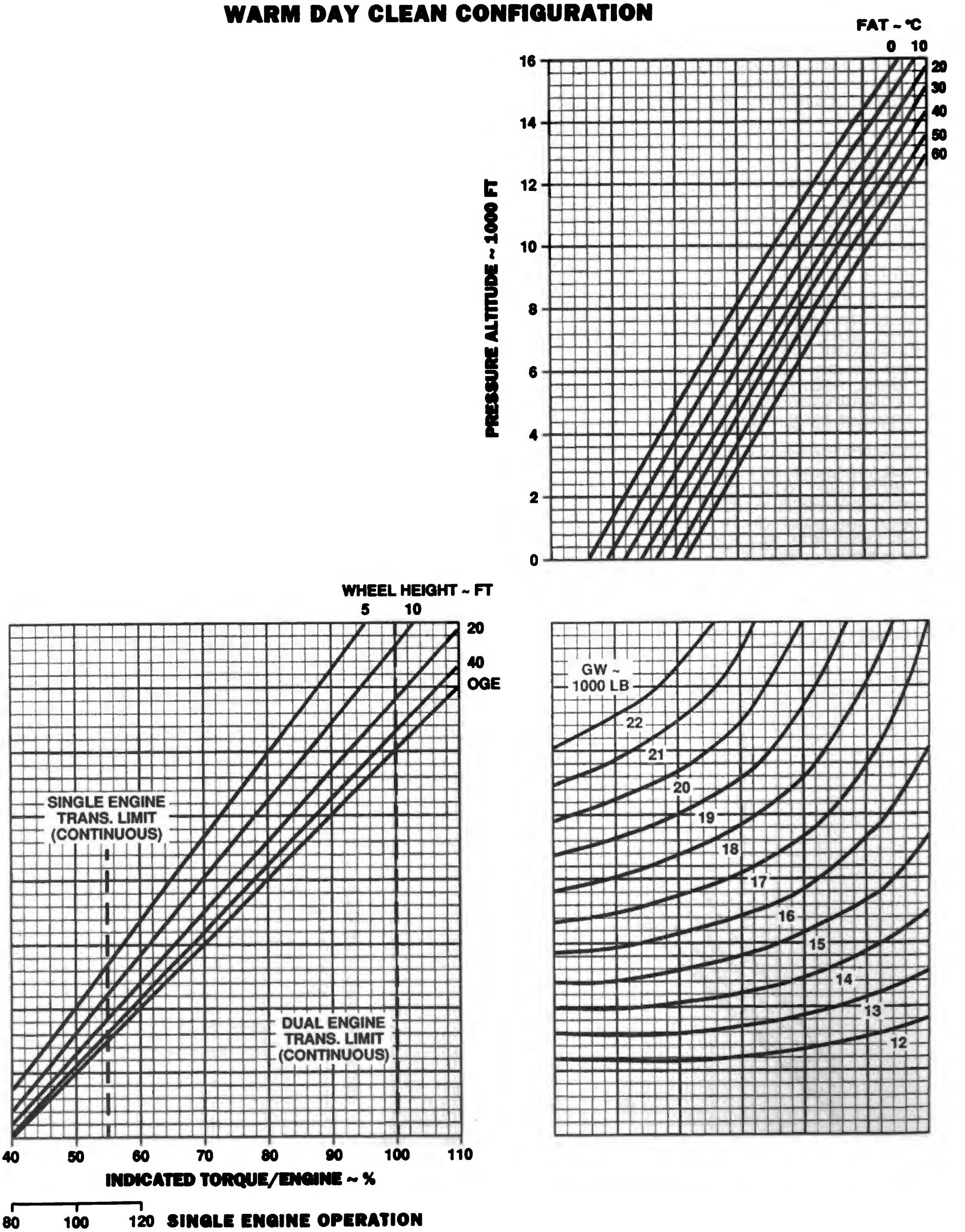
SA

Figure 7-4. Hover - Clean Configuration (Sheet 1 of 2)

HOVER

100% RPM R
ZERO WIND LEVEL SURFACE
WARM DAY CLEAN CONFIGURATION



DATA BASE: FLIGHT TEST

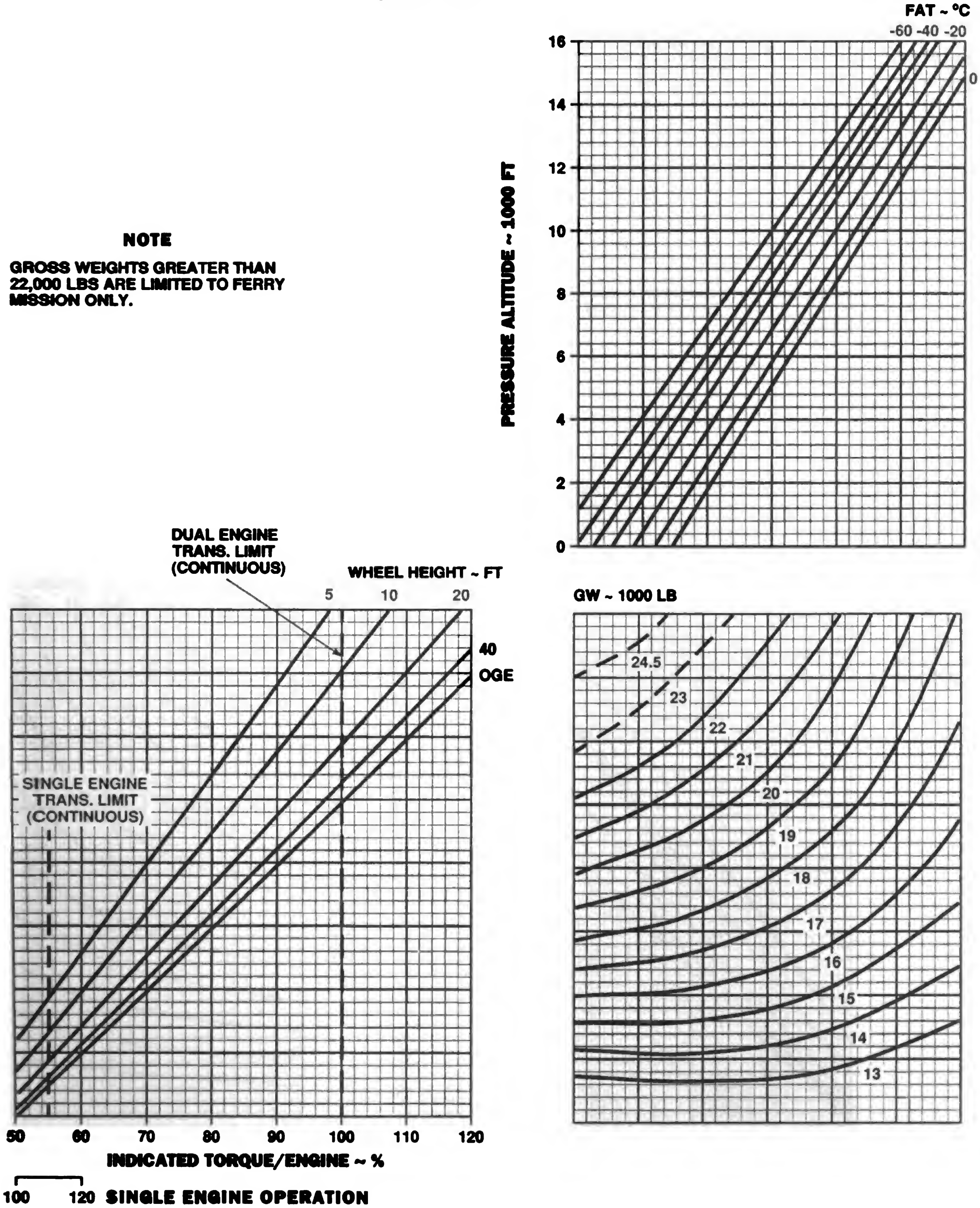
Figure 7-4. Hover - Clean Configuration (Sheet 2 of 2)

HOVER

100% RPM R
ZERO WIND LEVEL SURFACE
COLD DAY

NOTE

GROSS WEIGHTS GREATER THAN 22,000 LBS ARE LIMITED TO FERRY MISSION ONLY.



DATA BASE: FLIGHT TEST

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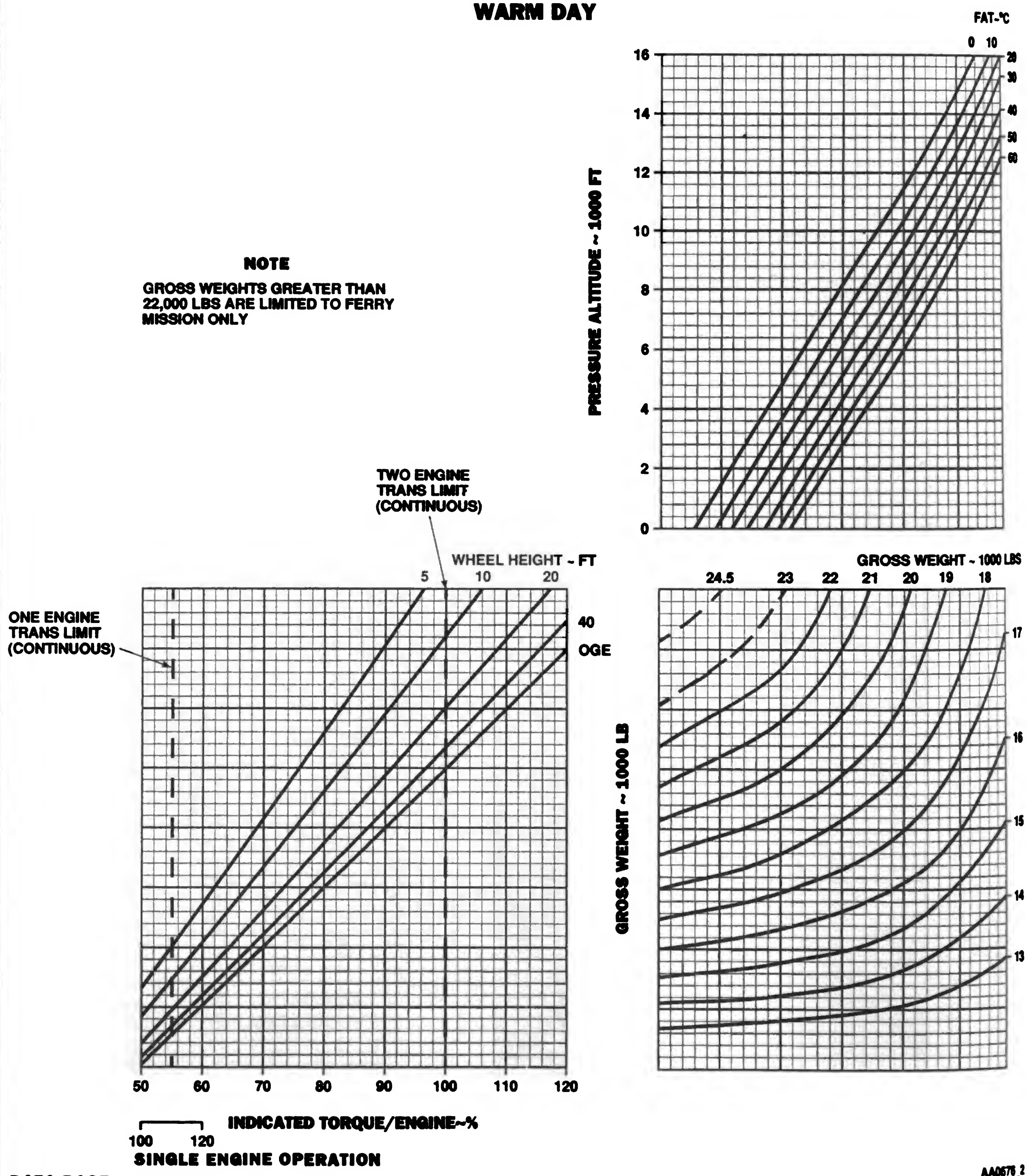
Figure 7-5. Hover - High Drag (Sheet 1 of 2)

HOVER
100% RPM R
ZERO WIND LEVEL SURFACE
WARM DAY

NOTE

GROSS WEIGHTS GREATER THAN 22,000 LBS ARE LIMITED TO FERRY MISSION ONLY

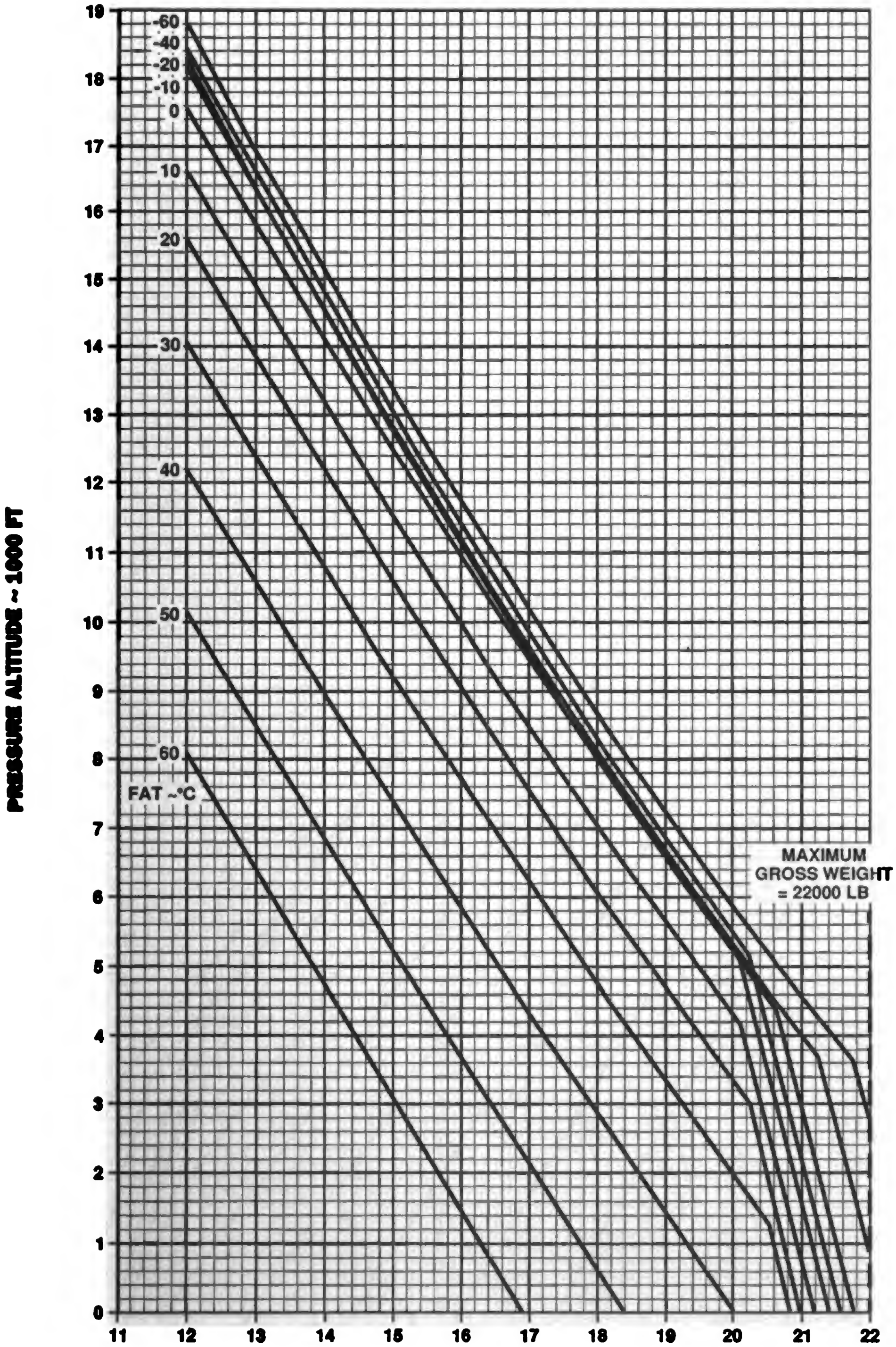


DATA BASE: FLIGHT TEST

Figure 7-5. Hover - High Drag (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

CLEAN CONFIGURATION 100% RPM R
30 MINUTE POWER ATF = 1.0
HIRSS (BAFFELS INSTALLED)

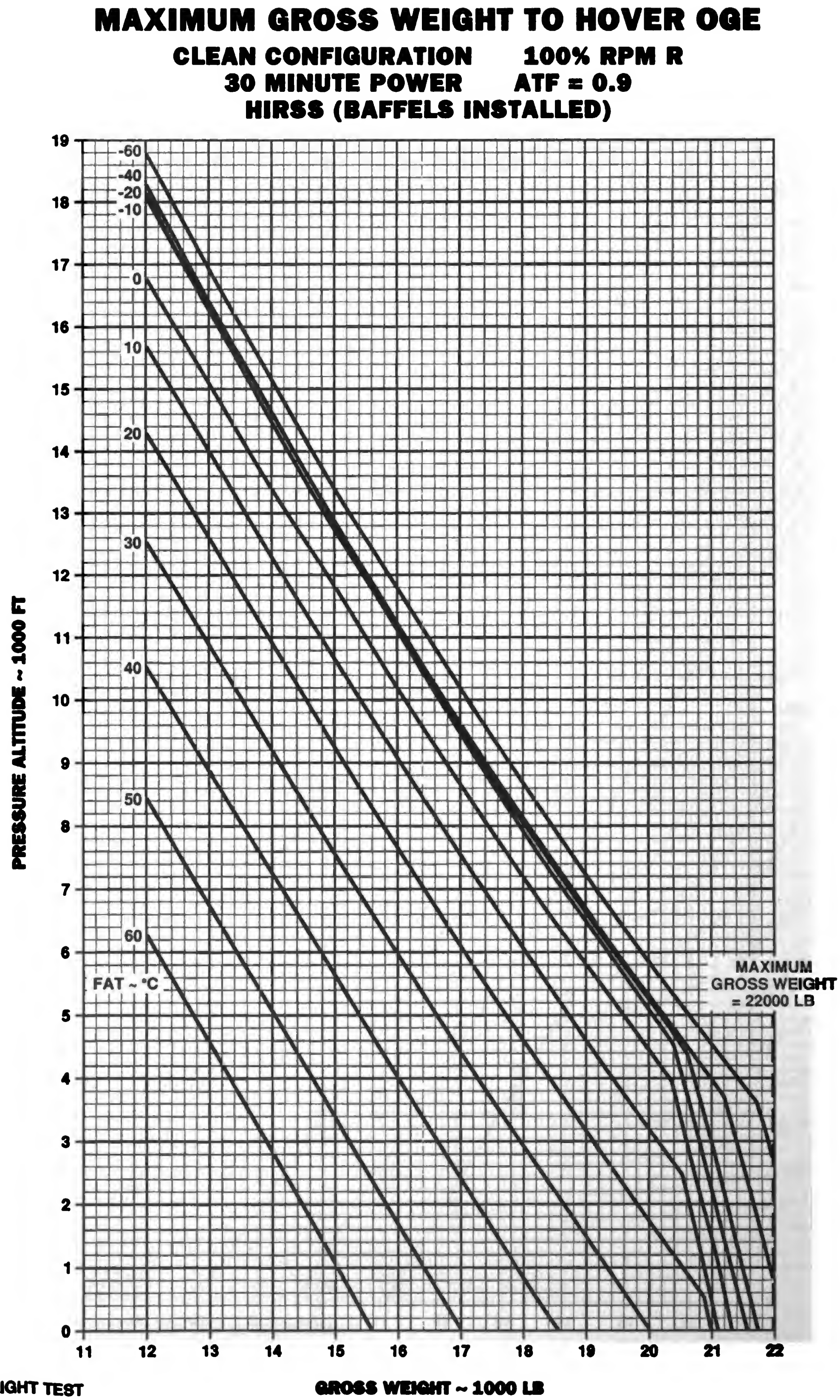


DATA BASE: FLIGHT TEST

GROSS WEIGHT ~ 1000 LB

AA0677_1

Figure 7-6. Maximum Gross Weight to Hover OGE - Clean (Sheet 1 of 2)



DATA BASE: FLIGHT TEST

AA0577_2

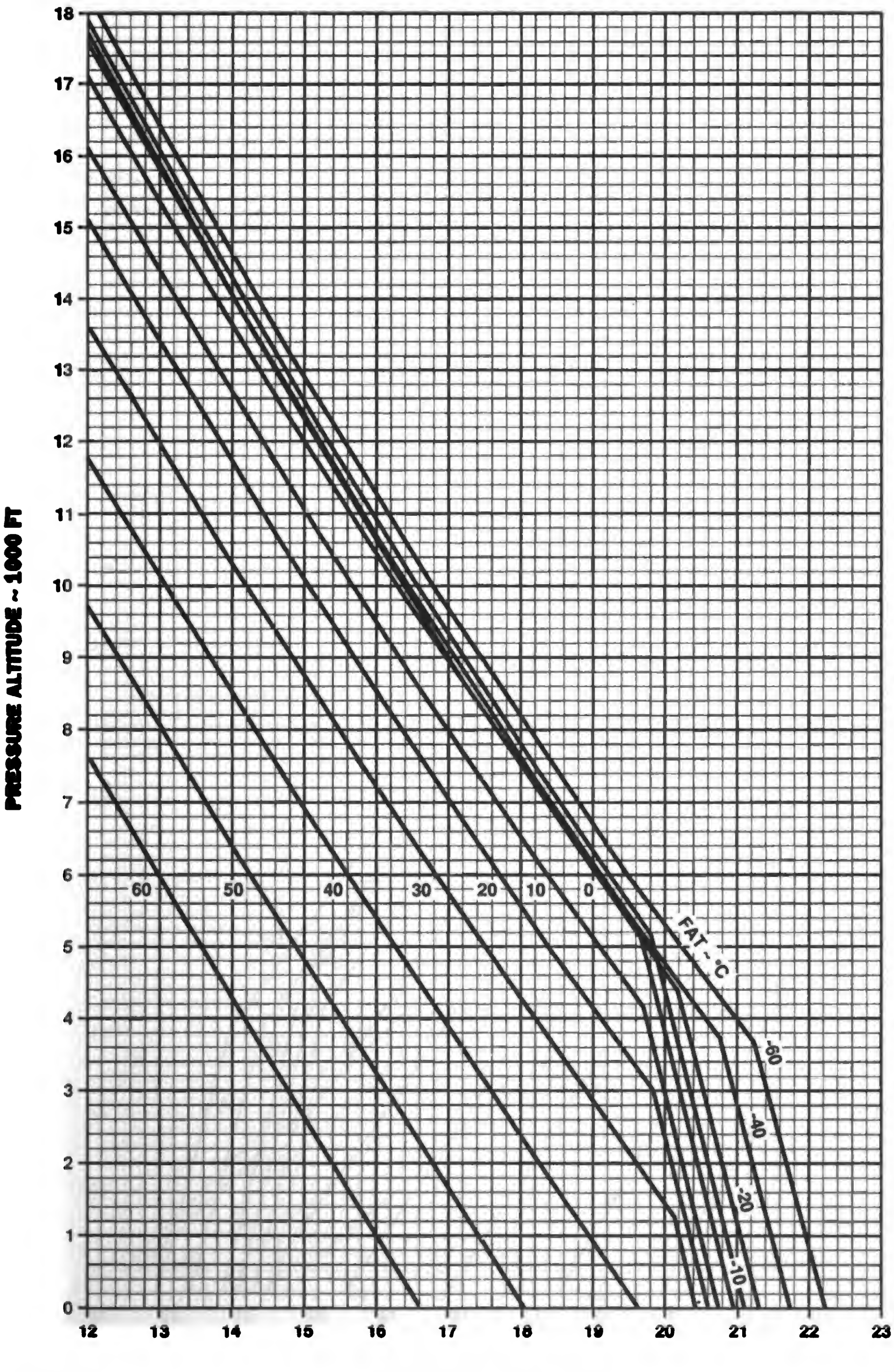
Figure 7-6. Maximum Gross Weight to Hover OGE - Clean (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

100% RPM R

30 MINUTE POWER ATF = 1.0

HIRSS (BAFFELS INSTALLED)



DATA BASE: FLIGHT TEST

Figure 7-7. Maximum Gross Weight to Hover OGE - High Drag (Sheet 1 of 2)

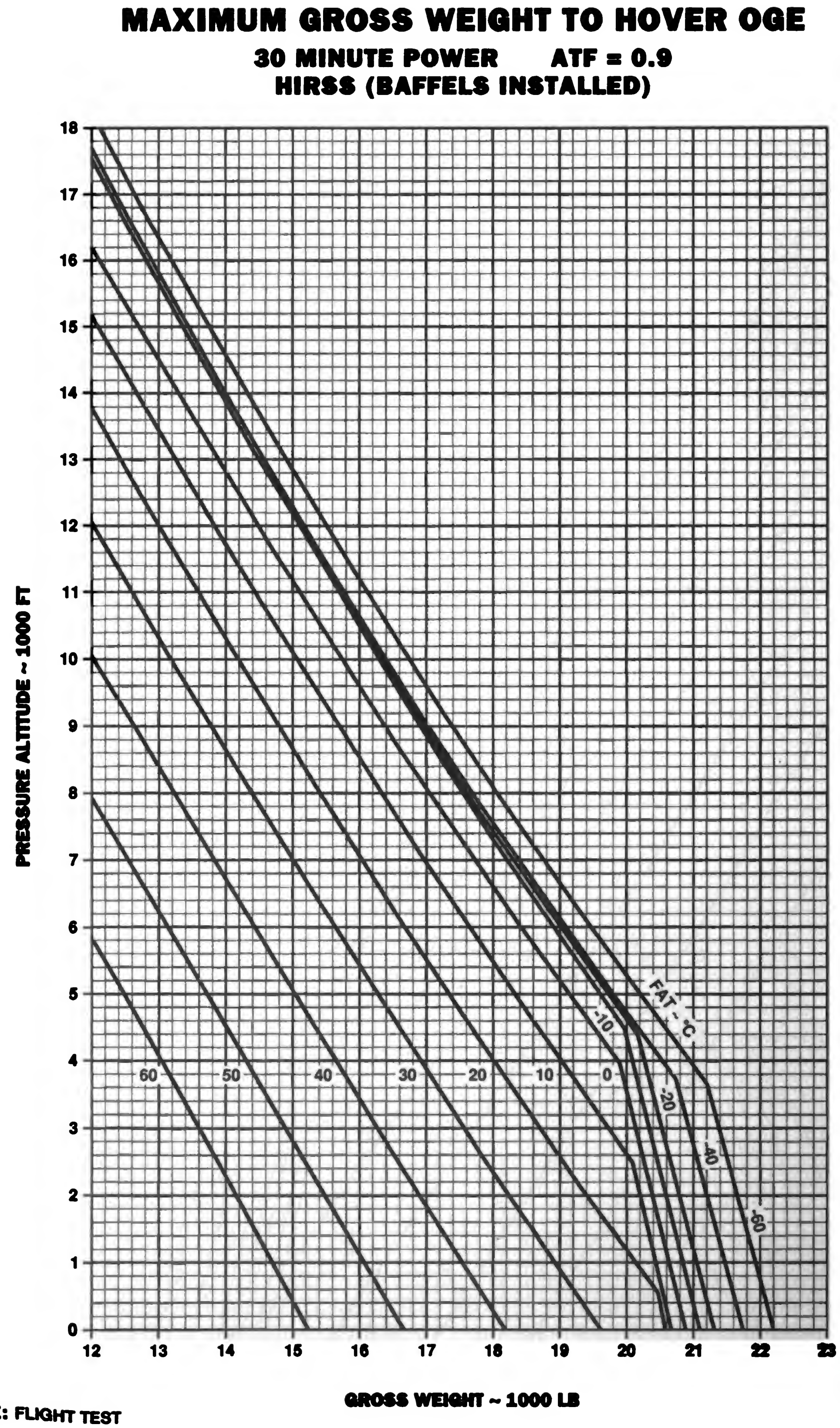


Figure 7-7. Maximum Gross Weight to Hover OGE - High Drag (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER IN GROUND EFFECT

CLEAN CONFIGURATION 100% RPM R

EXAMPLE

WANTED

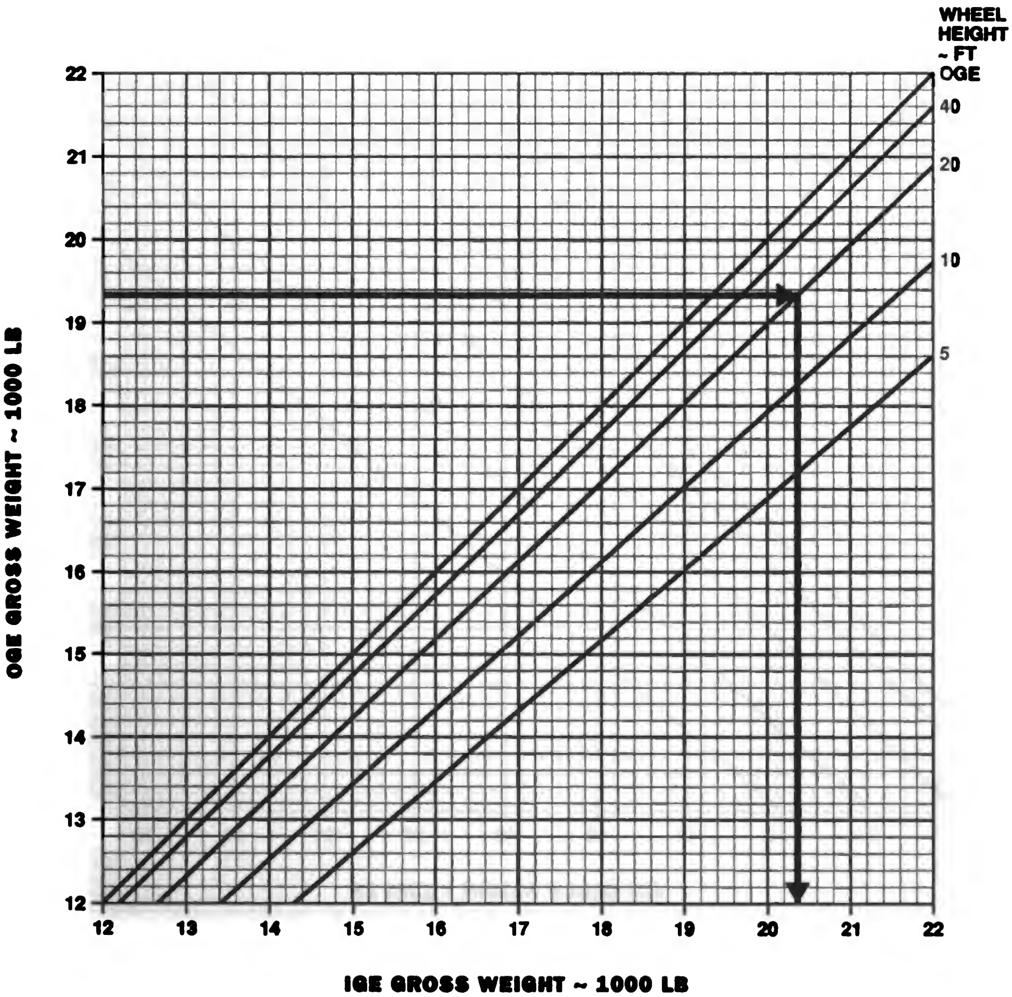
MAXIMUM GROSS WEIGHT TO HOVER AT 20 FEET WHEEL HEIGHT.

KNOWN

MAXIMUM OGE GROSS WEIGHT AT 4000 FT / 12 °C WAS 19300 LB FROM FIGURE 7-6.

METHOD

ENTER CHART ON OGE GROSS WEIGHT SCALE AT 19300 LB. MOVE RIGHT UP TO 20 FT WHEEL HEIGHT LINE, MOVE DOWN READ IGE GROSS WEIGHT = 20400 LB.



AA0679
SA

Figure 7-8. Maximum Gross Weight to Hover IGE - Clean

MAXIMUM GROSS WEIGHT TO HOVER IN GROUND EFFECT

100% RPM R

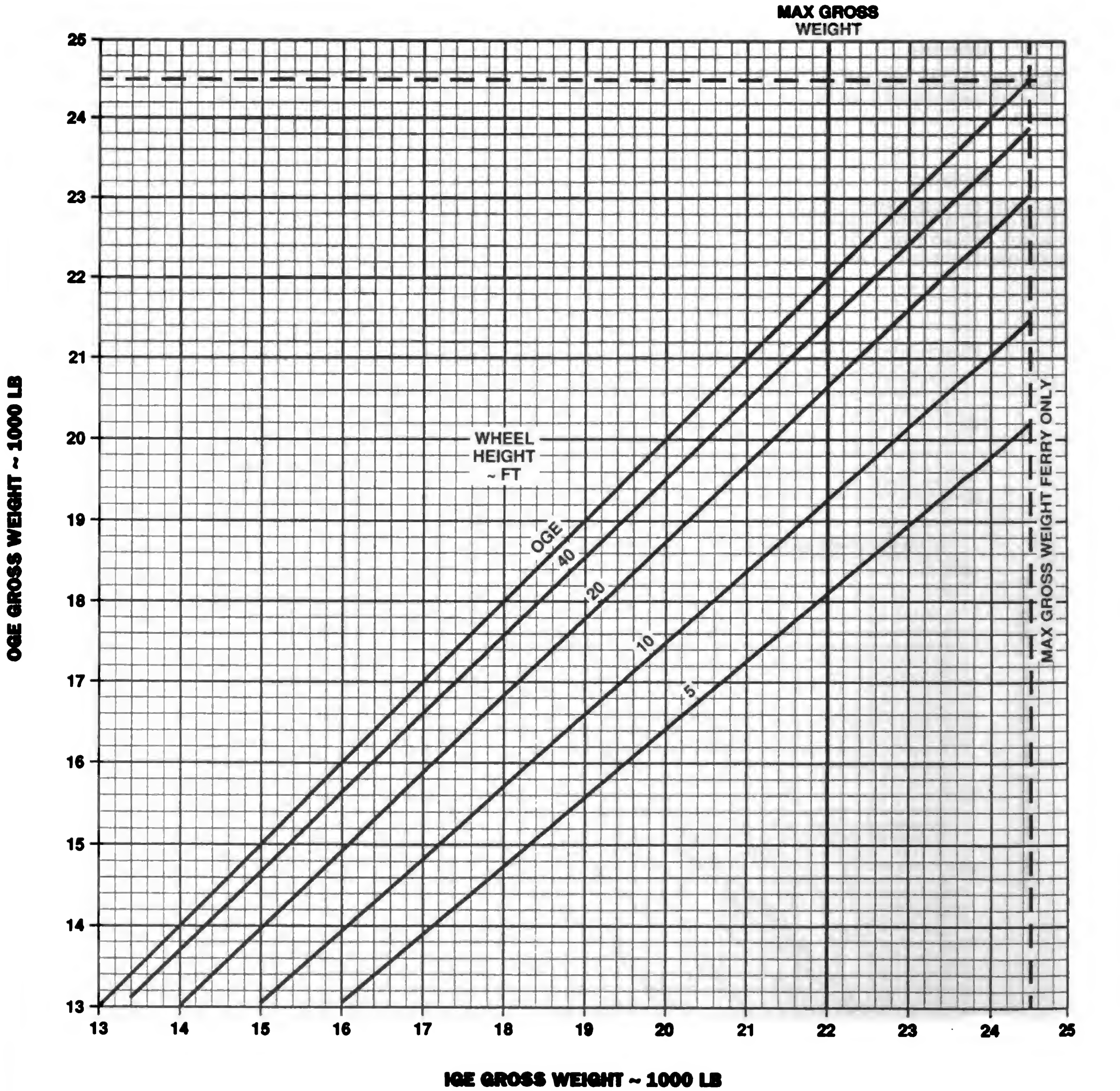


Figure 7-9. Maximum Gross Weight to Hover IGE - High Drag

Section IV TAKEOFF

7-20. Description.

The takeoff chart (Figure 7-10) provides the distances required to clear a 50-foot obstacle, based upon maximum hover wheel height capabilities determined from Figure 7-4 for gross weights, pressure altitude and FAT conditions and torque. Distances are contingent on the use of a takeoff technique as follows: The takeoff profile shown on Figure 7-10 and is started with a level flight acceleration from a 5-foot hover, with rotation to climbout attitude initiated at 5 knots below climbout airspeed.

NOTE

The maximum hover heights shown are only a measure of the helicopter's climb capability and do not imply that a hover height greater than 5 feet should be used during actual takeoff.

7-21. Use of Chart.

The primary use of the chart is illustrated by the example.

a. To determine the distance required to clear a 50 foot obstacle it is necessary to know maximum hover height and climbout true airspeed. Calculation of maximum hover height is described in Section III, Hover.

NOTE

Indicated airspeeds below 40 KIAS are unreliable. Airspeed conversion data KIAS to KTAS for speeds above 40 KIAS are provided in Section V Cruise.

Select a climbout indicated airspeed of 40 KIAS or greater and determine corresponding true airspeed from applicable cruise chart in Section V.

b. Before takeoff a hover check may be made to verify the hover capability. If winds are present, the hover check may disclose that the helicopter can actually hover at a greater wheel height than the calculated value, since the hover chart is based upon calm wind conditions. The calculated value, however, should be used to determine the takeoff distance required.

7-22. Conditions.

a. The takeoff chart is based on calm wind conditions. Since the surface wind velocity and direction cannot be accurately predicted, all takeoff planning should be based on calm wind conditions. Takeoff into the wind will improve the takeoff performance.

b. All takeoff performance data are based on the use of maximum torque available.

TAKE OFF

AT MAXIMUM HOVER CAPABILITY
LEVEL ACCELERATION/CLIMB TECHNIQUE.
ZERO WIND MAXIMUM TORQUE AVAILABLE 100% RPMR

TAKEOFF

EXAMPLE

WANTED:

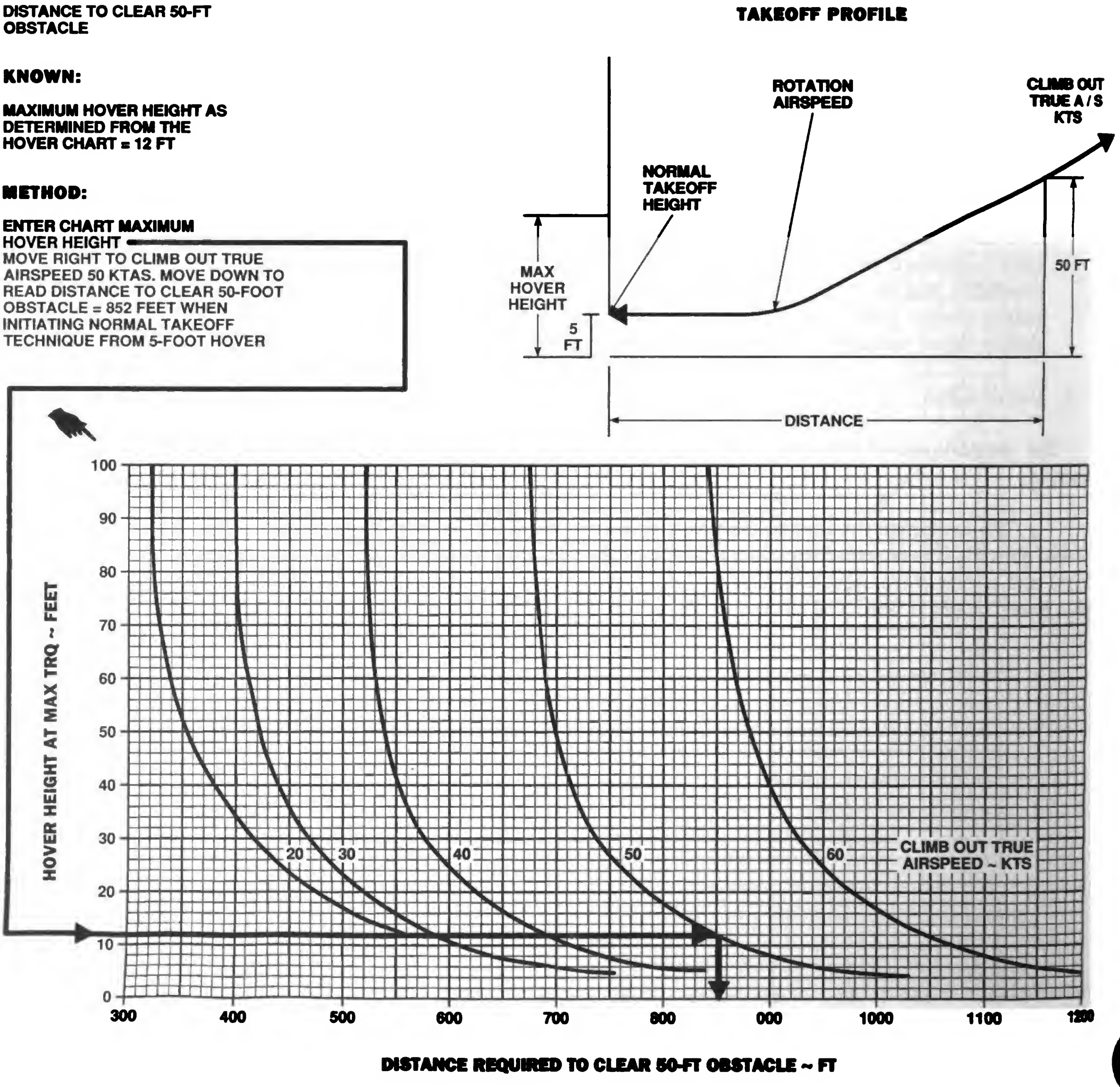
DISTANCE TO CLEAR 50-FT OBSTACLE

KNOWN:

MAXIMUM HOVER HEIGHT AS DETERMINED FROM THE HOVER CHART = 12 FT

METHOD:

ENTER CHART MAXIMUM HOVER HEIGHT
MOVE RIGHT TO CLIMB OUT TRUE AIRSPEED 50 KTAS. MOVE DOWN TO READ DISTANCE TO CLEAR 50-FOOT OBSTACLE = 852 FEET WHEN INITIATING NORMAL TAKEOFF TECHNIQUE FROM 5-FOOT HOVER



DATA BASE: CALCULATED

AA0661

Figure 7-10. Takeoff

Section V CRUISE

7-23. Description.

The cruise charts (Figures 7-12 through 7-33) present torque required and total fuel flow as a function of airspeed, altitude, temperature, and gross weight at 100% rotor speed. Scales for both true airspeed and indicated airspeed are presented. The baseline aircraft configuration for these charts was the "clean" configuration as defined in Section I. Each cruise chart also presents the change in torque (ΔTRQ) required for 10 sq. ft. of additional flat plate drag with a dashed line on a separate scale. This line is utilized to correct torque required for external loads as discussed in Section VII Drag. Maximum level flight airspeed (V_h) is obtained at the intersection of gross weight arc and torque available - 30 minutes or the transmission torque limit, whichever is lower. Airspeeds that will produce maximum range, maximum endurance, and maximum rate of climb are also shown. Cruise charts are provided from sea level to 20,000 feet pressure altitude in units of 2,000 feet. Each figure number represents a different altitude. The charts provide cruise data for free air temperatures from −50° to +60°C, in units of 10°. Charts with FAT's that exceed the engine ambient temperature limits by more than 10°C are deleted.

7-24. Use of Charts.

The primary uses of the charts are illustrated by the examples of Figure 7-12. To use the charts, it is usually necessary to know the planned pressure altitude, estimated free air temperature, planned cruise speed, TAS, and gross weight. First, select the proper chart on the basis of pressure altitude and FAT. Enter the chart at the cruise airspeed, IAS, move right and read TAS, move left to the gross weight, move down and read torque required, and then move up and read associated fuel flow. Maximum performance conditions are determined by entering the chart where the maximum range line or the maximum endurance and rate of climb line intersects the gross weight line; then read airspeed, fuel flow, and torque required. Normally, sufficient accuracy can be obtained by selecting the chart nearest the planned cruising altitude and FAT or, more conservatively, by selecting the chart with the next higher altitude and FAT. If greater accuracy is required, interpolation between altitudes and/or temperatures is permissible. To be conservative, use the gross weight at the beginning of the cruise flight. For greater accuracy on long flights, however, it is preferable to determine cruise information for several flight segments to allow for the decreasing gross weight.

a. Airspeed. True and indicated airspeeds are presented at opposite sides of each chart. On any chart, indicated airspeed can be directly converted to true airspeed (or vice versa) by reading directly across the chart without regard for the other chart information. The level flight airspeed calibration for aircraft with the ESSS provisions (hard points only) was used to convert indicated to true airspeed.

b. Torque. Since pressure altitude and temperature are fixed for each chart, torque required varies according to gross weight and airspeed. The torque and torque limits shown on these charts are for dual-engine operation. The maximum torque available is presented on each chart as either the transmission torque limit or torque available - 30 minute for both ATF-1.0 and 0.9 values. The maximum torque available for aircraft with an ATF value between these must be interpolated. The continuous torque available values shown represent the minimum torque available for ATF's of 0.95 or greater. For ATF's less than 0.95 maximum continuous torque available may be slightly reduced. Higher torque than that represented by these lines may be used if it is available without exceeding the limitations presented in Chapter 5. An increase or decrease in torque required because of a drag area change is calculated by adding or subtracting the change in torque from the torque on the curve, and then reading the new fuel flow total.

c. Fuel Flow. Fuel flow scales are provided opposite the torque scales. On any chart, torque may be converted directly to fuel flow without regard to other chart information. Data shown in this section is for two-engine operation. For one-engine fuel flow, refer to Section IX Fuel Flow.

(1) With bleed-air extracted, fuel flow increases:

(a) ENG ANTI-ICE ON - About 60 lbs/hr Example: (760 lbs/hr + 60 lbs/hr = 820 lbs/hr.)

(b) HEATER ON - About 20 lbs/hr.

(c) Both ON - About 80 lbs/hr.

(2) When the cruise IR suppressors are removed or hover IR suppressor system is installed and operating in the benign mode (exhaust baffles removed), the dual-engine fuel flow will decrease about 16 lb/hour.

d. Maximum Range. The maximum range lines (MAX RANGE) indicate the combinations of gross weight and airspeed that will produce the greatest flight range per pound of fuel under zero wind conditions. When maximum range airspeed line is above the maximum torque available, the resulting maximum airspeed should be used for maximum range. A method of estimating maximum range speed in winds is to increase IAS by 2.5 knots per each 10 knots of effective headwind (which reduces flight time and minimizes loss in range) and decrease IAS by 2.5 knots per 10 knots of effective tailwind for economy.

e. Maximum Endurance and Rate of Climb. The maximum endurance and rate of climb lines (MAX END and R/C) indicate the combinations of gross weight and airspeed that will produce the maximum endurance and the maximum rate of climb. The torque required for level flight at this condition is a minimum, providing a minimum fuel flow (maximum endurance) and a maximum torque change available for climb (maximum rate of climb).

f. Change in Frontal Area. Since the cruise information is given for the "clean configuration," adjustments to torque should be made when operating with external sling loads or aircraft external configuration changes. To determine the change in torque, first obtain the appropriate multiplying factor from the drag load chart (Figure 7-35), then enter the cruise chart at the planned cruise speed TAS, move right to the broken Δ TRQ line, and move up and read Δ TRQ. Multiply Δ TRQ by the multiplying factor to obtain change in torque, then add or subtract change in torque from torque required for the primary mission configuration. Enter the cruise chart at resulting torque required, move up, and read fuel flow. If the resulting torque required exceeds the governing torque limit, the torque required must be reduced to the limit. The resulting reduction in airspeed may be found by subtracting the change in torque from the limit torque; then enter the cruise chart at the reduced torque, and move up to the gross weight. Move left or right to read TAS or IAS. The engine torque setting for maximum range obtained from the clean configuration cruise chart will generally result in cruise at best range airspeed for the higher drag configuration. To determine the approximate airspeed for maximum range for alternative or external load configurations, reduce the value from the cruise chart by 6 knots for each 10 square foot increase in drag area, ΔF. For example, if both cabin doors are open the ΔF increases 6 ft^2 and the maximum range airspeed would be reduced by approximately 4 knots (6 Kts/10 $ft^2 \times 6$ ft^2 = 3.6 Kts).

g. Additional Uses. The low speed end of the cruise change (below 40 knots) is shown primarily to familiarize you with the low speed power requirements of the helicopter. It shows the power margin available for climb or acceleration during maneuvers, such as NOE flight. At zero airspeed, the torque represents the torque required to hover out of ground effect. In general, mission planning for low speed flight should be based on hover out of ground effect.

CRUISE EXAMPLE
CLEAN CONFIGURATION
100% RPM R

EXAMPLE

WANTED:

A. CRUISE CONDITIONS FOR MAXIMUM RANGE
B. CONDITIONS FOR MAXIMUM ENDURANCE
C. MAXIMUM AIRSPEED IN LEVEL FLIGHT
D. DETERMINE TORQUE AND FUEL FLOW REQUIRED TO CRUISE AT THE CONDITIONS OF EXAMPLE A WITH CABIN DOORS OPEN

KNOWN:

FAT = + 30°C
PRESSURE ALTITUDE = 6000 FT
GW = 17000 LBS
ATF = 0.95

METHOD:

A. TURN TO CRUISE CHARTS NEAREST KNOWN FLIGHT CONDITIONS, AT INTERSECTION OF MAX RANGE LINE AND KNOWN VALUE OF GROSS WEIGHT:
MOVE LEFT, READ TAS = 135 KTS
MOVE RIGHT, READ IAS = 119 KTS
MOVE DOWN, READ TORQUE = 62% TRQ
MOVE UP, READ TOTAL FUEL FLOW = 900 LBS / HR

B. AT INTERSECTION OF MAX END. / AND R / C LINE AND KNOWN VALUE OF GROSS WEIGHT:
MOVE LEFT, READ TAS = 82 KTS
MOVE RIGHT, READ IAS = 67 KTS
MOVE DOWN, READ TORQUE = 41% TRQ
MOVE UP, READ TOTAL FUEL FLOW = 700 LBS / HR

C. AT INTERSECTION OF 30-MINUTE TORQUE AVAILABLE AS INTERPOLATED FOR THE ATF VALUE AT THE KNOWN GROSS WEIGHT:
MOVE LEFT, READ MAXIMUM TAS = 153 KTS
MOVE RIGHT, READ MAXIMUM IAS = 135 KTS
MOVE DOWN, READ MAXIMUM TORQUE = 82% TRQ
MOVE UP, READ TOTAL FUEL FLOW = 1125 LBS / HR

D. ENTER △TRQ% PER 10 SQ FT SCALE AT 135 KTAS
MOVE UP READ △TRQ = 8.0%
TURN TO DRAG TABLE IN SECTION VII
NOTE CABIN DOORS OPEN = 6.0 SQ FT△F
AND HAS A DRAG MULTIPLYING FACTOR VALUE OF 0.60, CALCULATE TOTAL TORQUE REQUIRED:

62% + (0.6 X 8.0%) = 66.8% TRQ

READ FUEL FLOW AT-TOTAL TORQUE = 950 LBS / HR

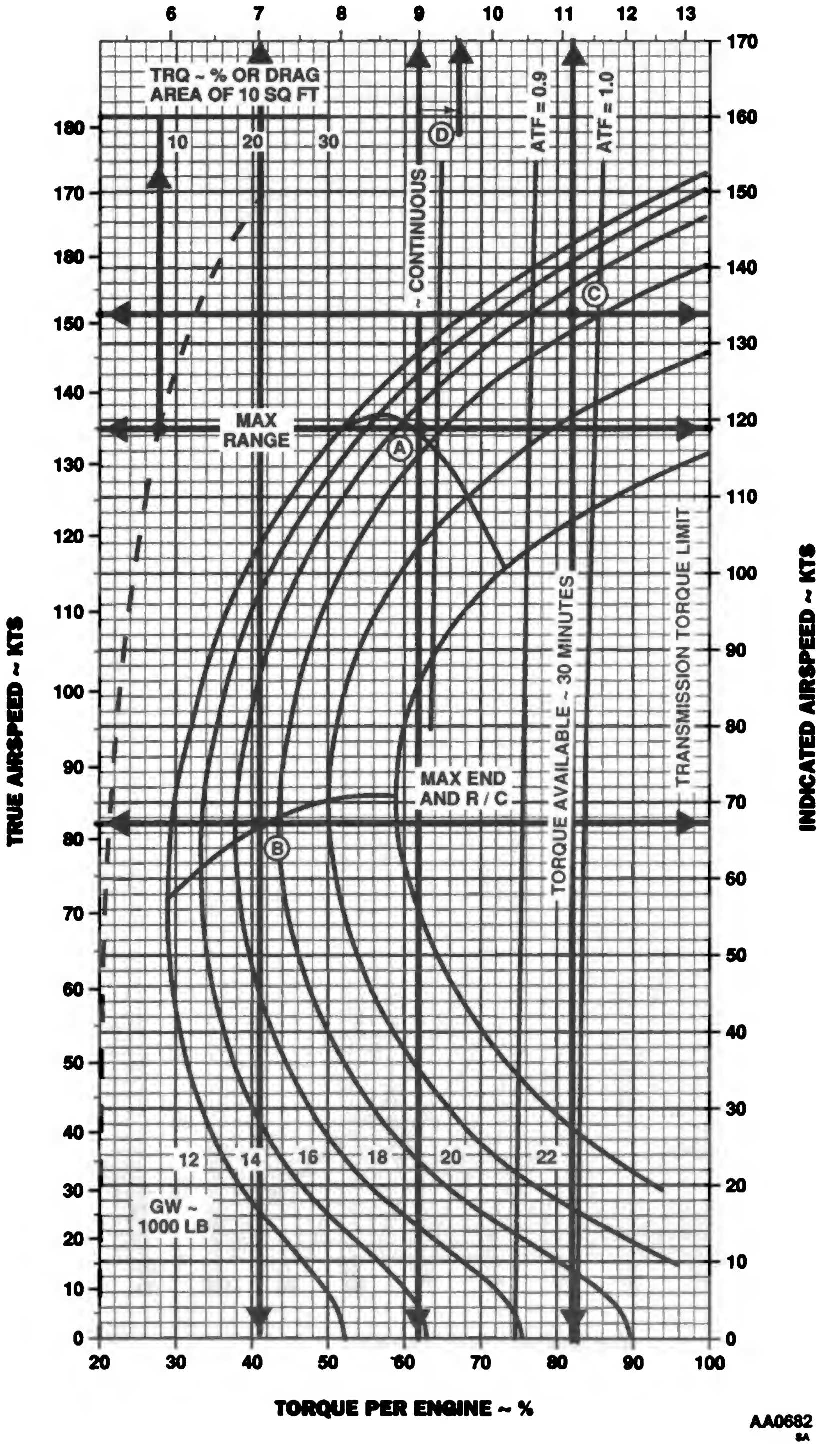
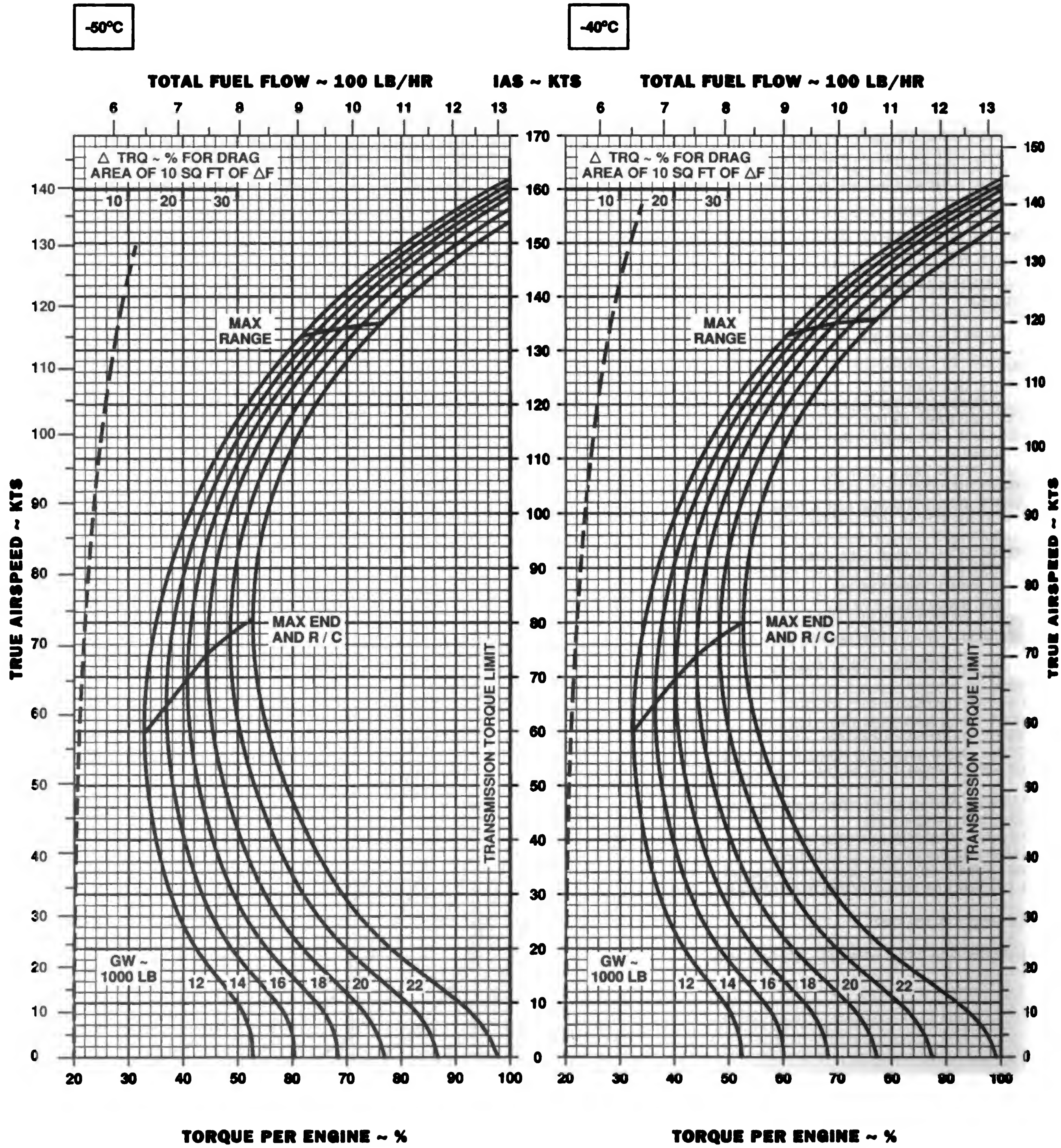


Figure 7-11. Sample Cruise Chart - Clean

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



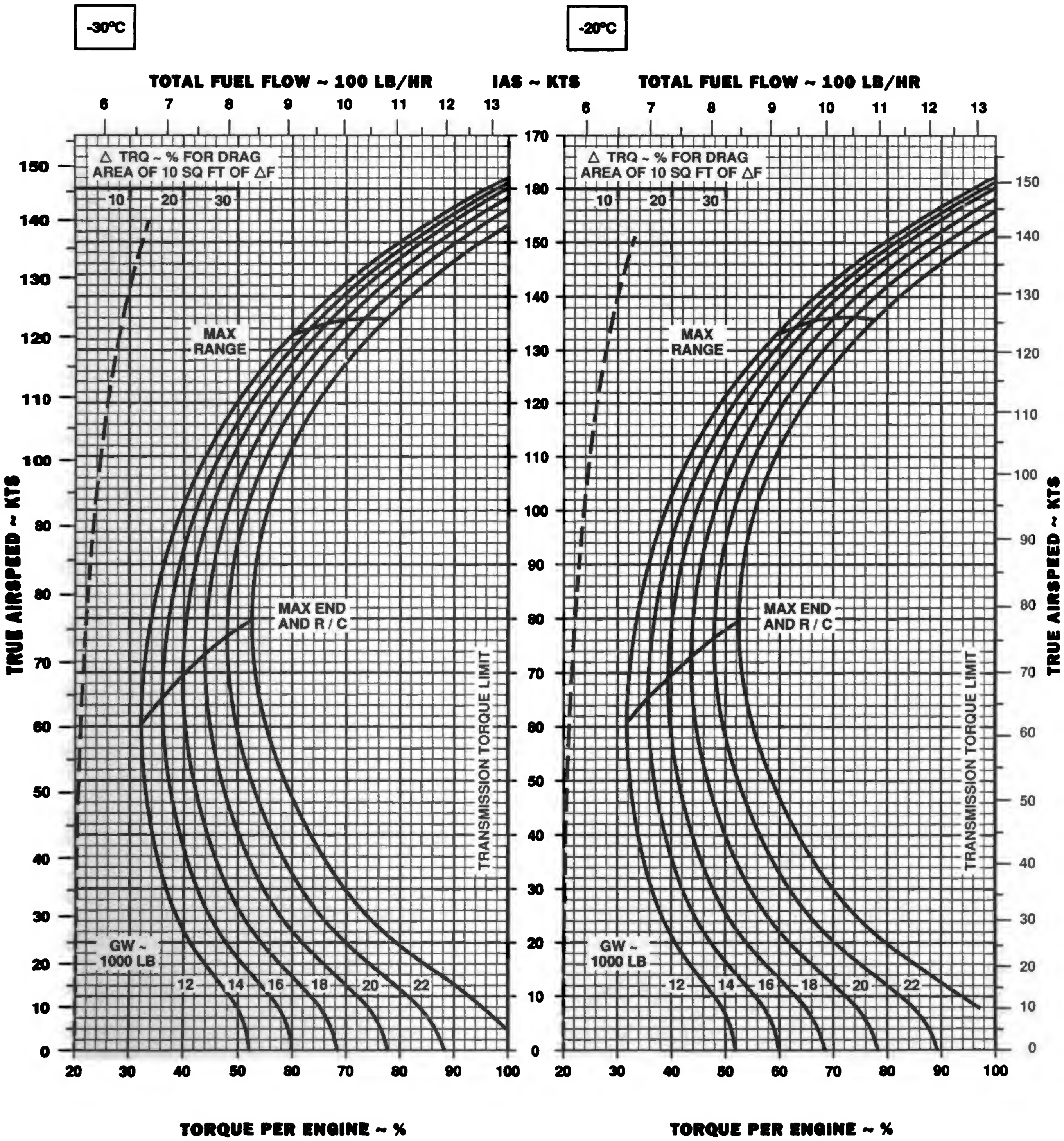
DATA BASE: FLIGHT TEST

AA0414
8A

Figure 7-12. Cruise - Pressure Altitude Sea Level (Sheet 1 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



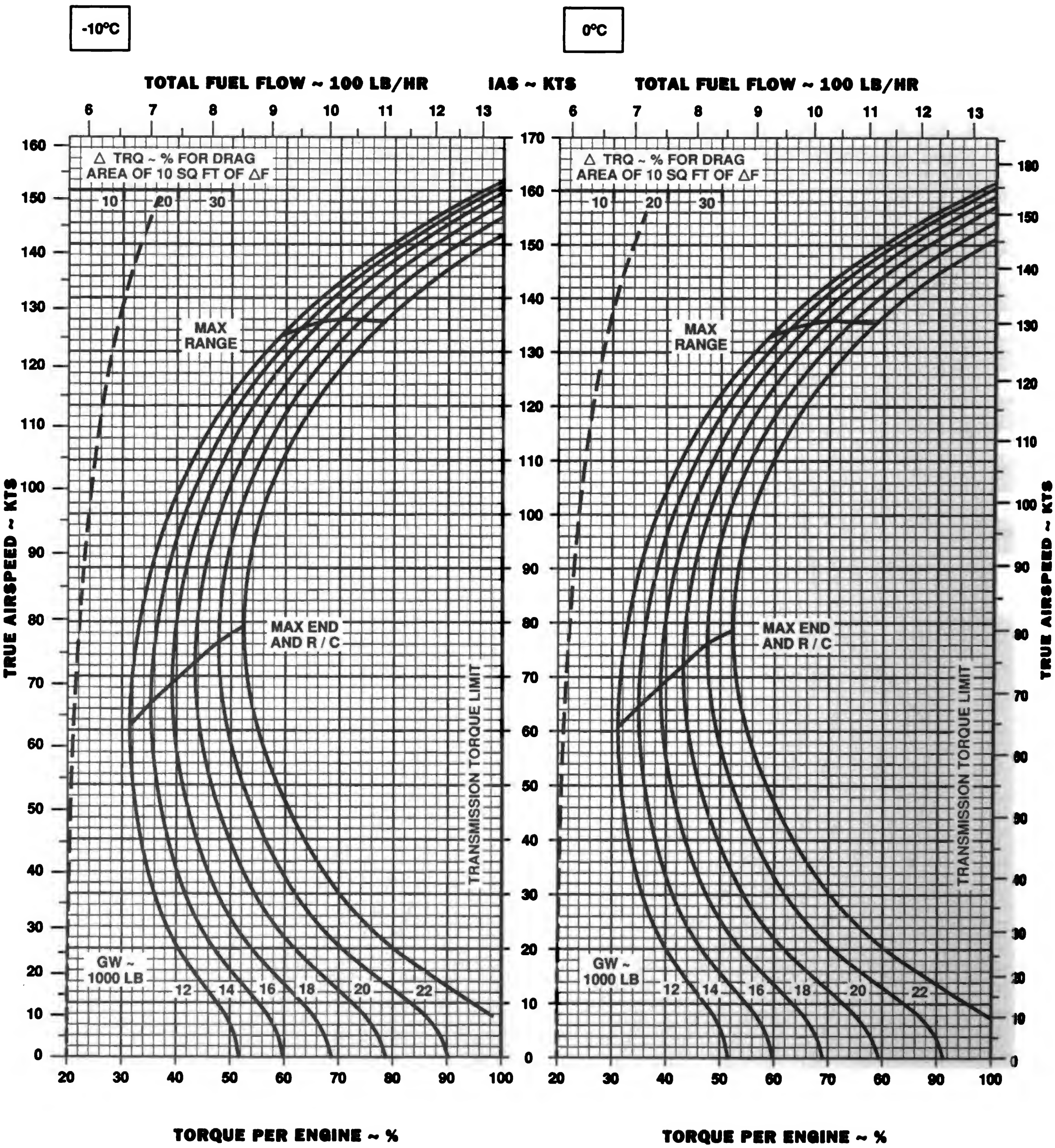
DATA BASE: FLIGHT TEST

AA0413

Figure 7-12. Cruise - Pressure Altitude Sea Level (Sheet 2 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



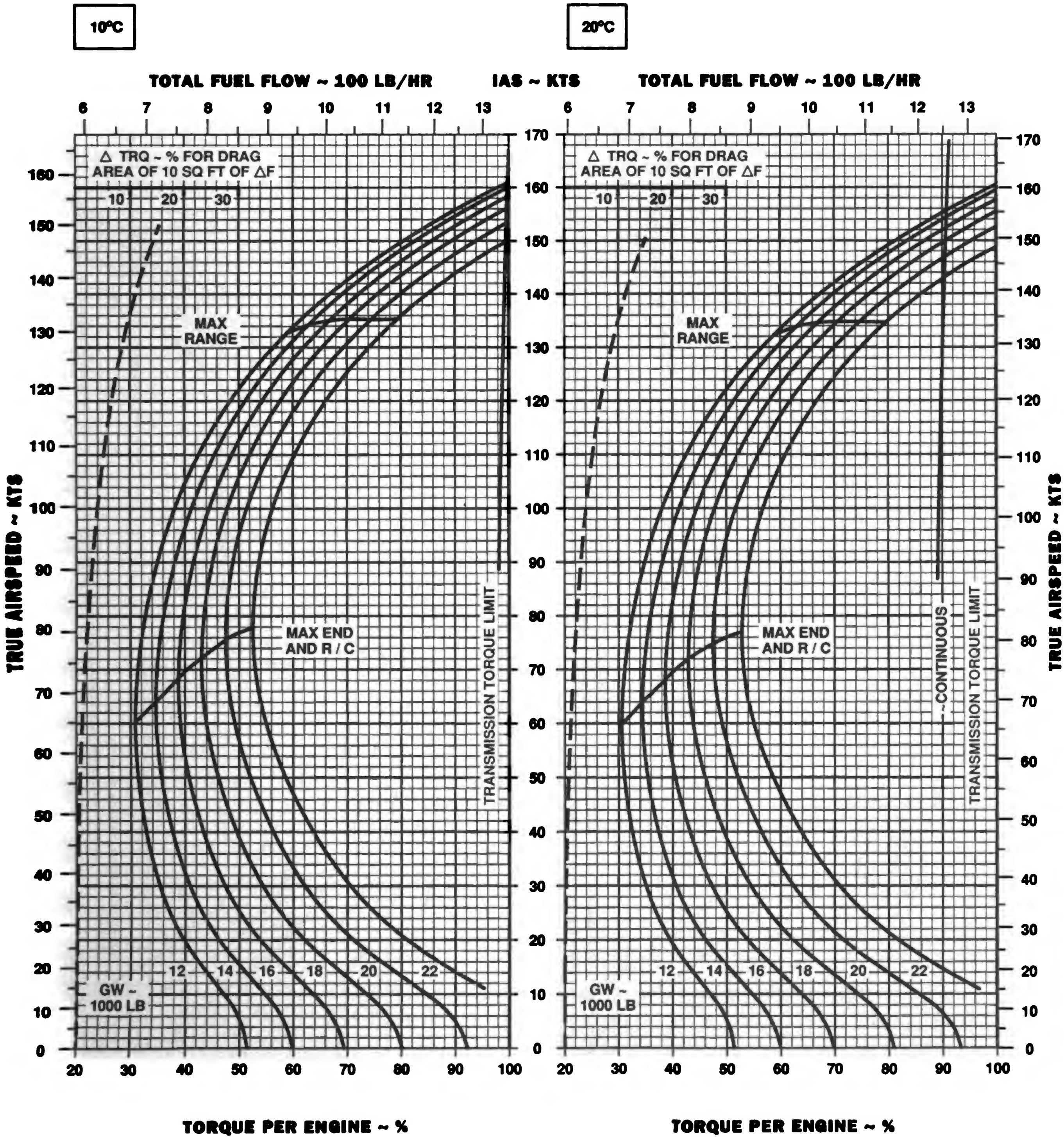
DATA BASE: FLIGHT TEST

AA0412

Figure 7-12. Cruise - Pressure Altitude Sea Level (Sheet 3 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



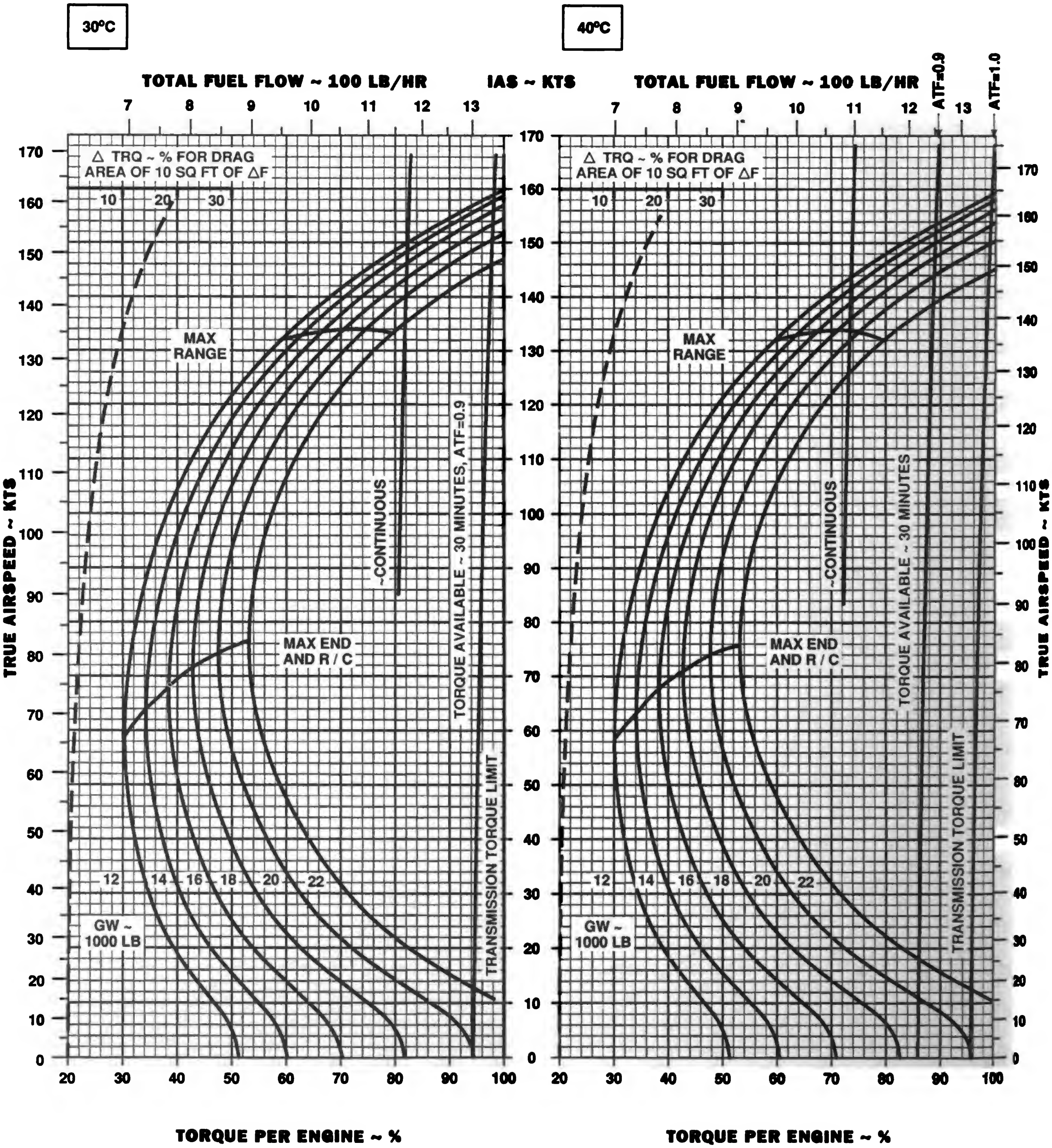
DATA BASE: FLIGHT TEST

AA0415 SA

Figure 7-12. Cruise - Pressure Altitude Sea Level (Sheet 4 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



DATA BASE: FLIGHT TEST

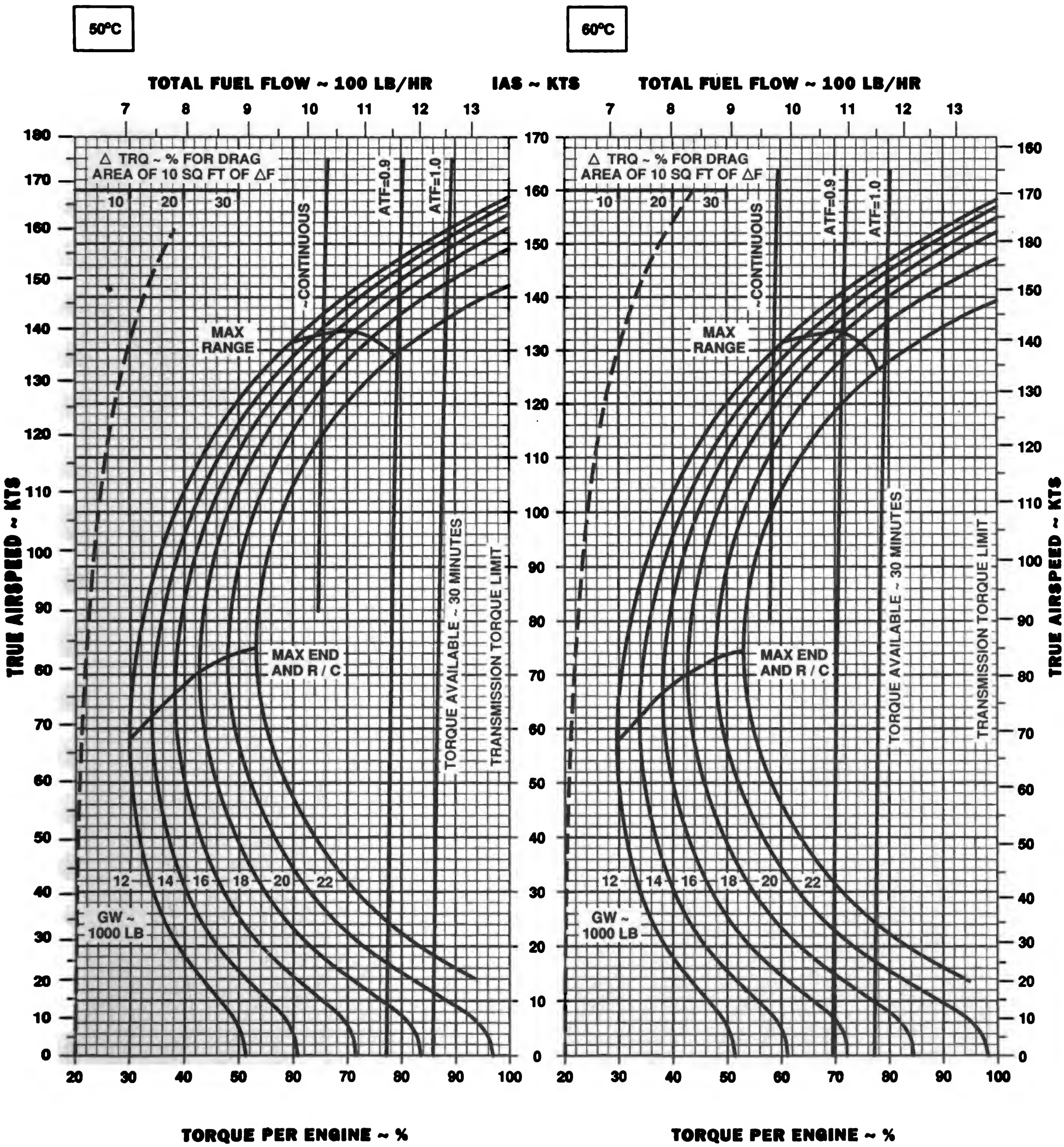
AA0416 SA

Figure 7-12. Cruise - Pressure Altitude Sea Level (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



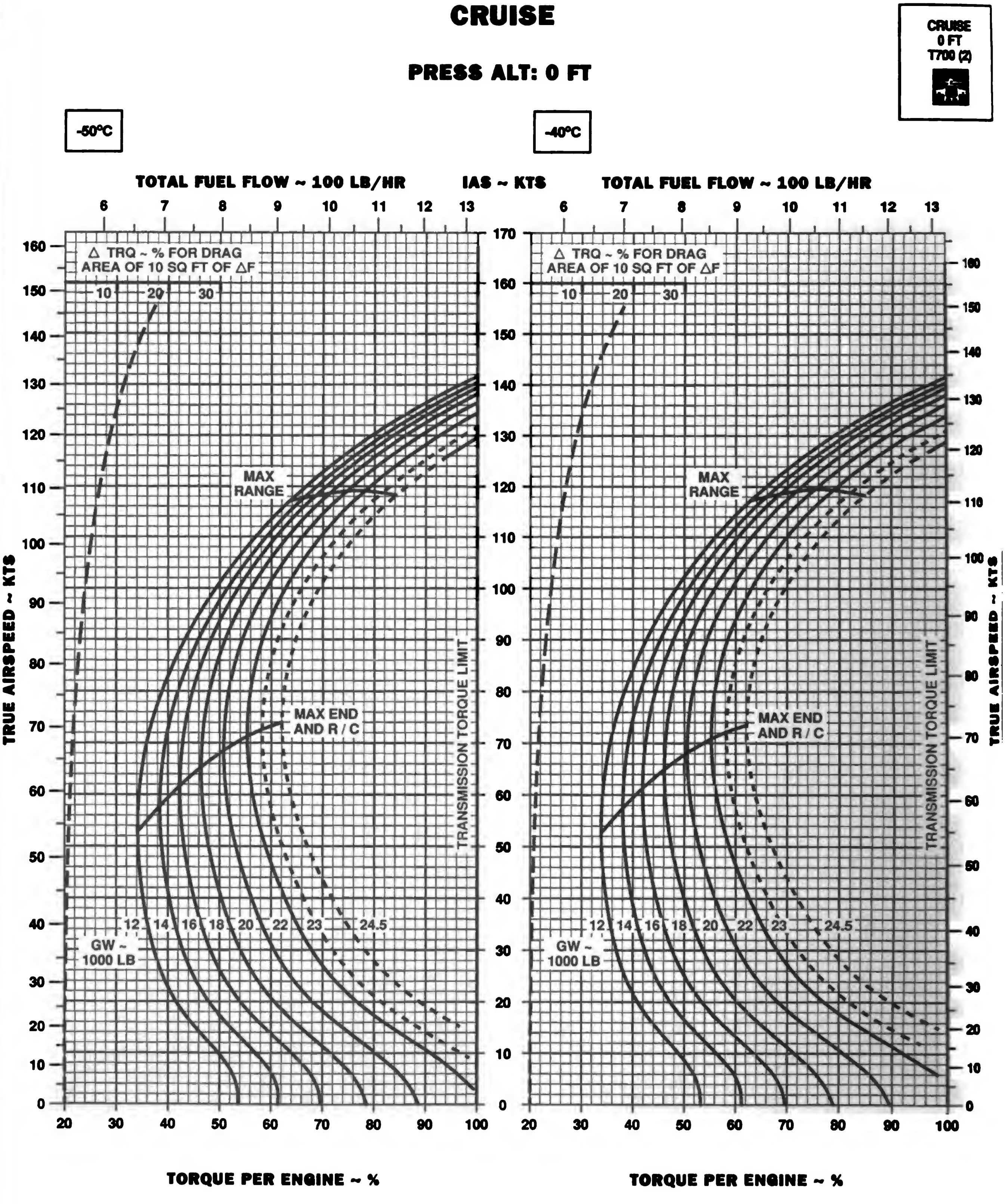
DATA BASE: FLIGHT TEST

AA0417
8A

Figure 7-12. Cruise - Pressure Altitude Sea Level (Sheet 6 of 6)

CRUISE

PRESS ALT: 0 FT



DATA BASE: FLIGHT TEST

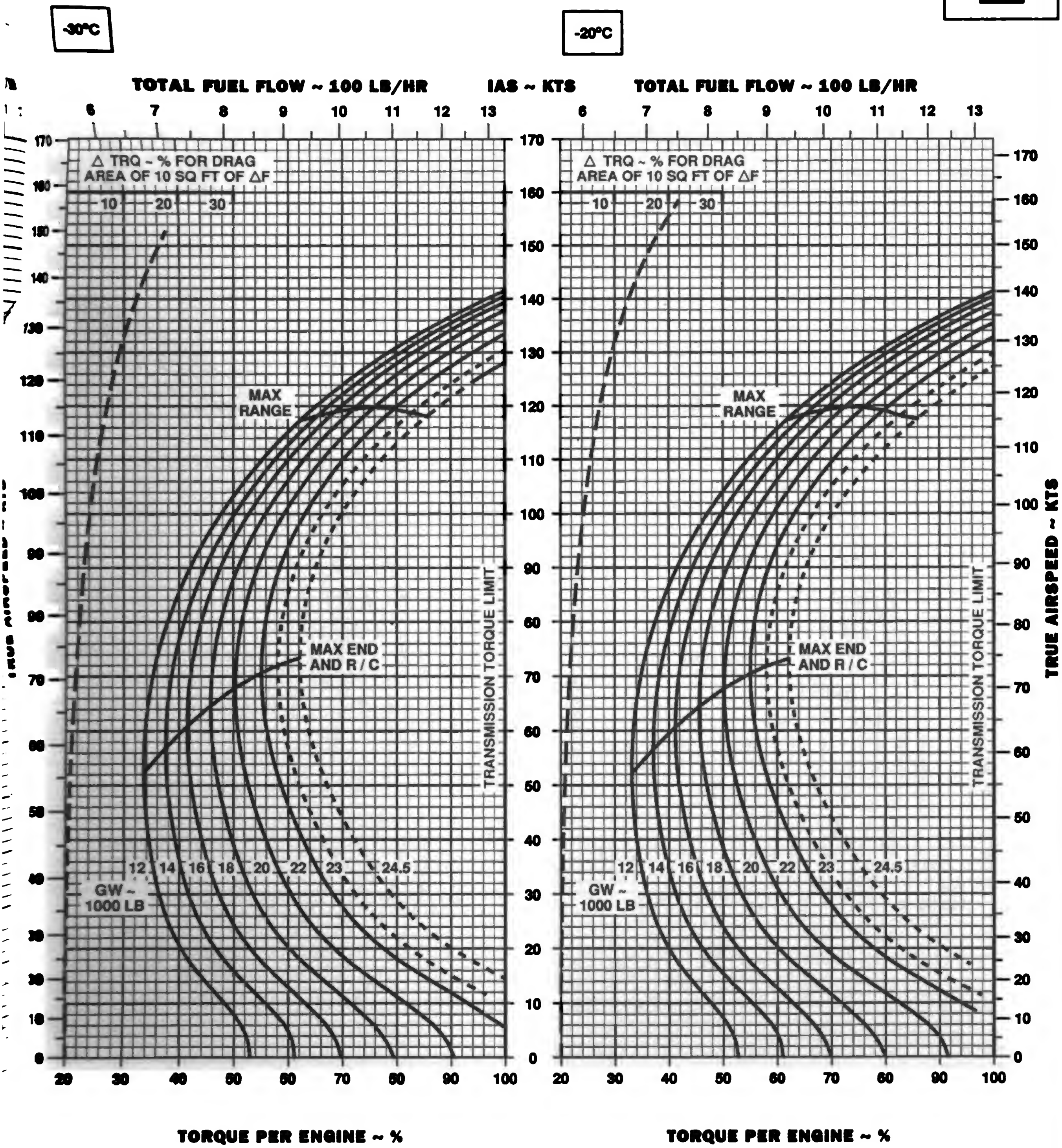
AA0534

Figure 7-13. Cruise High Drag - Pressure Altitude Sea Level (Sheet 1 of 6)

CRUISE

PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



DATA BASE: FLIGHT TEST

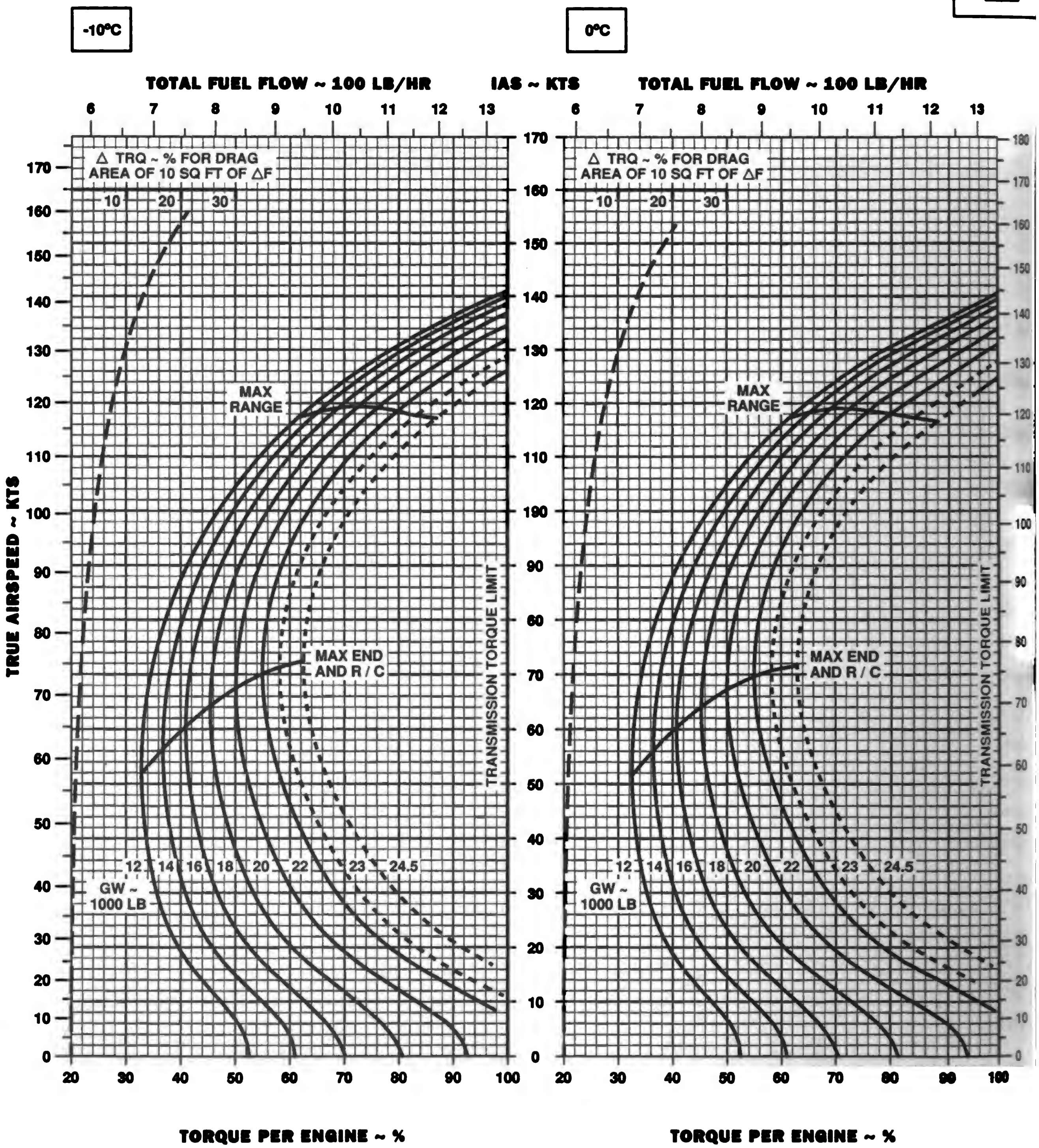
AA0535

Figure 7-13. Cruise High Drag - Pressure Altitude Sea Level (Sheet 2 of 6)

CRUISE

PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



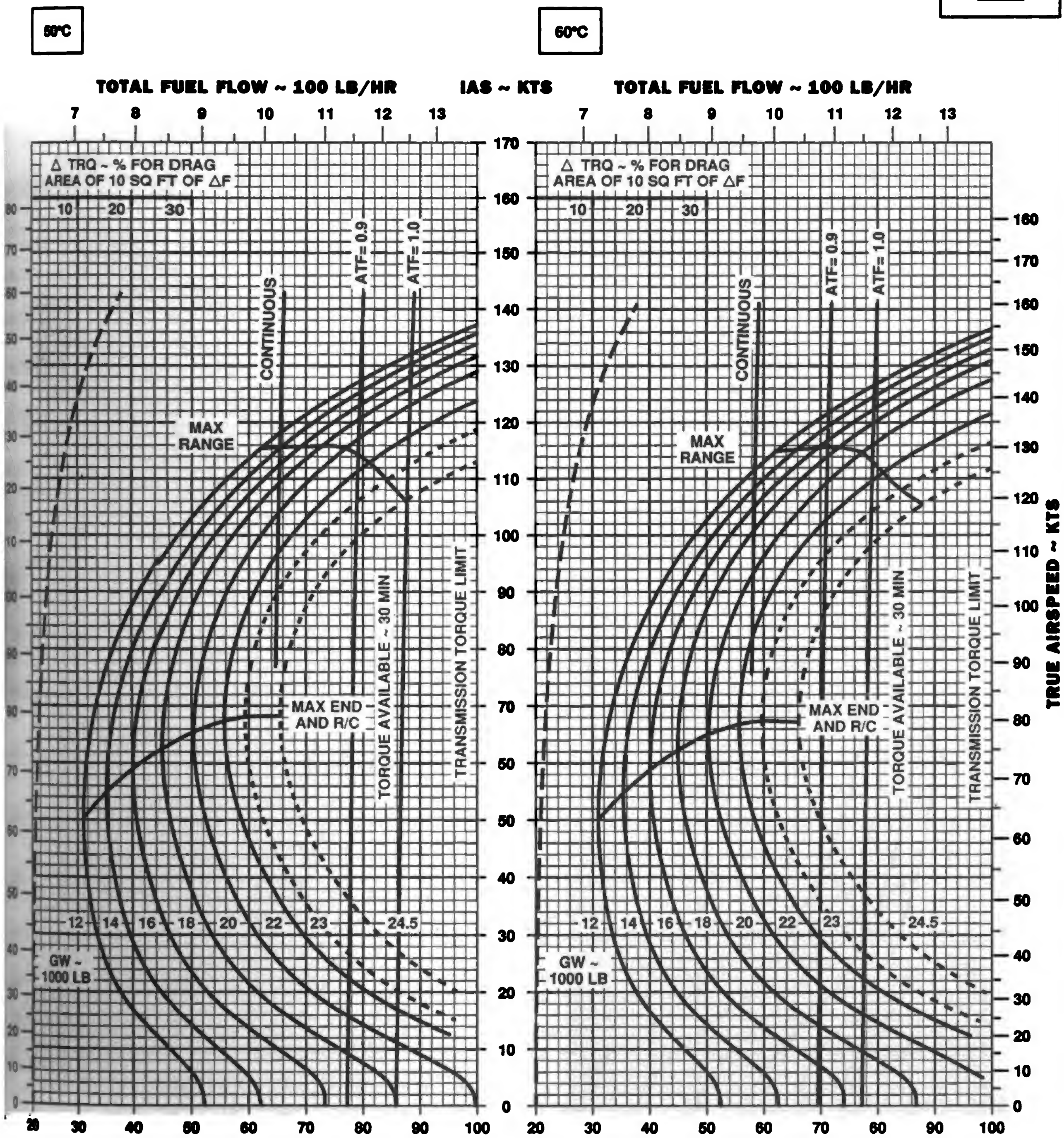
DATA BASE: FLIGHT TEST

Figure 7-13. Cruise High Drag - Pressure Altitude Sea Level (Sheet 3 of 6)

CRUISE

PRESS ALT: 0 FT

CRUISE
0 FT
T700 (2)



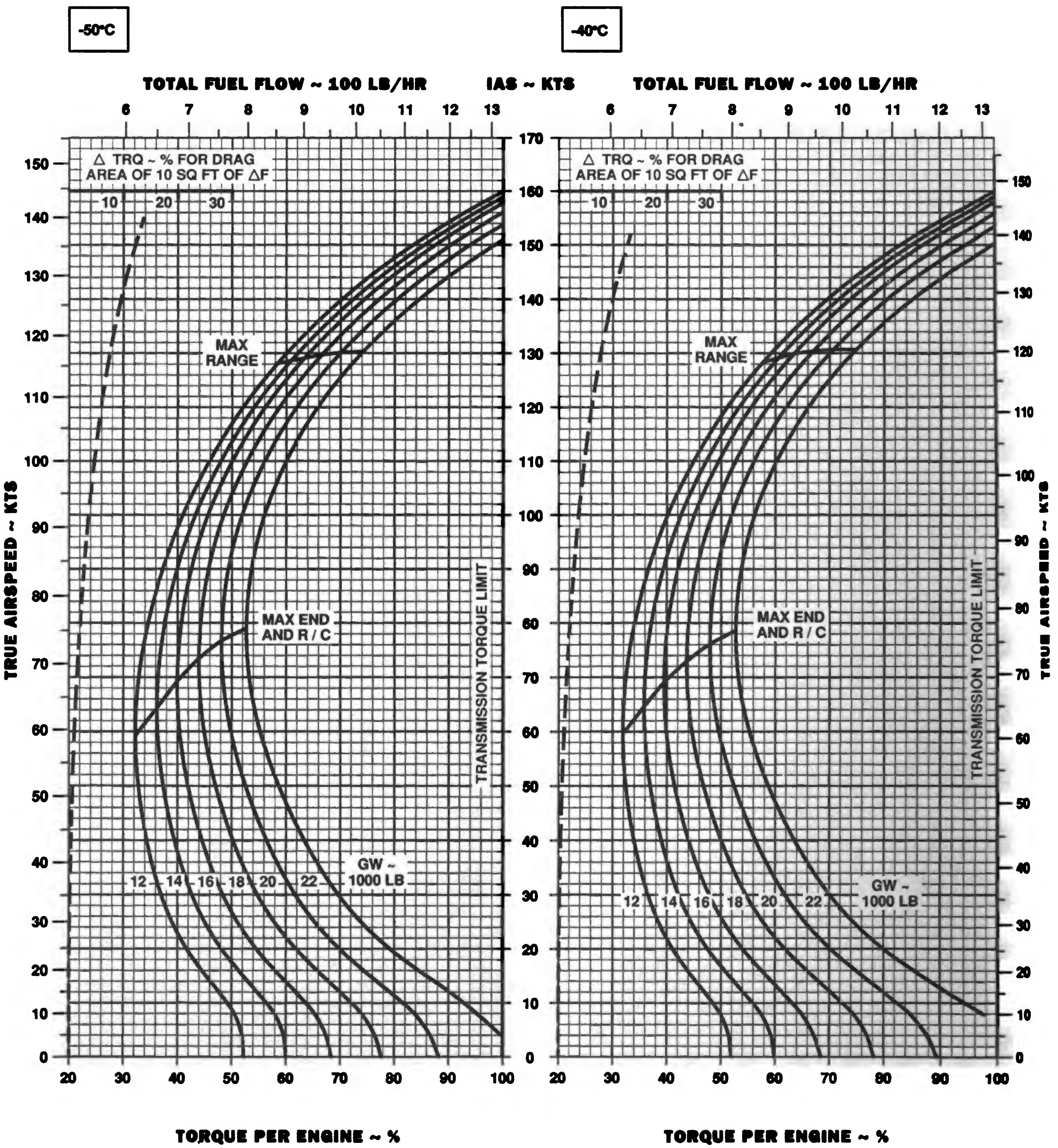
DATA BASE: FLIGHT TEST

AA0539
8A

Figure 7-13. Cruise High Drag - Pressure Altitude Sea Level (Sheet 6 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



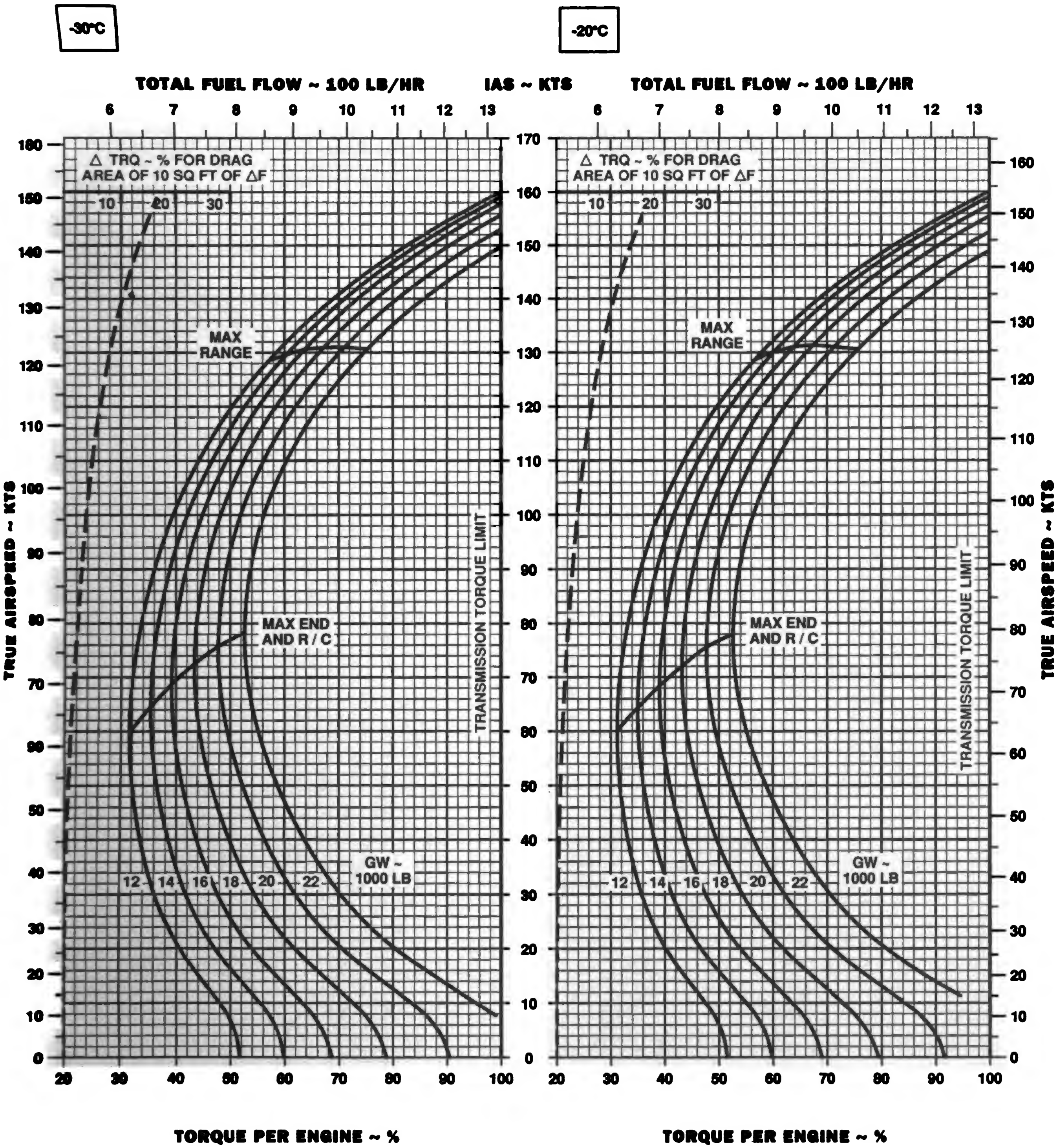
DATA BASE: FLIGHT TEST

AA0449

Figure 7-14. Cruise - Pressure Altitude 2,000 Feet (Sheet 1 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

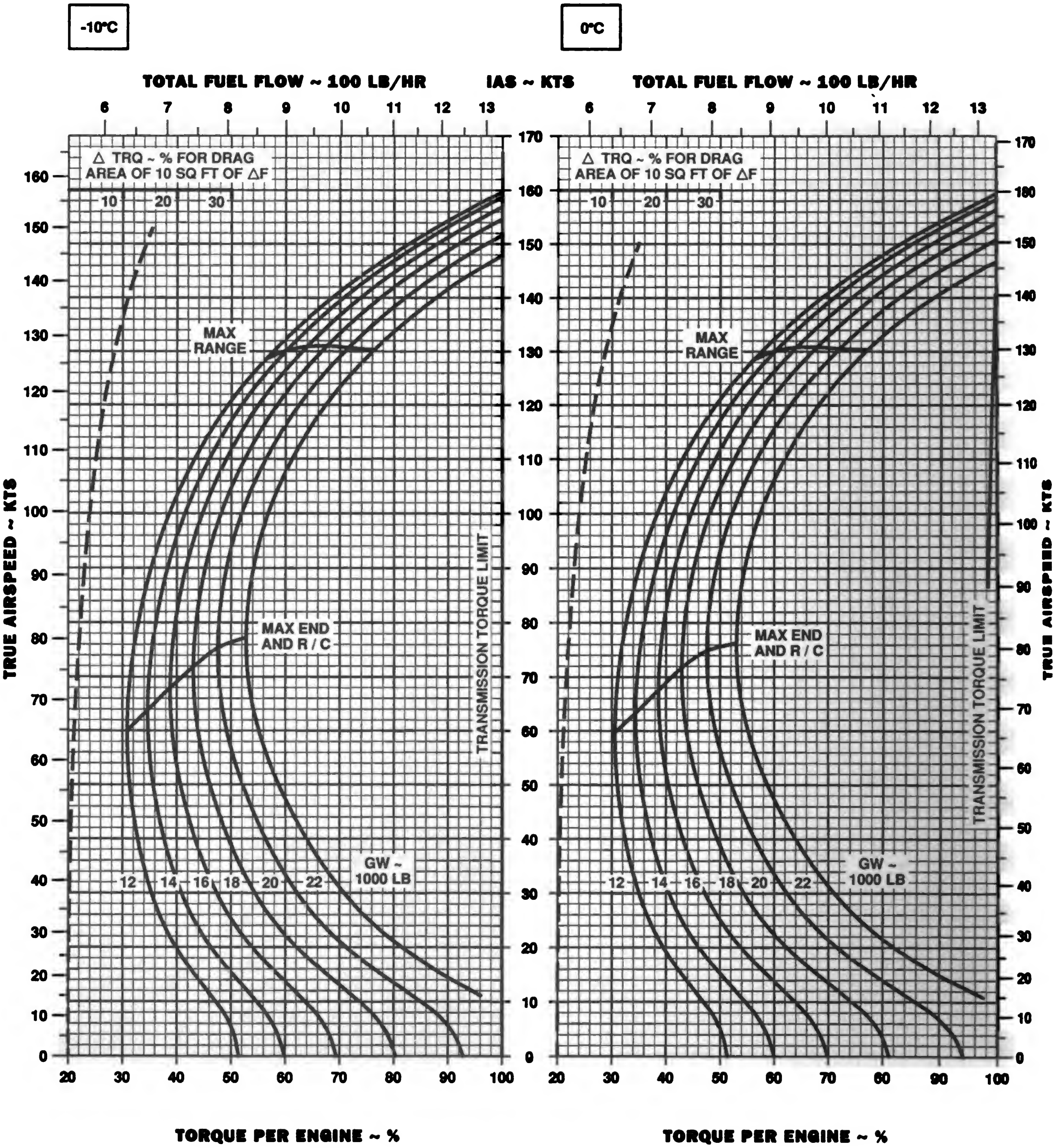
AA0448
SA

Figure 7-14. Cruise - Pressure Altitude 2,000 Feet (Sheet 2 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

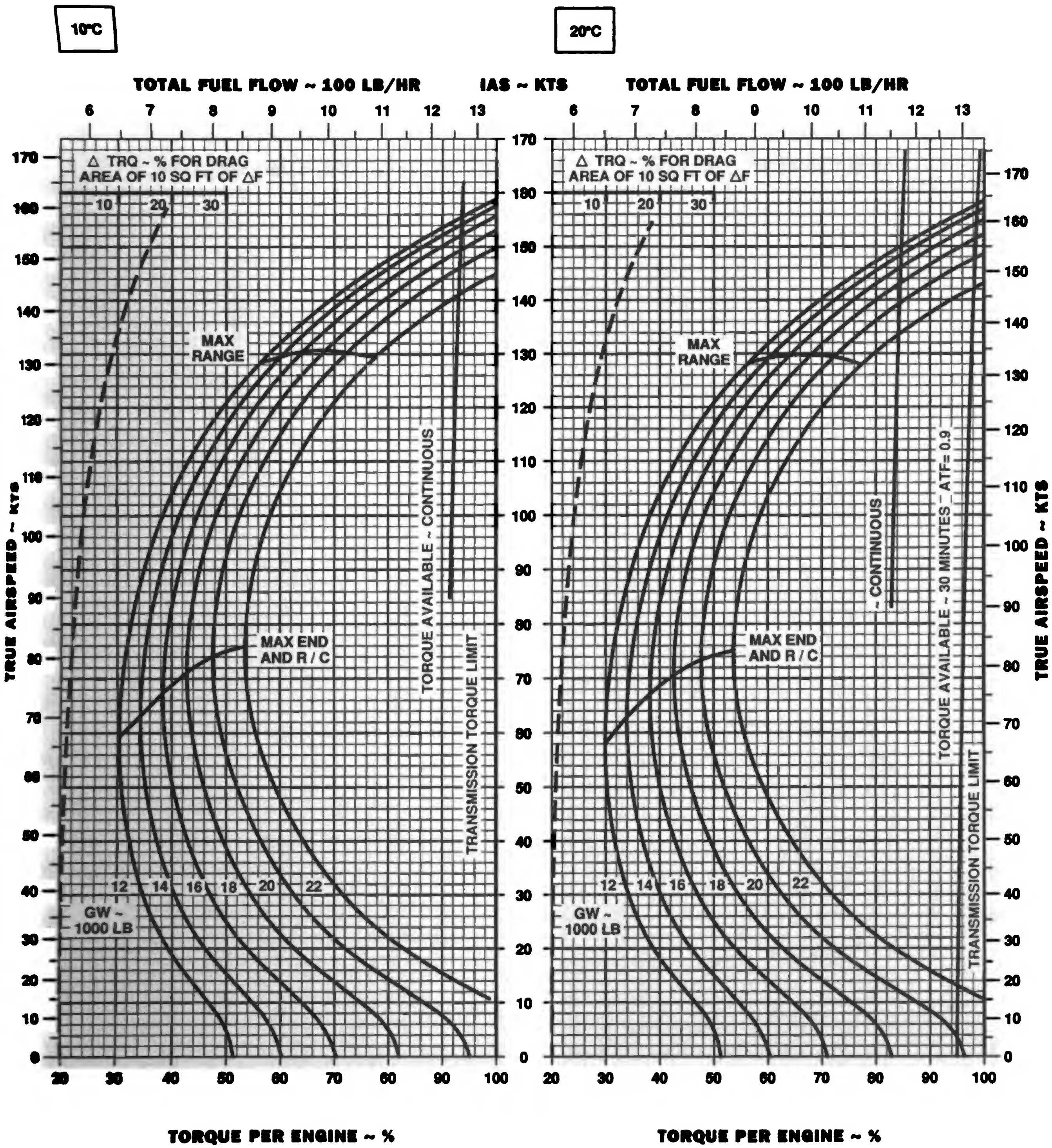
AA0447
SA

Figure 7-14. Cruise - Pressure Altitude 2,000 Feet (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0450
8A

Figure 7-14. Cruise - Pressure Altitude 2,000 Feet (Sheet 4 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)

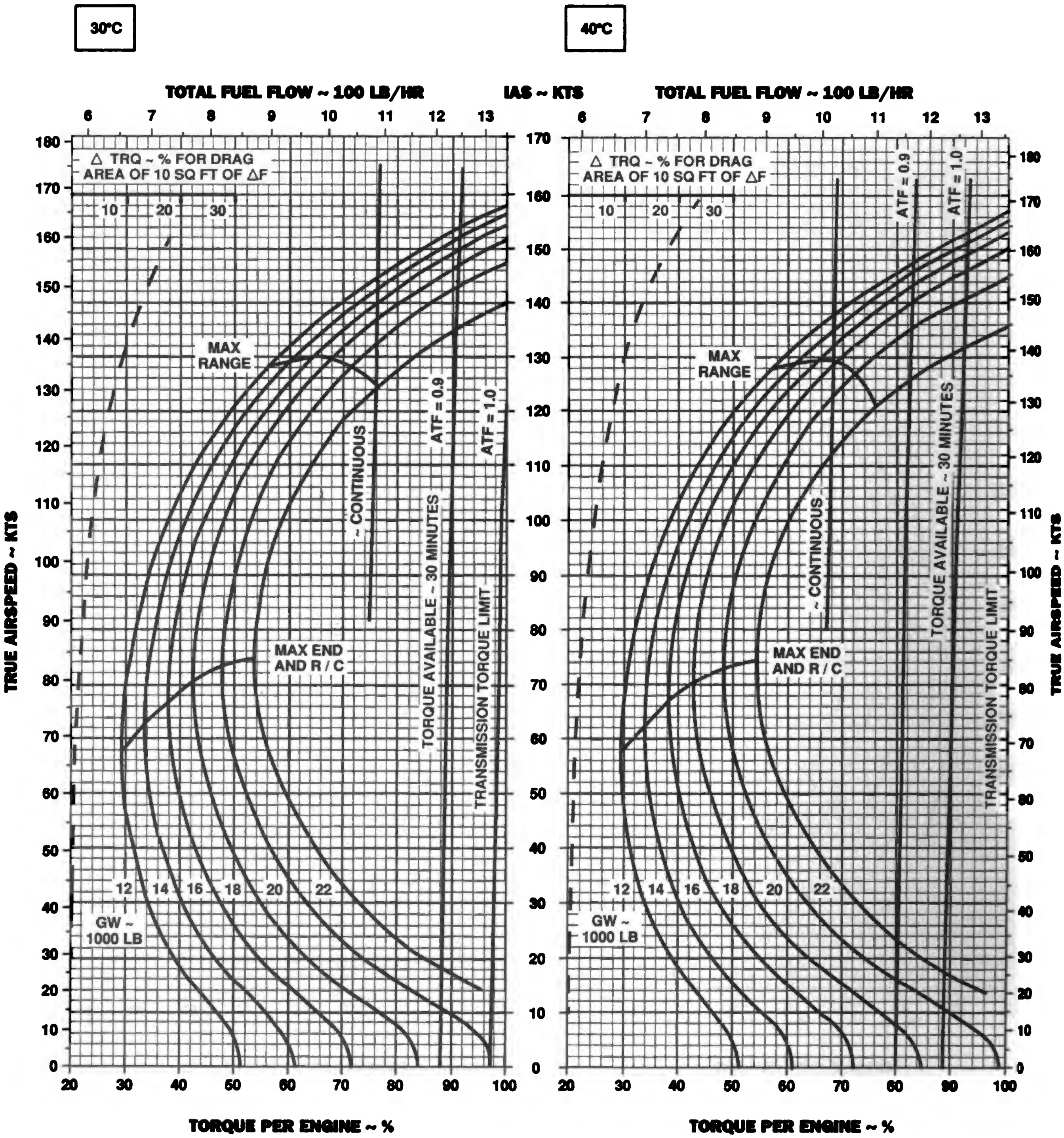
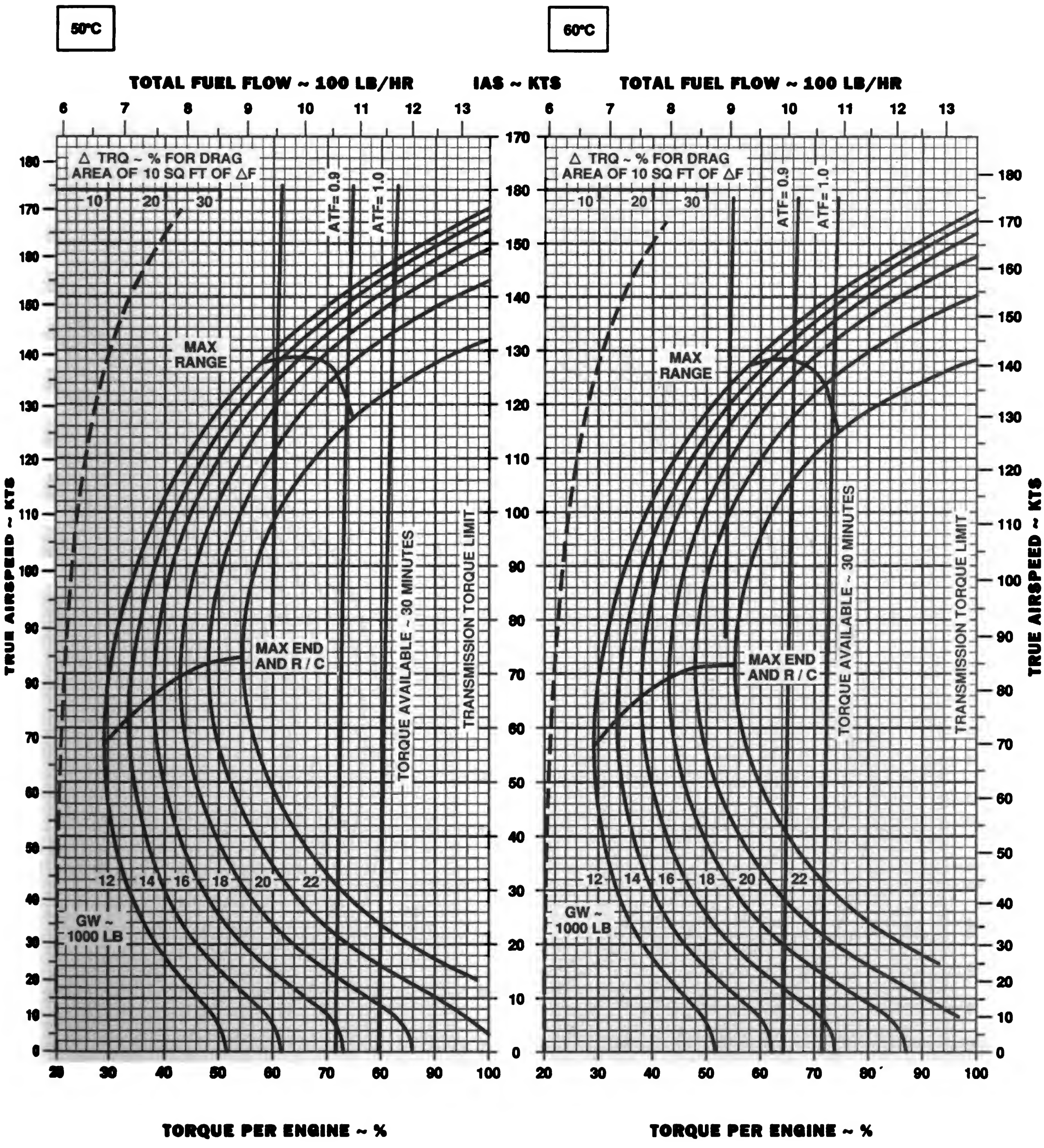


Figure 7-14. Cruise - Pressure Altitude 2,000 Feet (Sheet 5 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

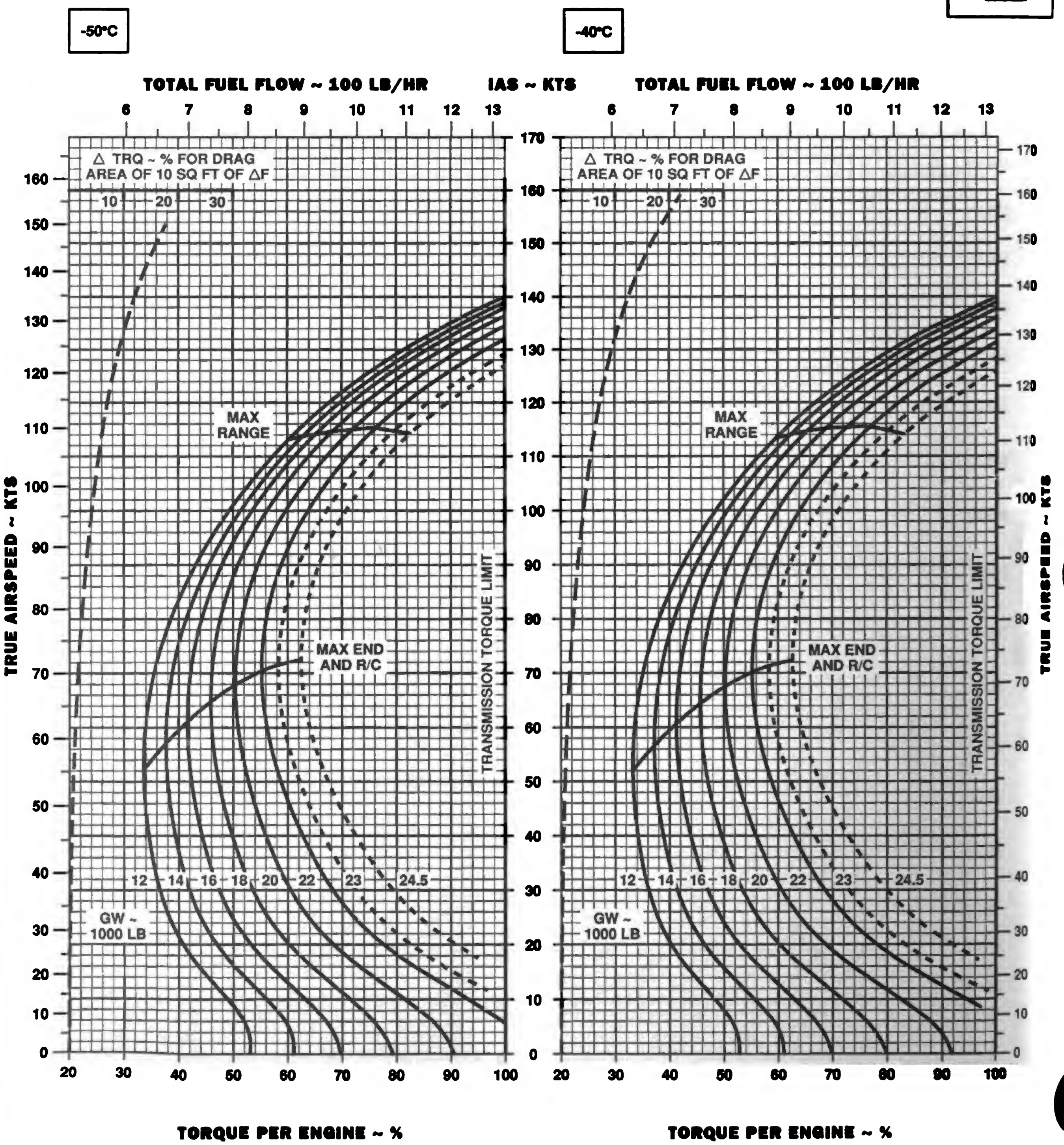
AA0452

Figure 7-14. Cruise - Pressure Altitude 2,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

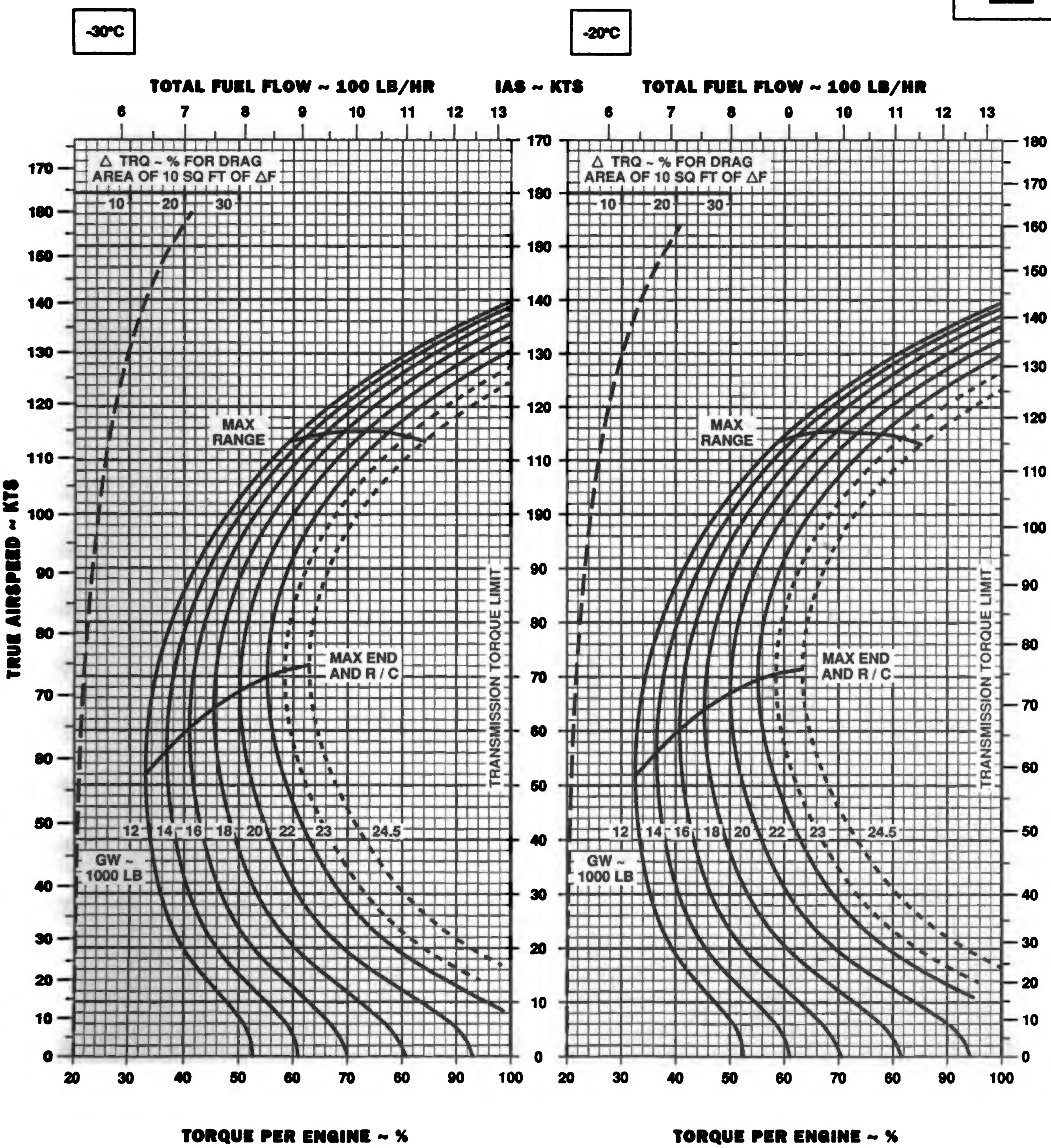
AA0540
8A

Figure 7-15. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

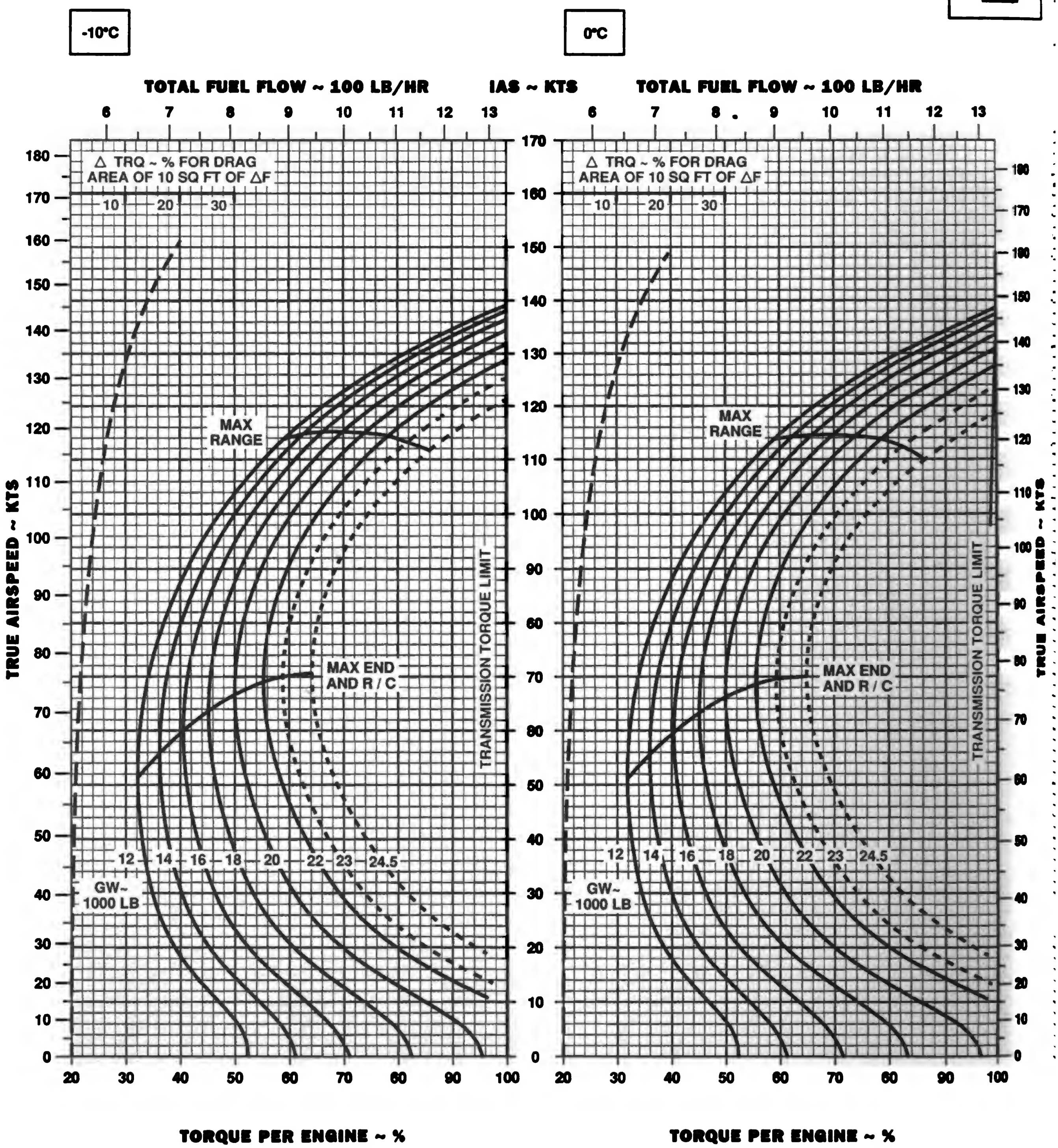
AA0541
SA

Figure 7-15. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

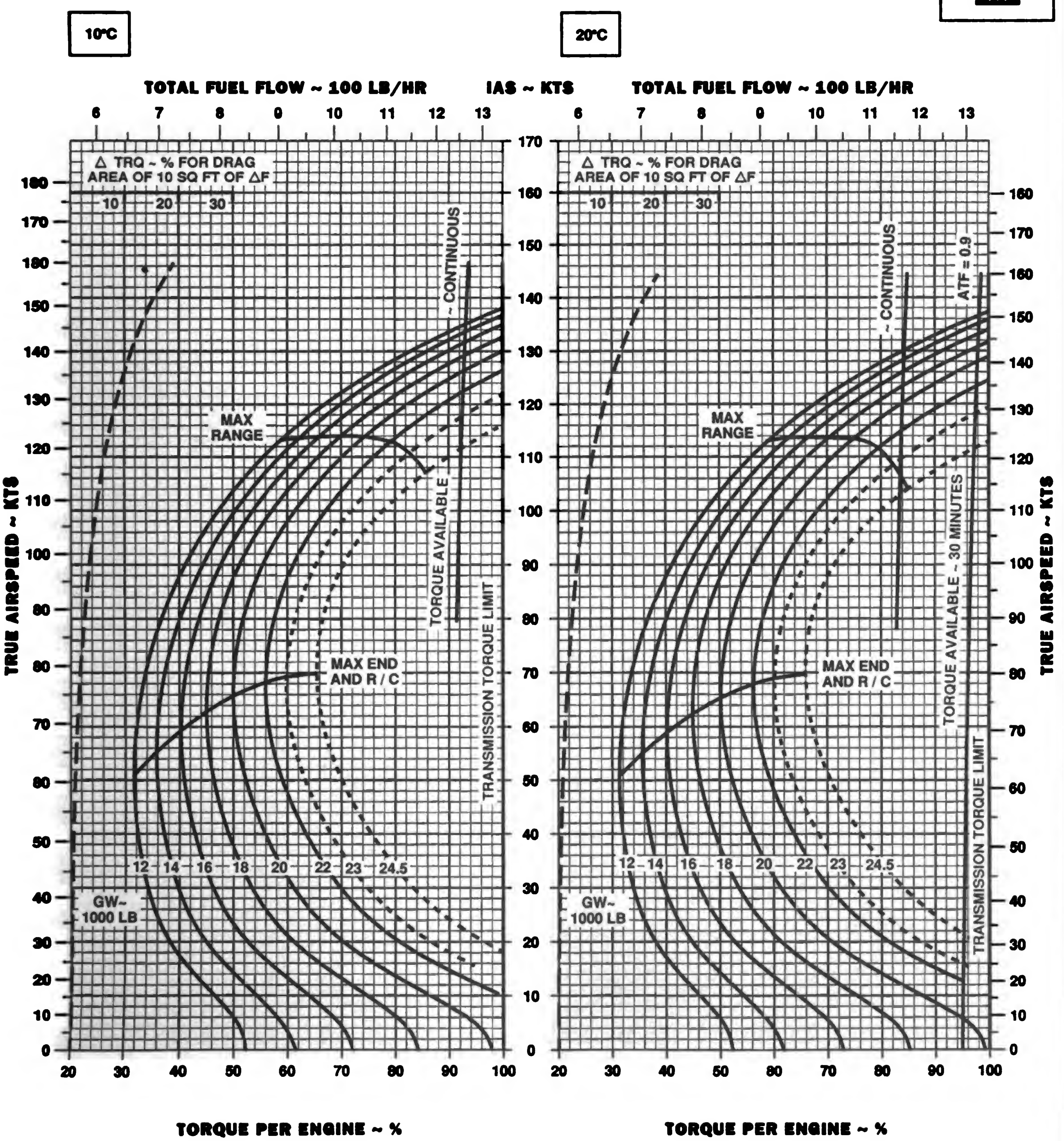
AA0542

Figure 7-15. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 3 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

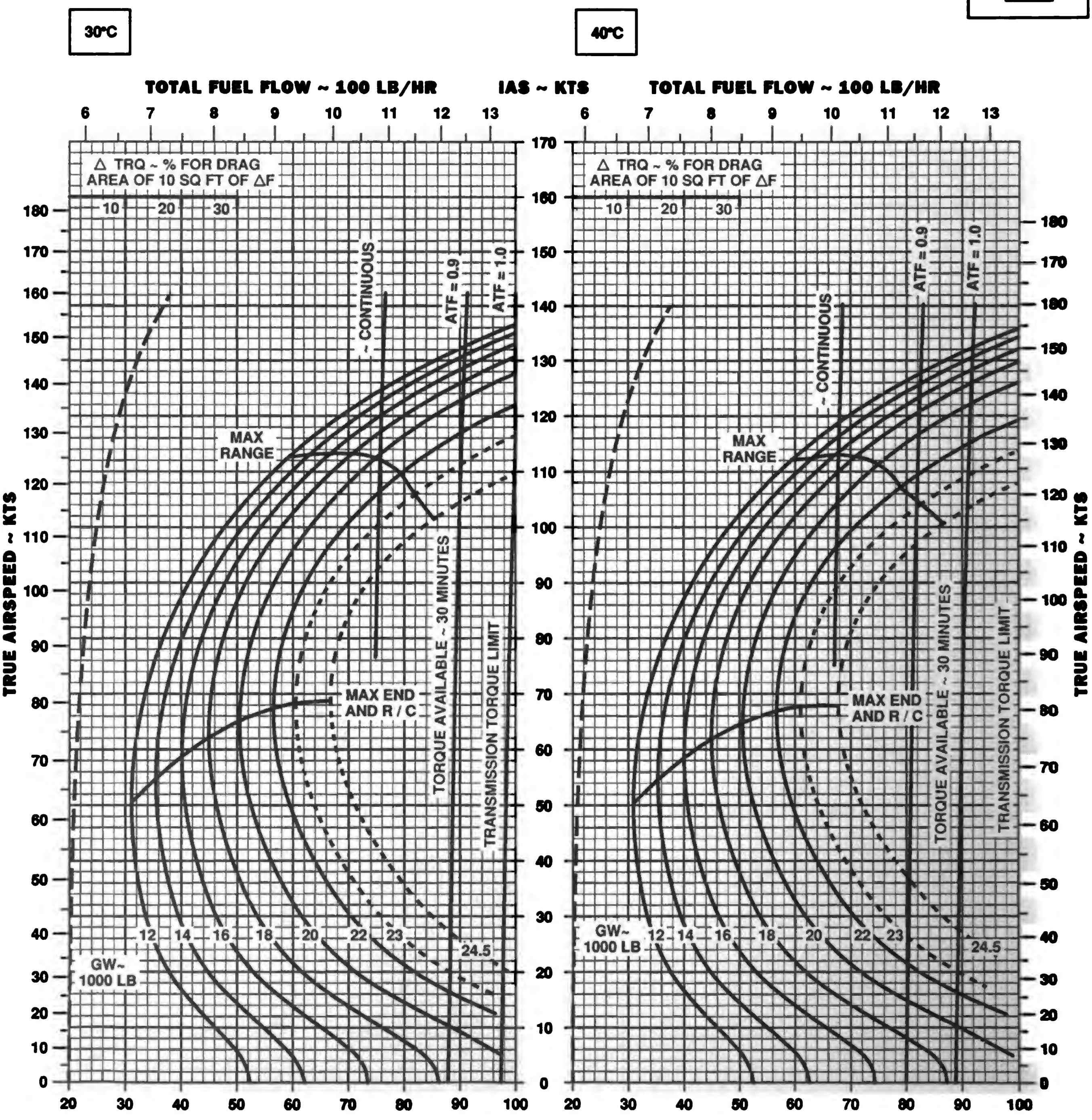
AA0543
SA

Figure 7-15. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

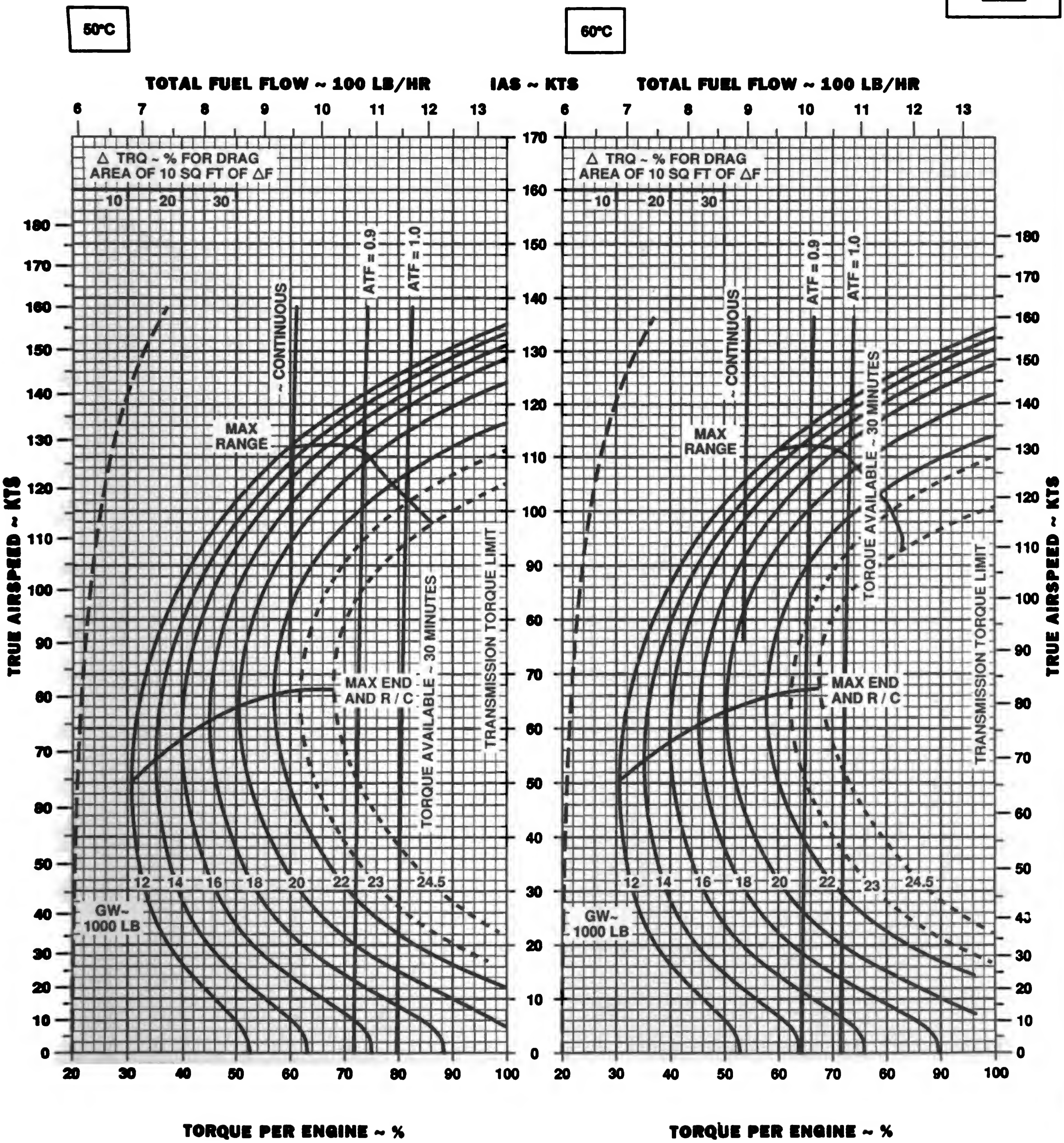
AA0544
SA

Figure 7-15. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 5 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T700 (2)



DATA BASE: FLIGHT TEST

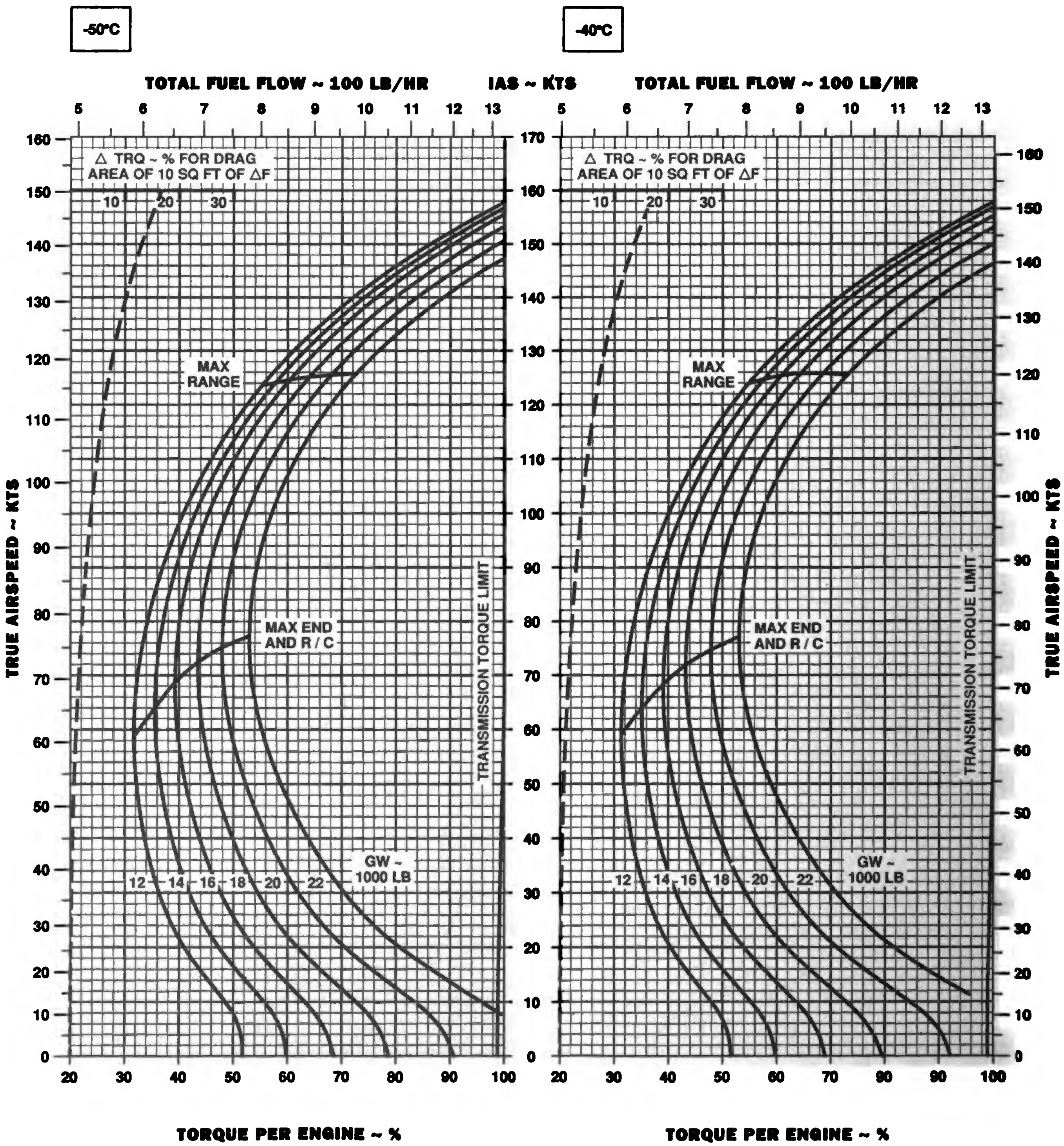
AA0545
SA

Figure 7-15. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



DATA BASE: FLIGHT TEST

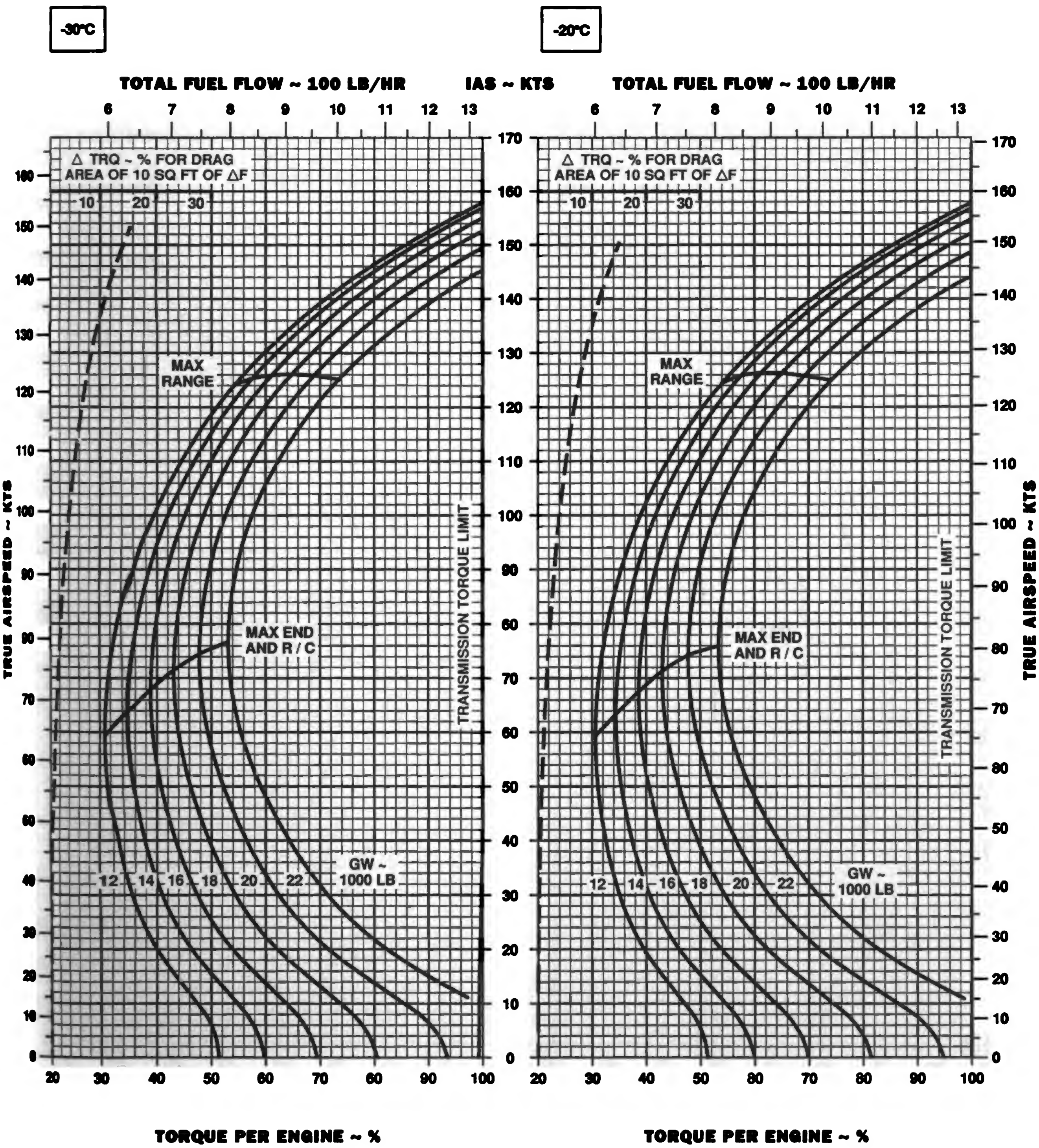
AA0455
8A

Figure 7-16. Cruise - Pressure Altitude 4,000 Feet (Sheet 1 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



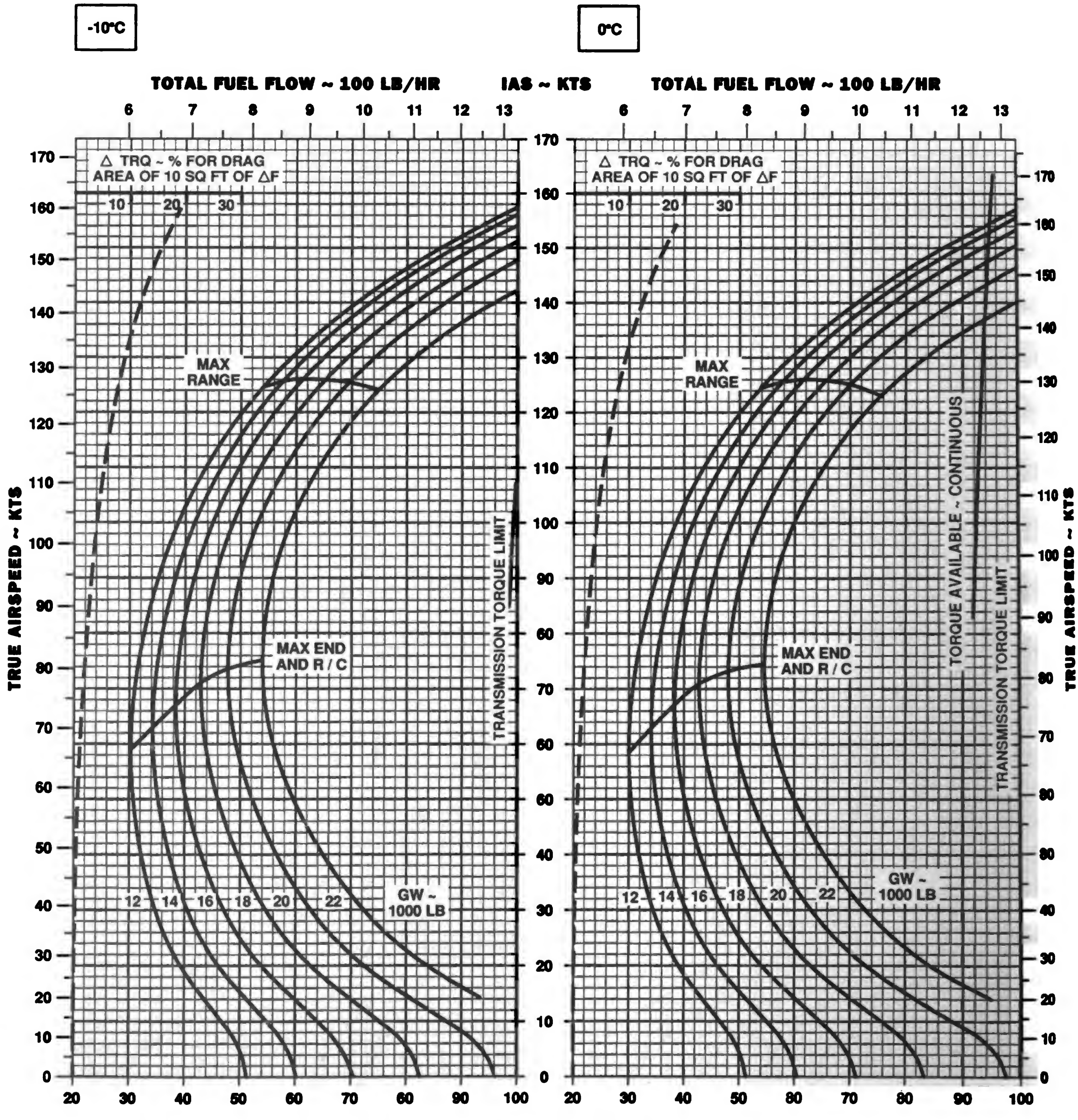
DATA BASE: FLIGHT TEST

AA0454
SA

Figure 7-16. Cruise - Pressure Altitude 4,000 Feet (Sheet 2 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



DATA BASE: FLIGHT TEST

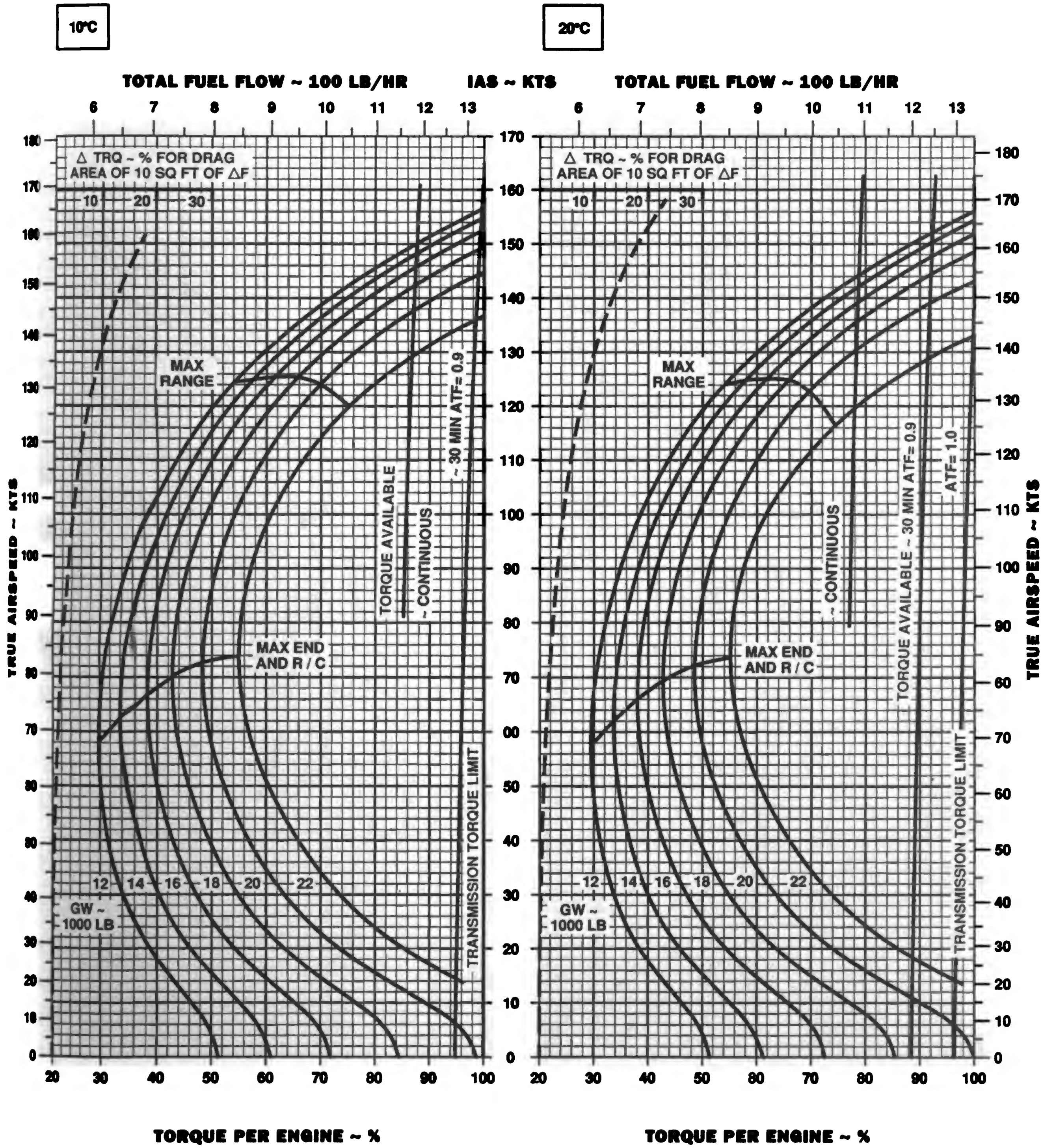
AA0453

Figure 7-16. Cruise - Pressure Altitude 4,000 Feet (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)

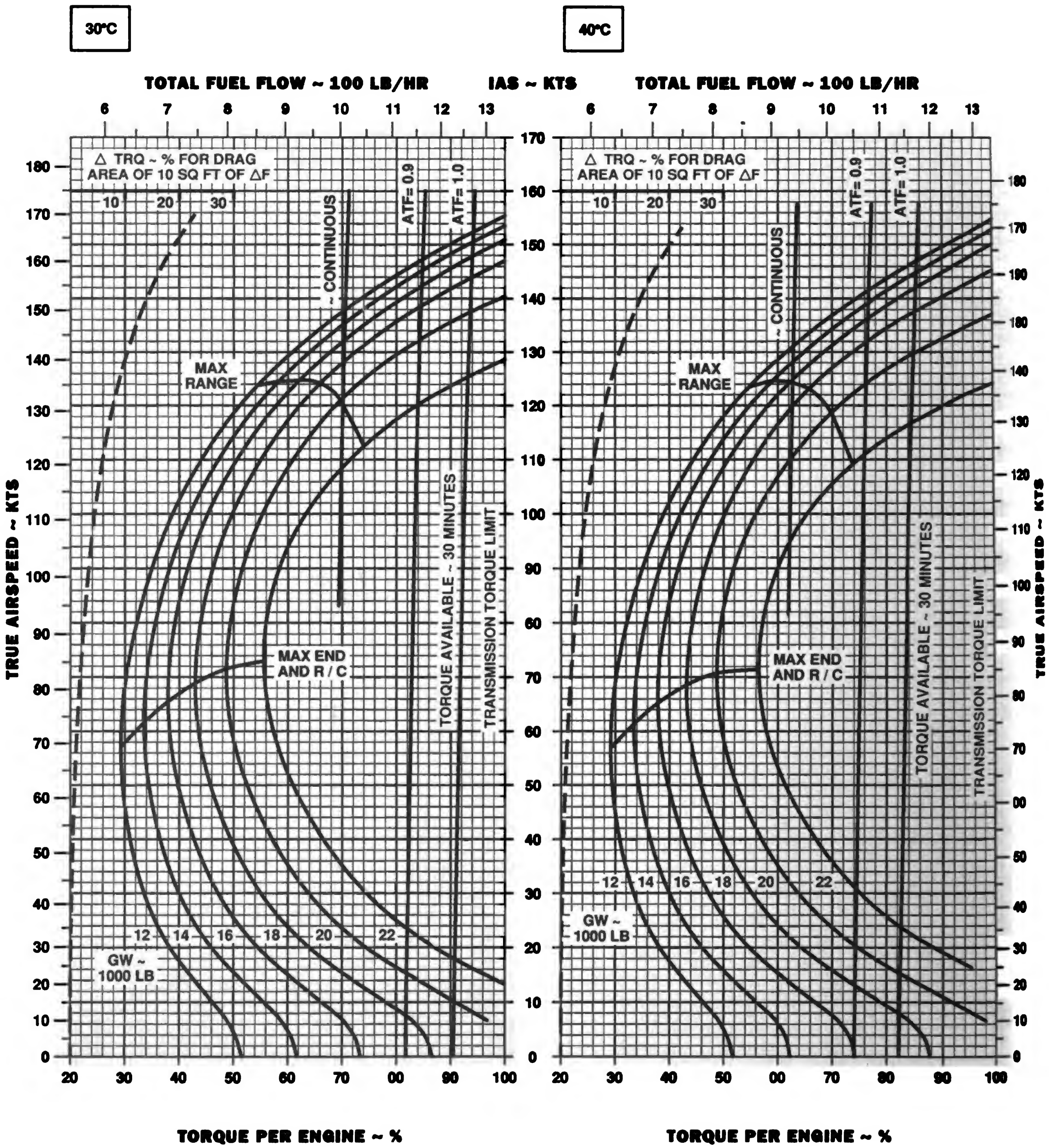


DATA BASE: FLIGHT TEST

AA0456
SA

Figure 7-16. Cruise - Pressure Altitude 4,000 Feet (Sheet 4 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 4000 FT



DATA BASE: FLIGHT TEST

AA0457

Figure 7-16. Cruise - Pressure Altitude 4,000 Feet (Sheet 5 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)

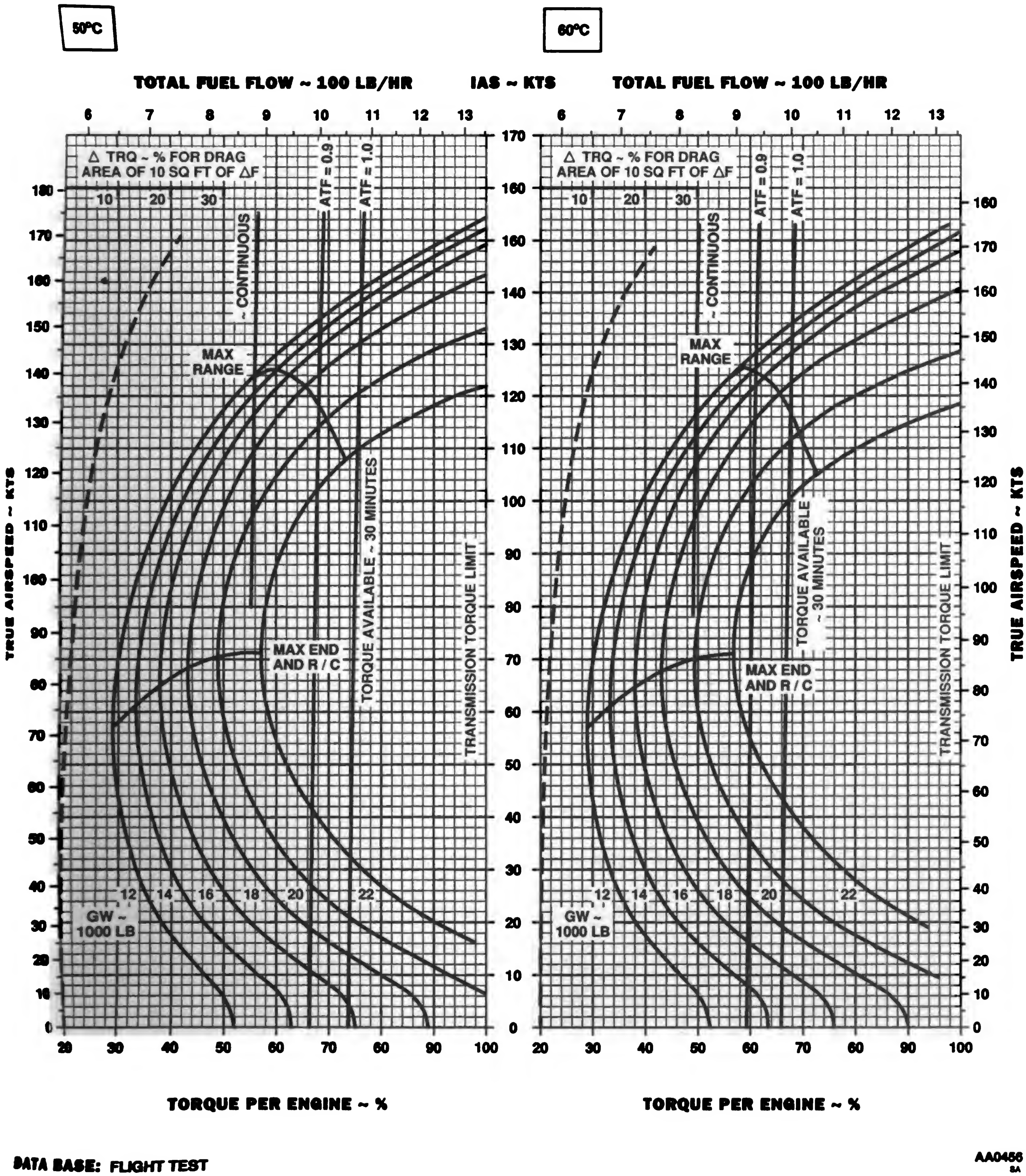
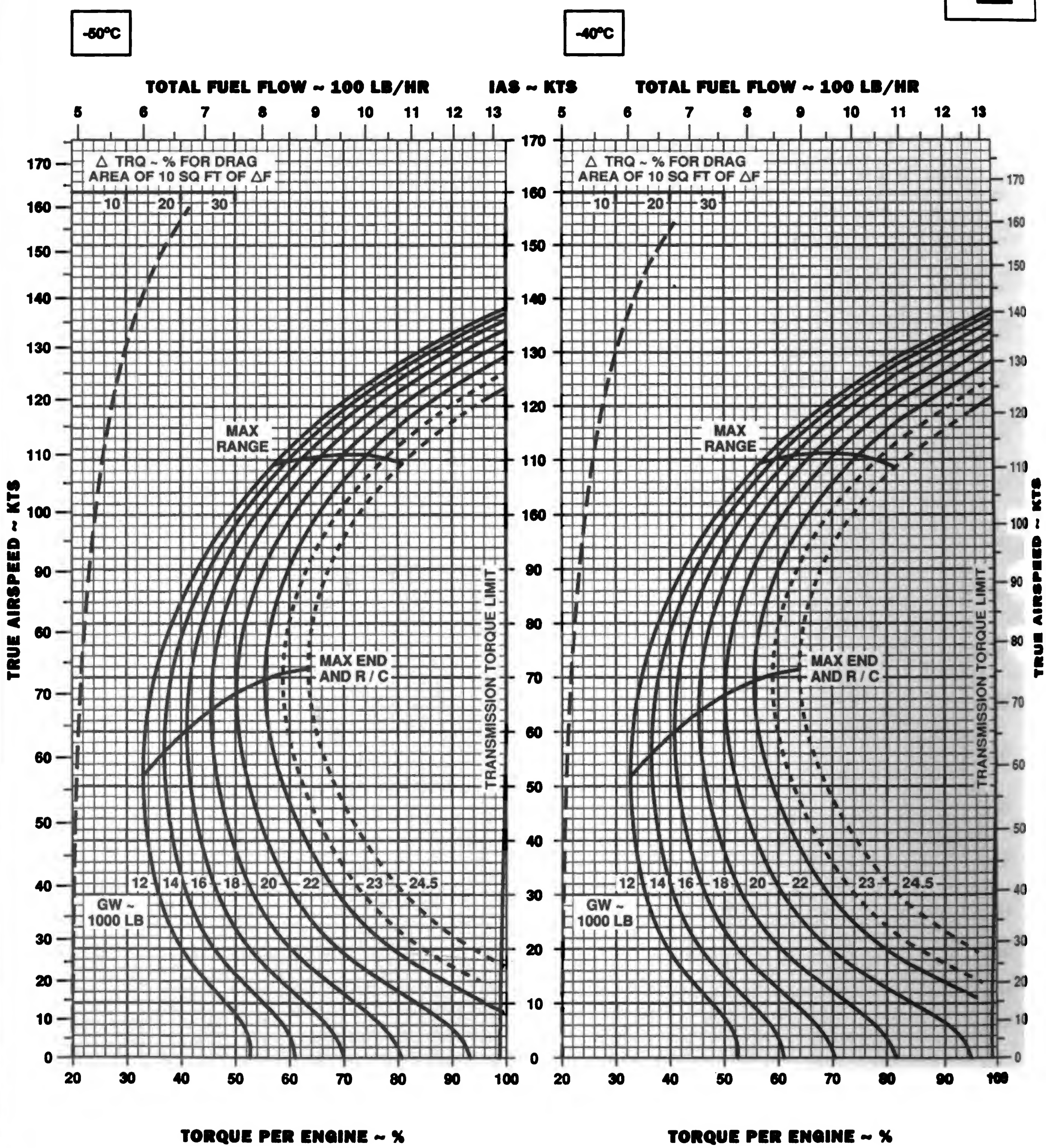


Figure 7-16. Cruise - Pressure Altitude 4,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



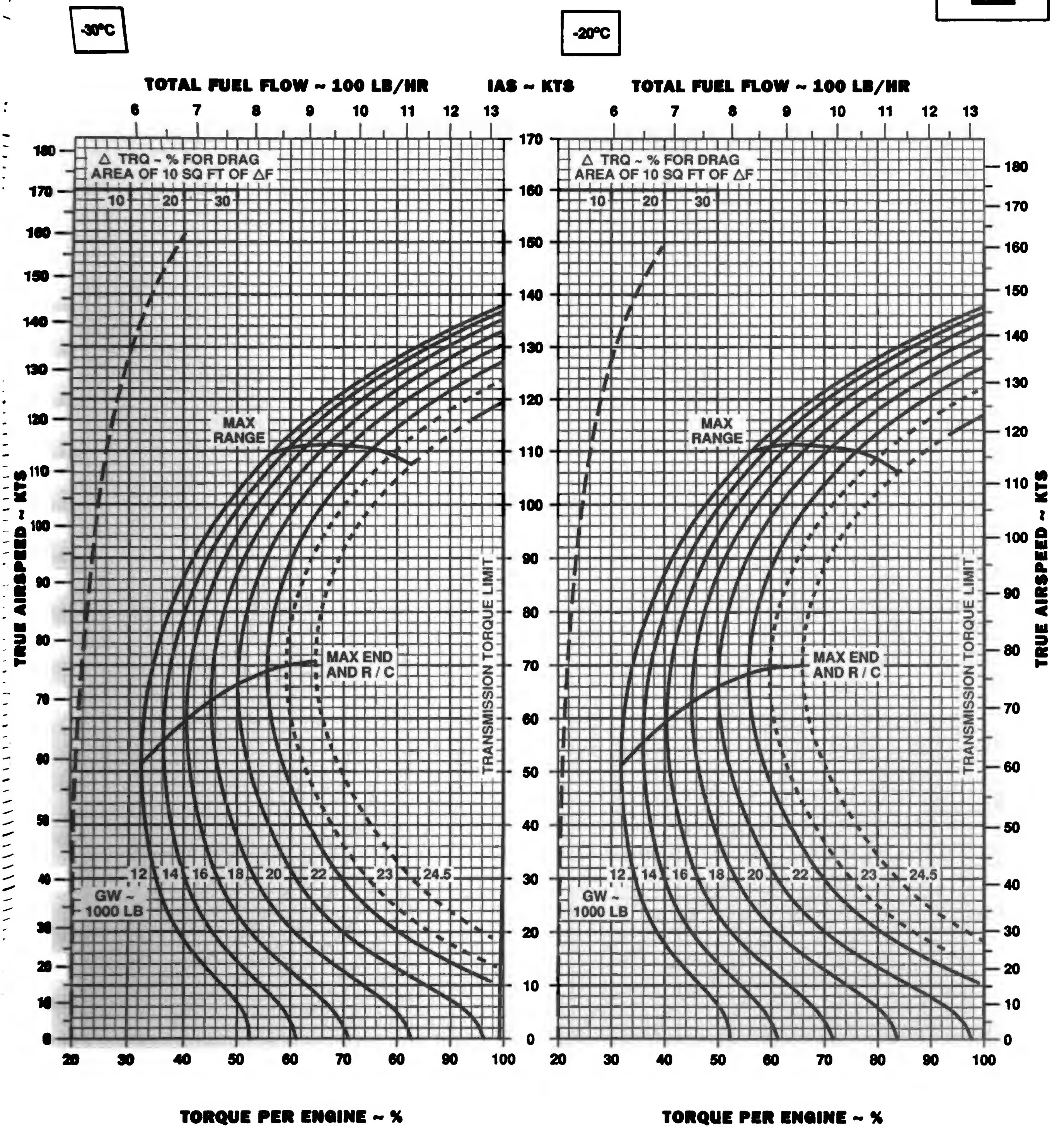
DATA BASE: FLIGHT TEST

Figure 7-17. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



DATA BASE: FLIGHT TEST

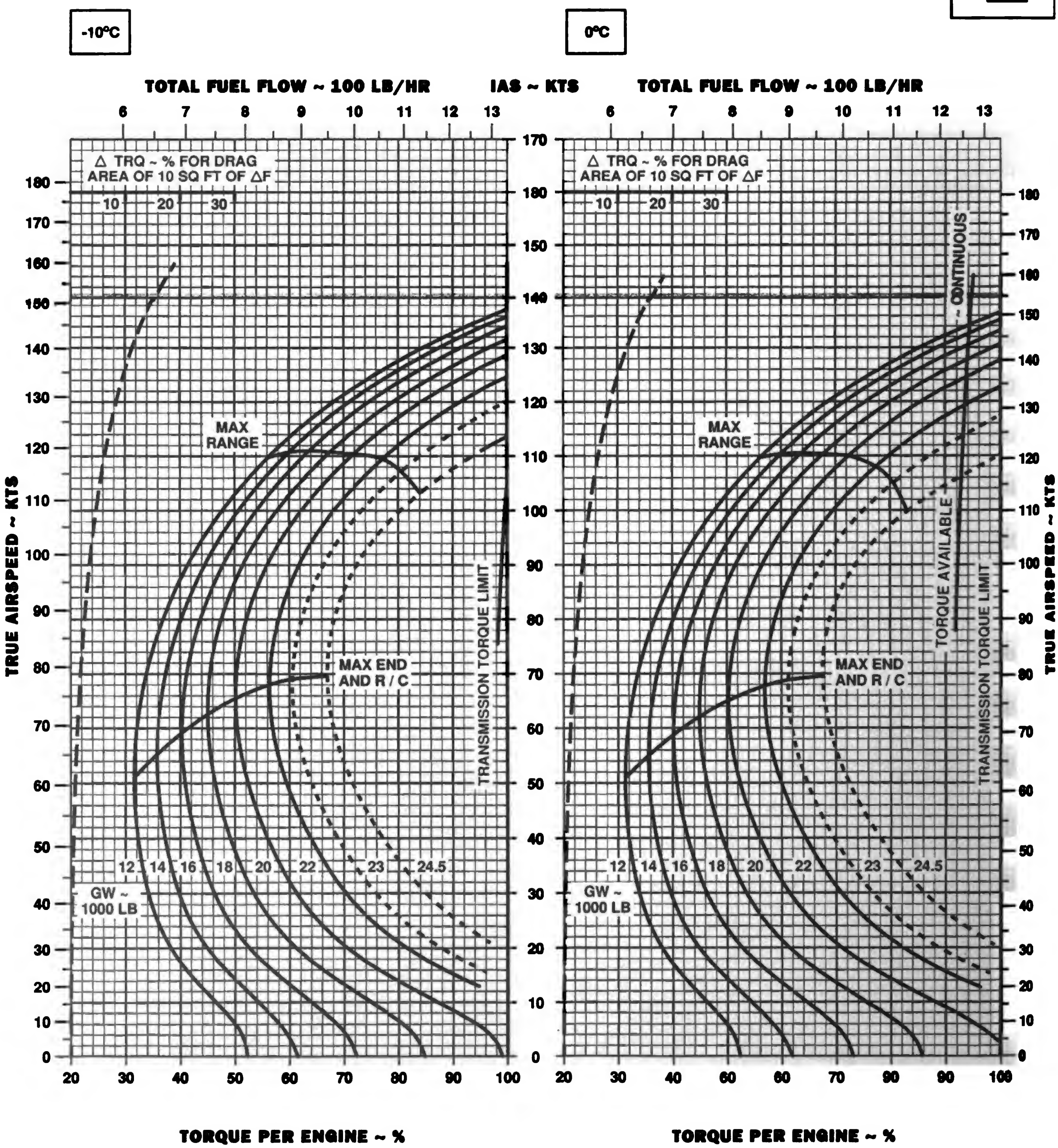
AA0547
SA

Figure 7-17. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



DATA BASE: FLIGHT TEST

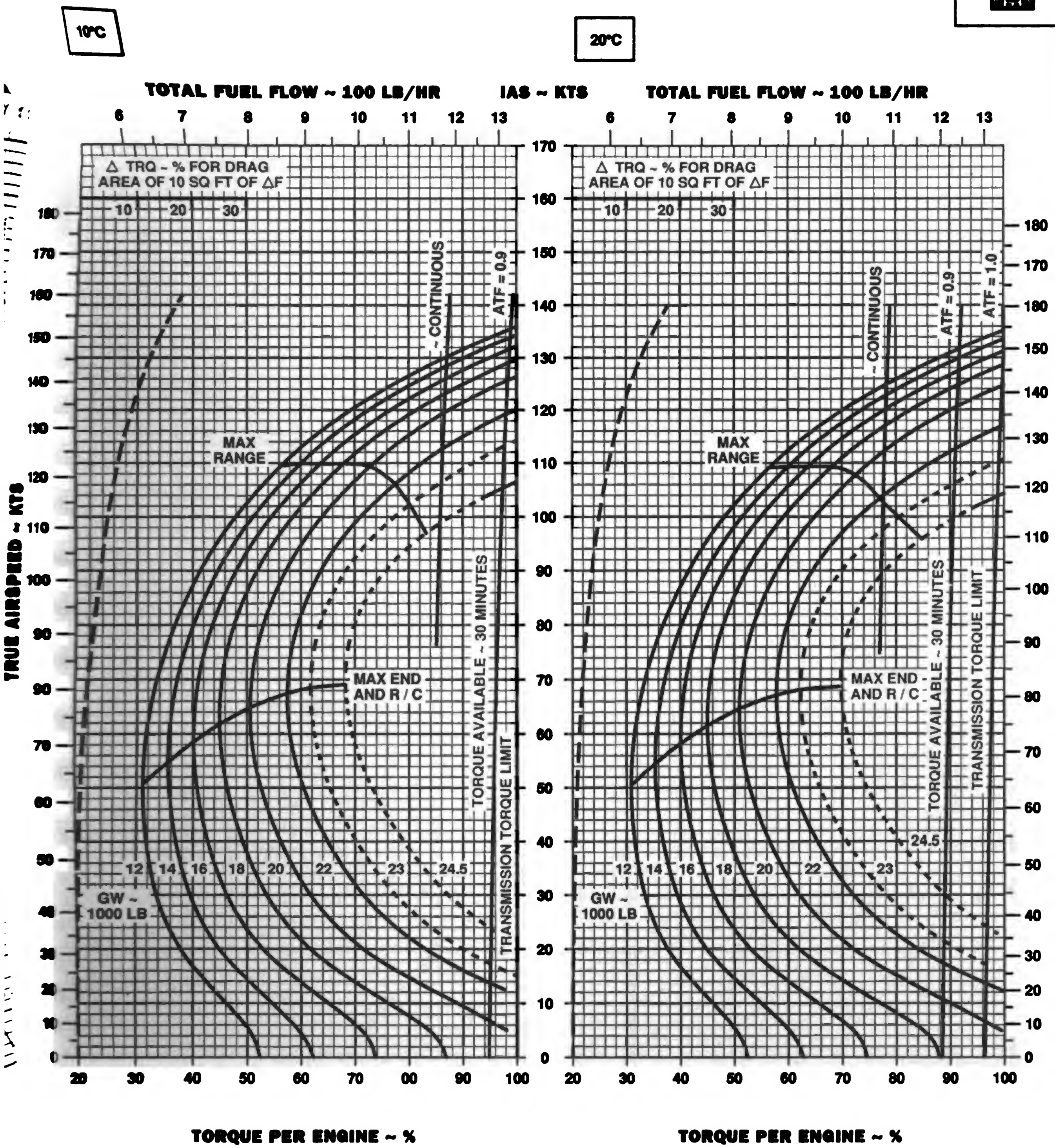
AA0548
SA

Figure 7-17. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 3 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



DATA BASE: FLIGHT TEST

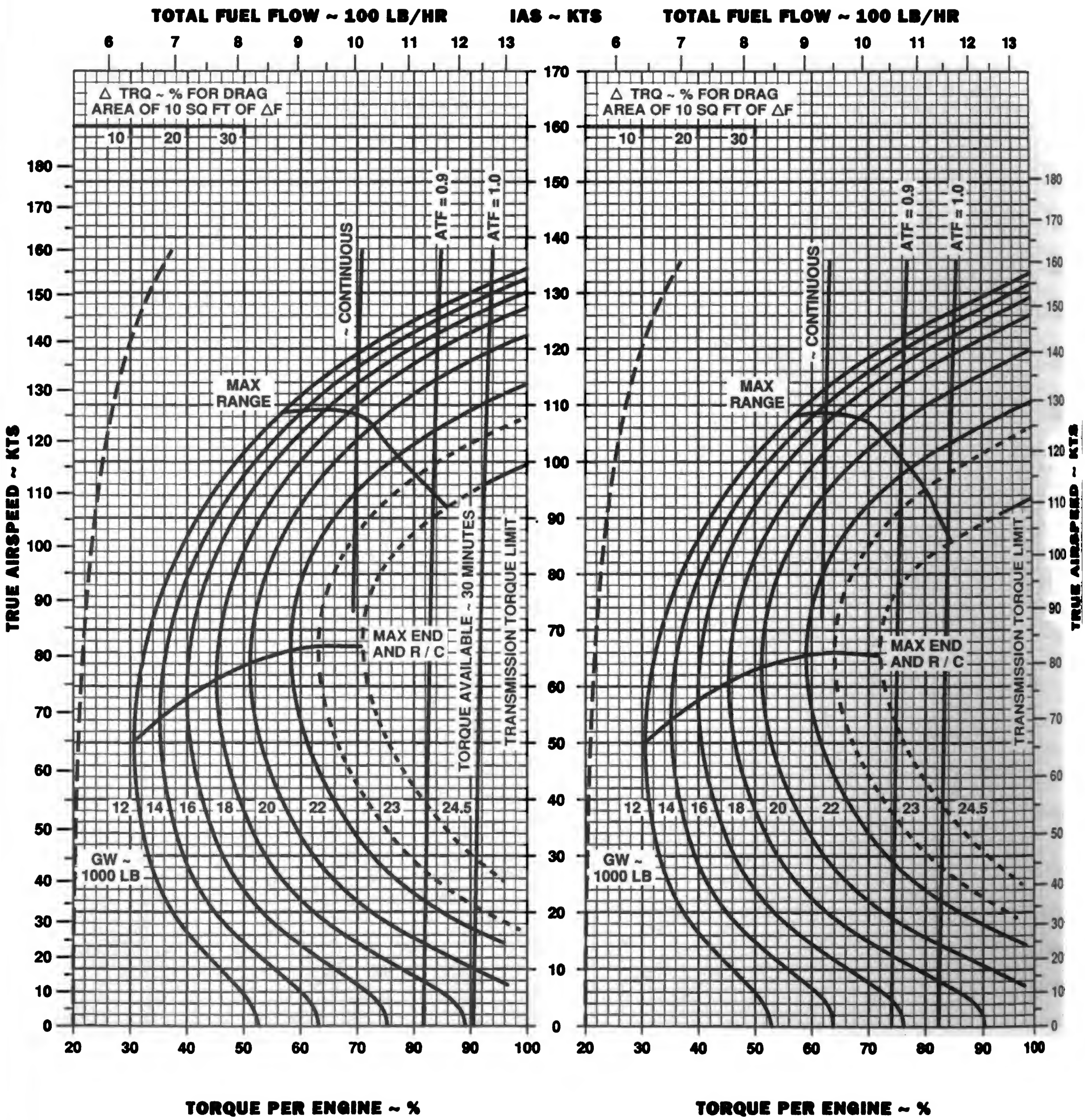
AA0549

Figure 7-17. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



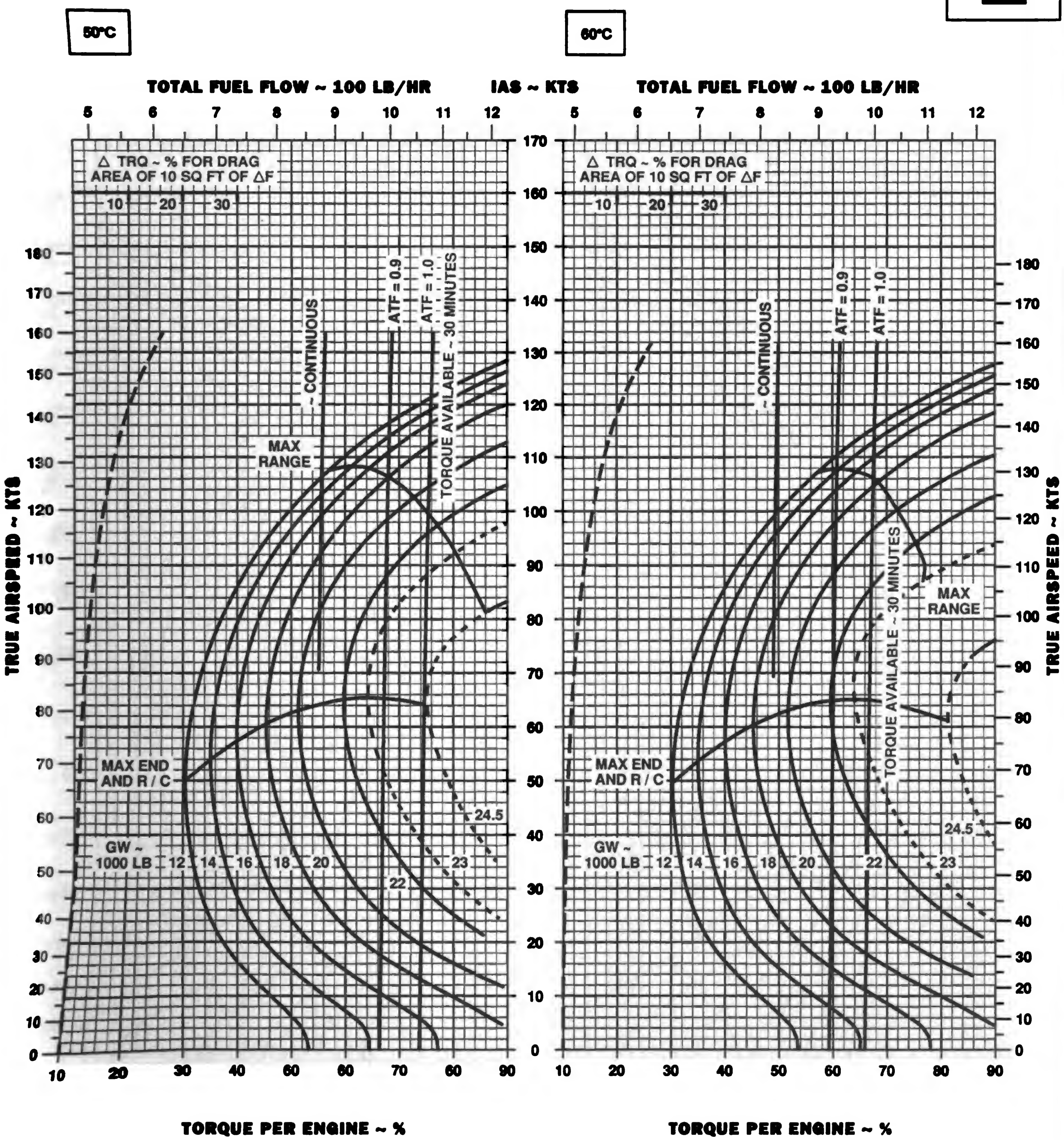
DATA BASE: FLIGHT TEST

Figure 7-17. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 5 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T700 (2)



DATA BASE: FLIGHT TEST

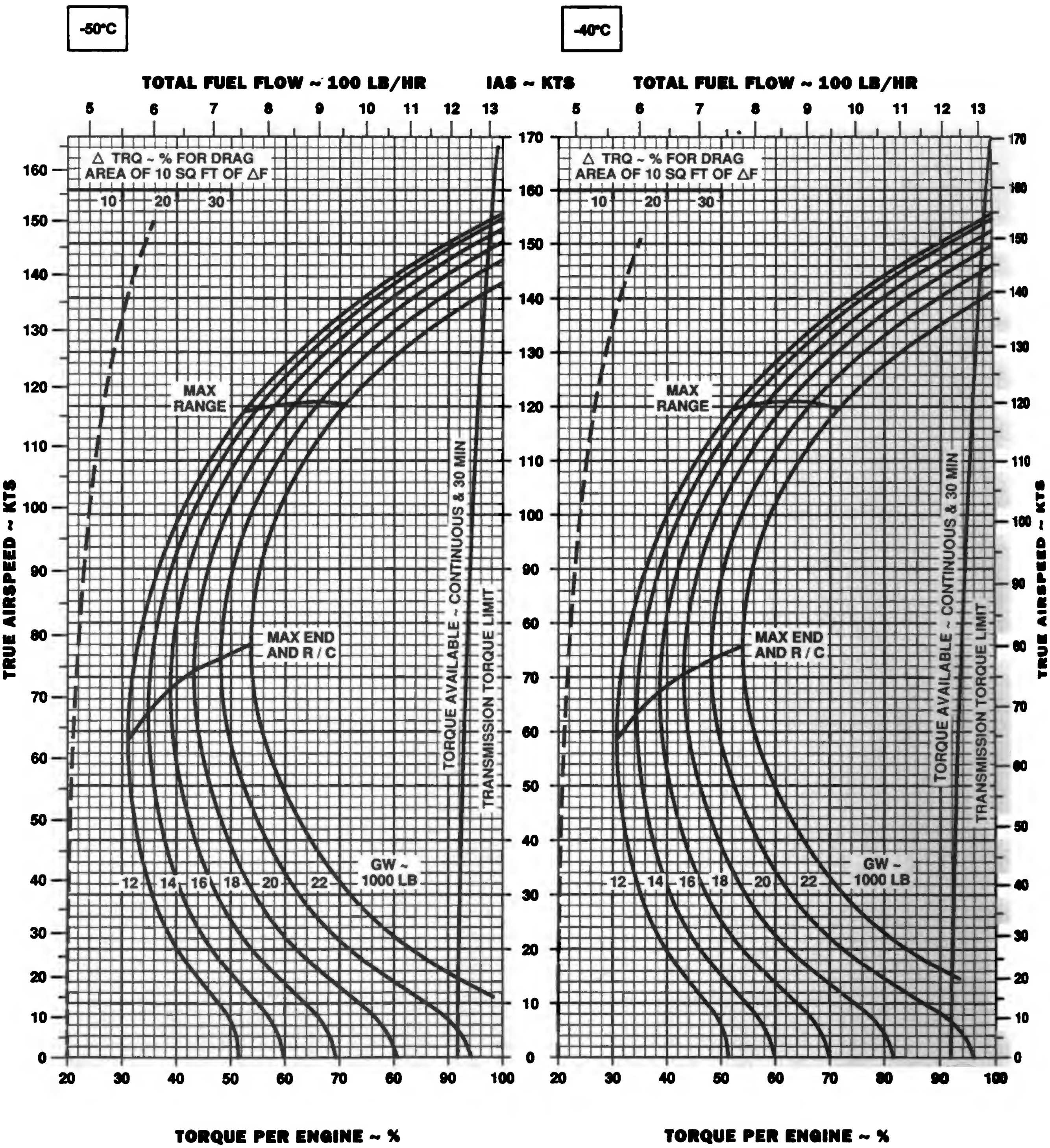
AA0551
SA

Figure 7-17. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0000 FT

CRUISE
6000 FT
T700 (2)



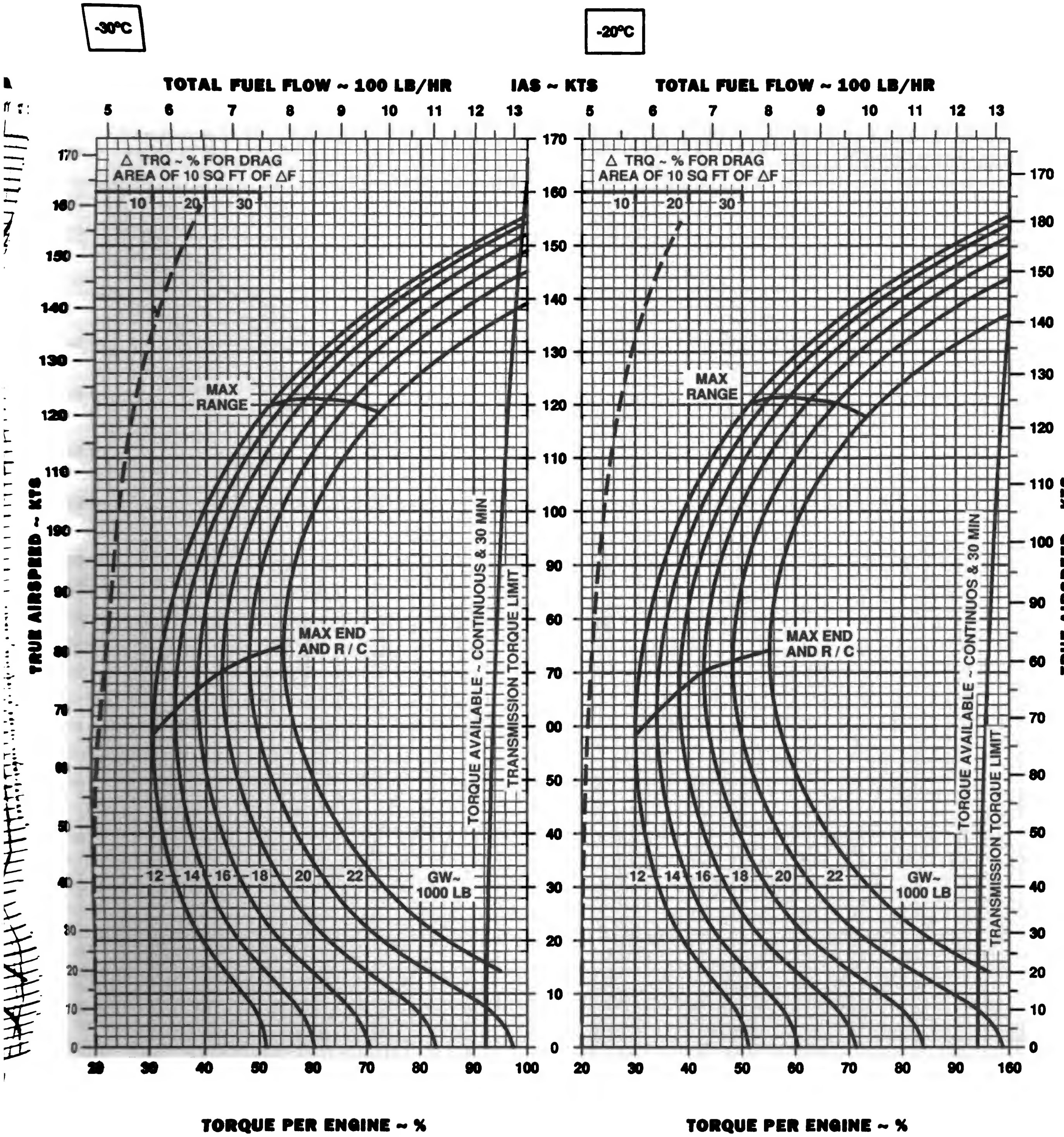
DATA BASE: FLIGHT TEST

AA0461
SA

Figure 7-18. Cruise - Pressure Altitude 6,000 Feet (Sheet 1 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



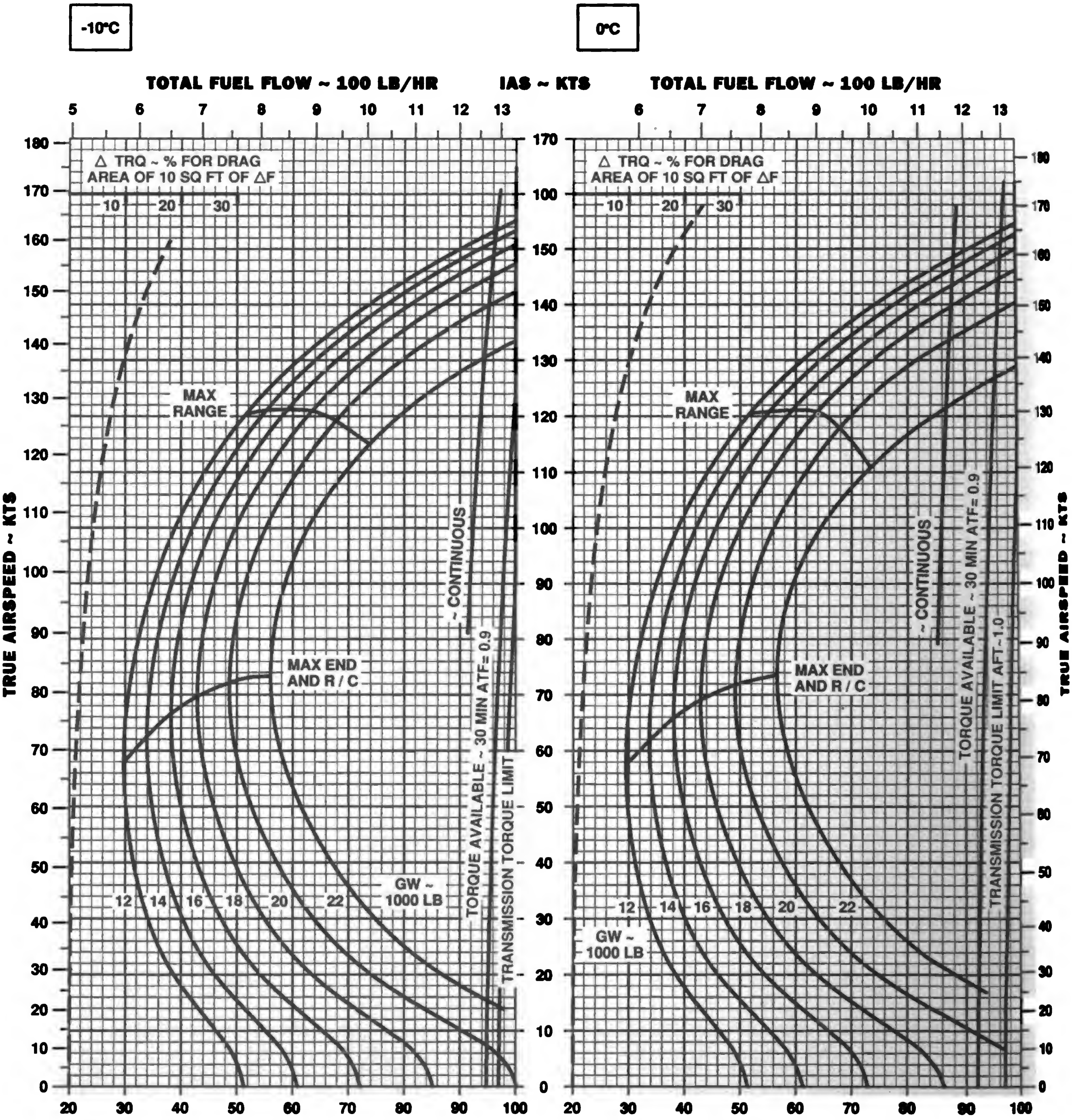
DATA BASE: *FLIGHT TEST*

AA0460
SA

Figure 7-18. Cruise - Pressure Altitude 6,000 Feet (Sheet 2 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



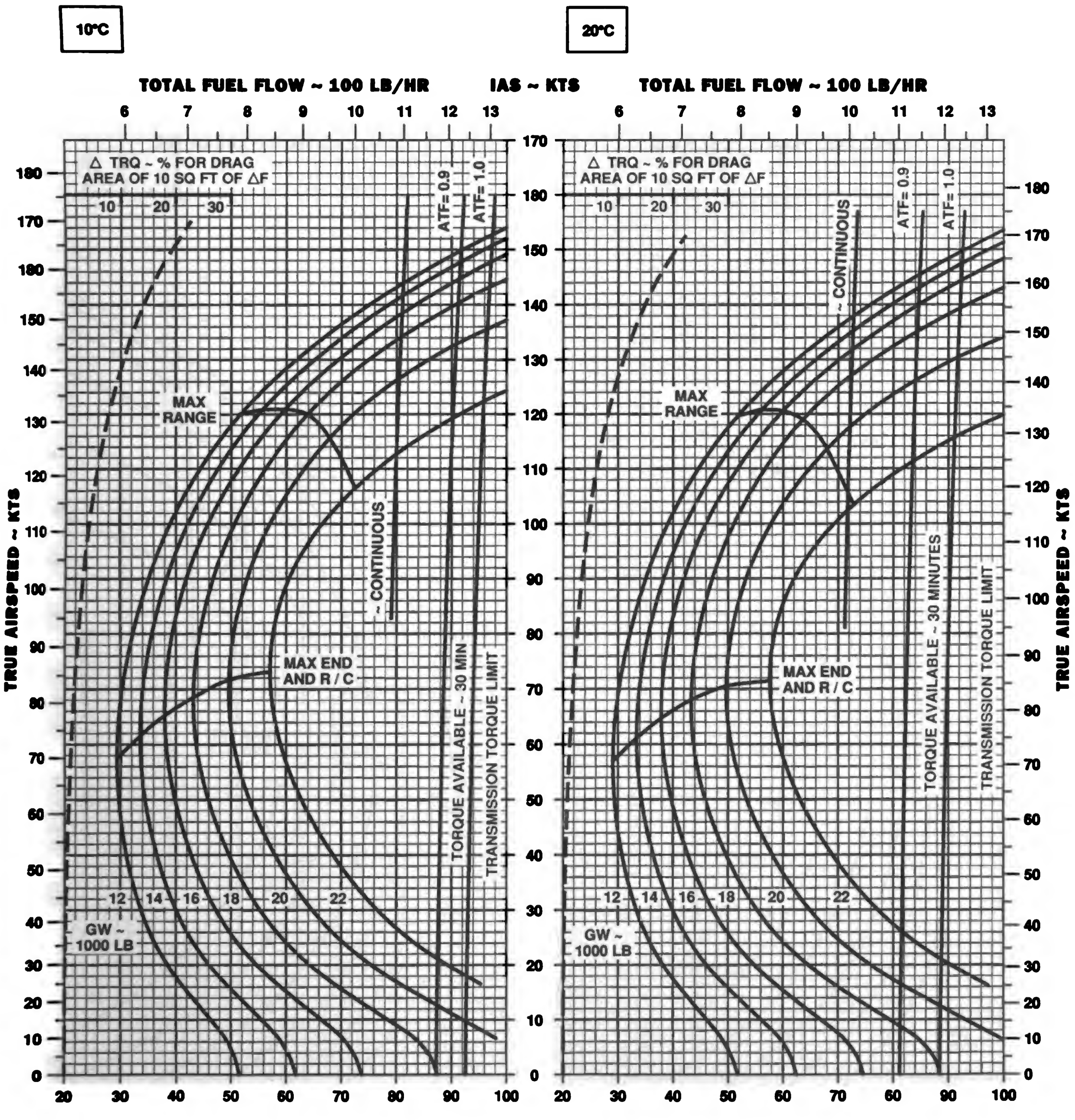
DATA BASE: FLIGHT TEST

AA0450

Figure 7-18. Cruise - Pressure Altitude 6,000 Feet (Sheet 3 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0462
SA

Figure 7-18. Cruise - Pressure Altitude 6,000 Feet (Sheet 4 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)

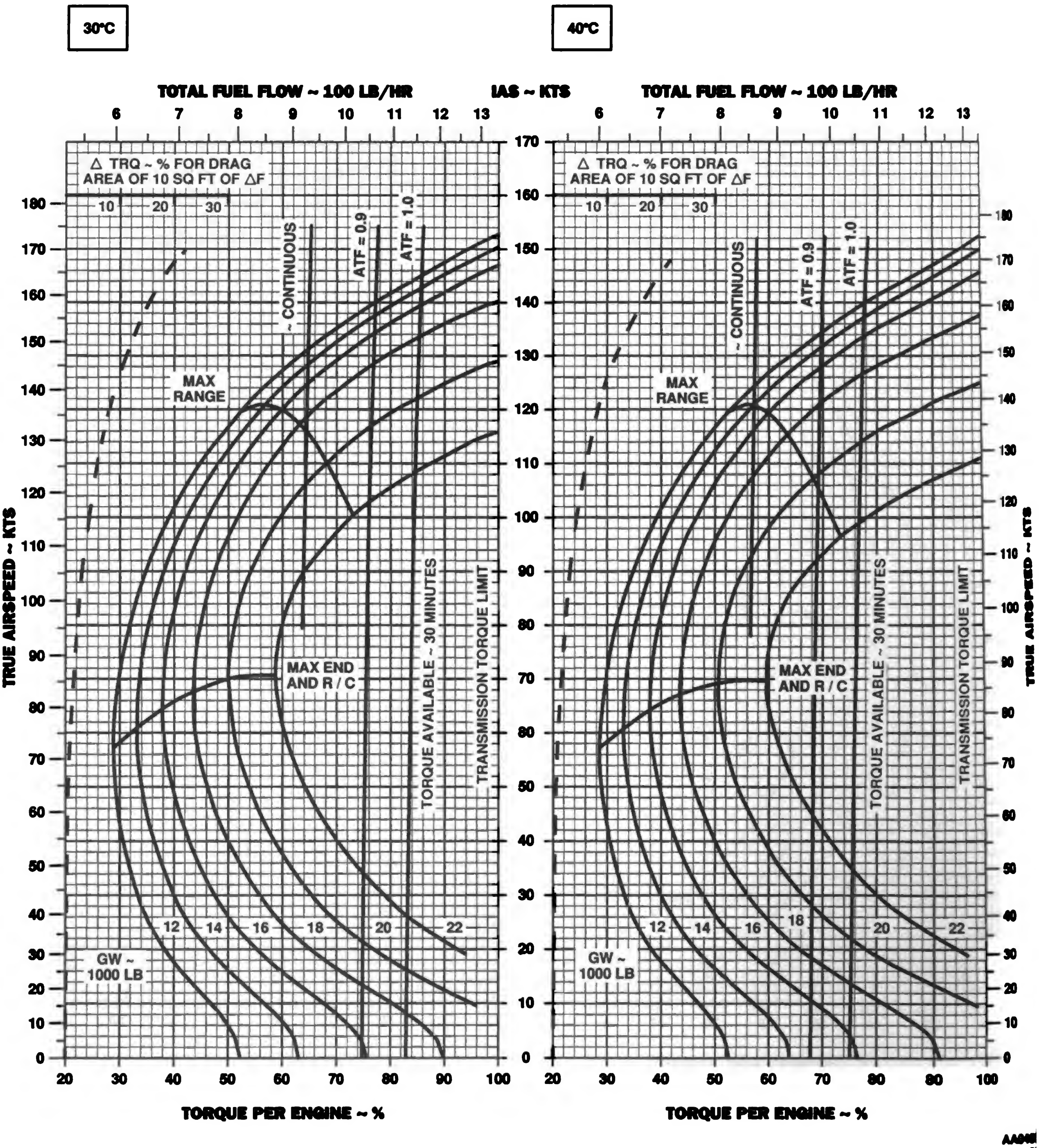
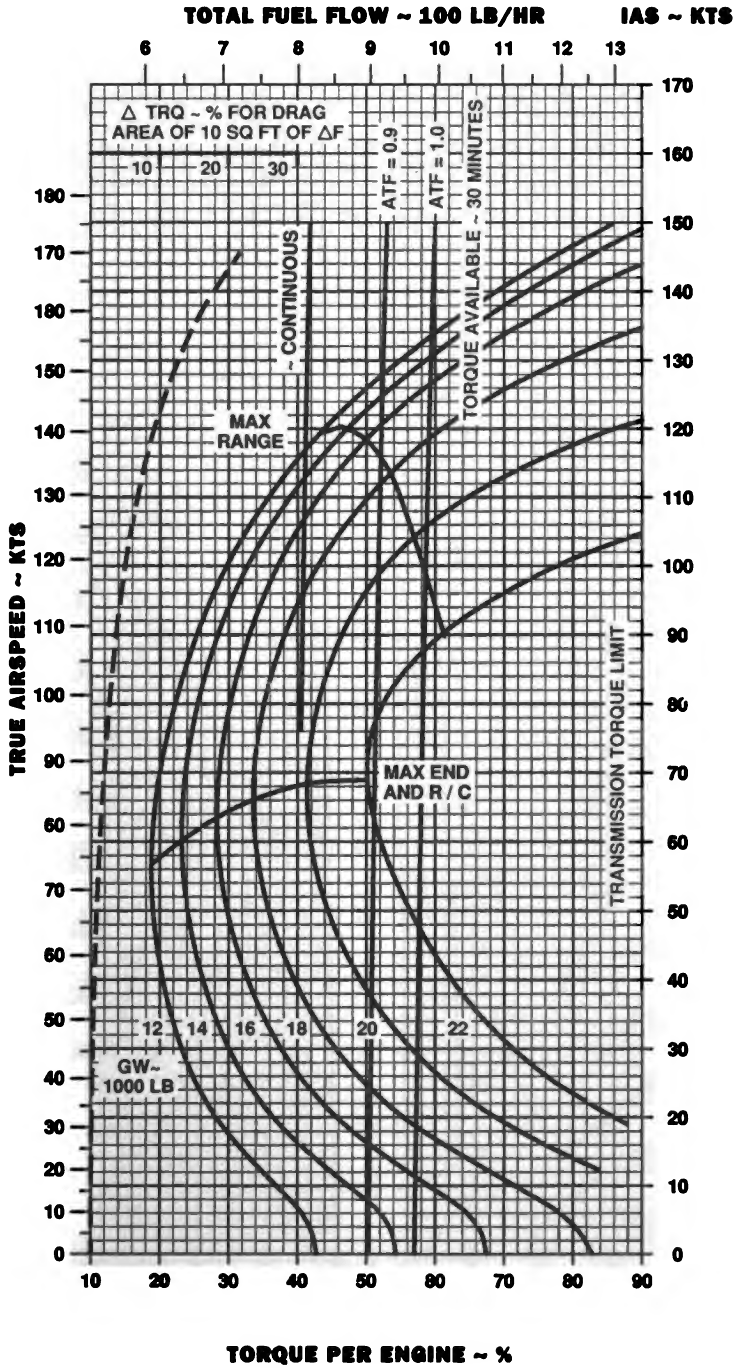


Figure 7-18. Cruise - Pressure Altitude 6,000 Feet (Sheet 5 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)

50°C



DATA BASE: FLIGHT TEST

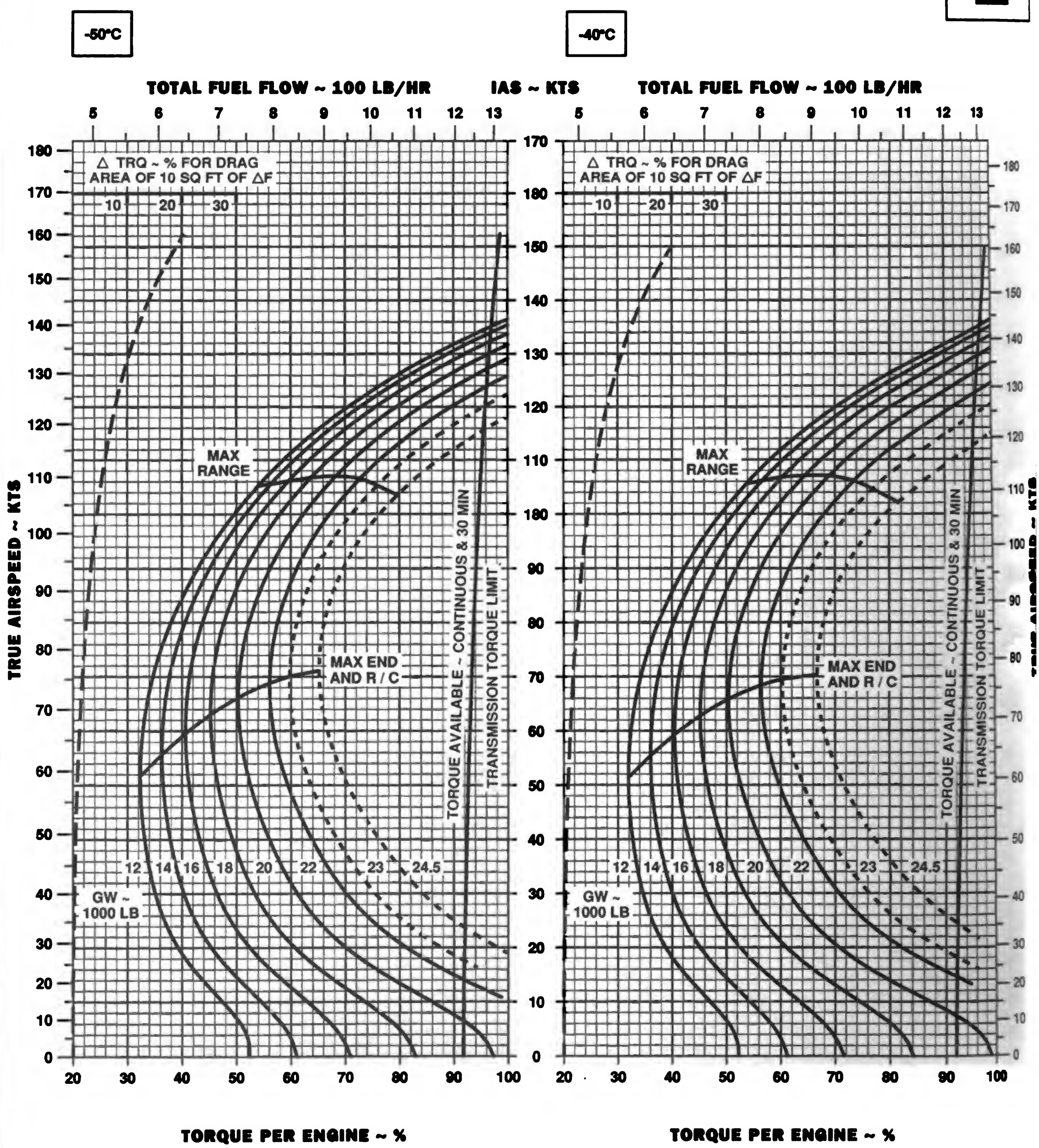
AA0464

Figure 7-18. Cruise - Pressure Altitude 6,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



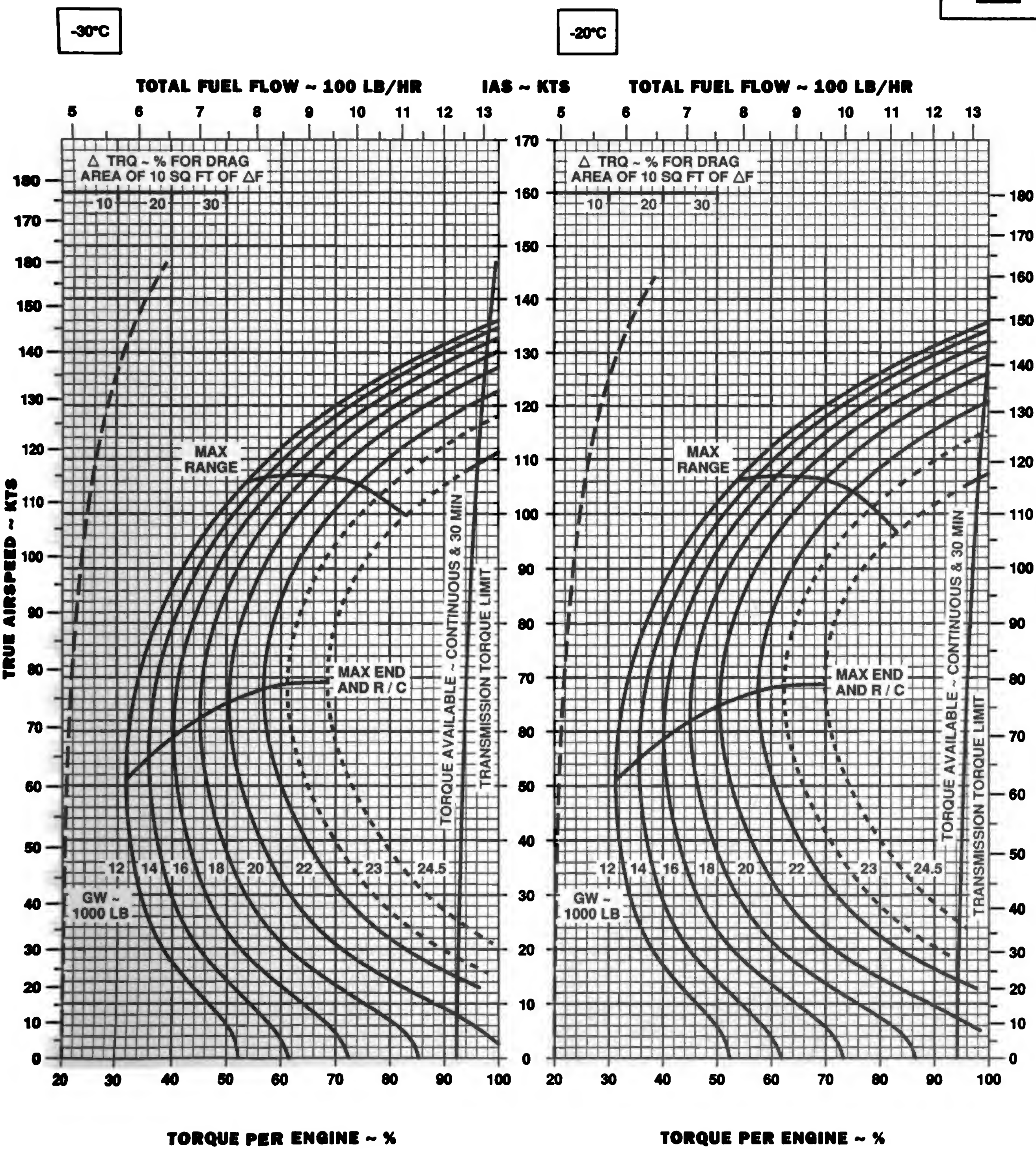
DATA BASE: FLIGHT TEST

Figure 7-19. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



AA0553
SA

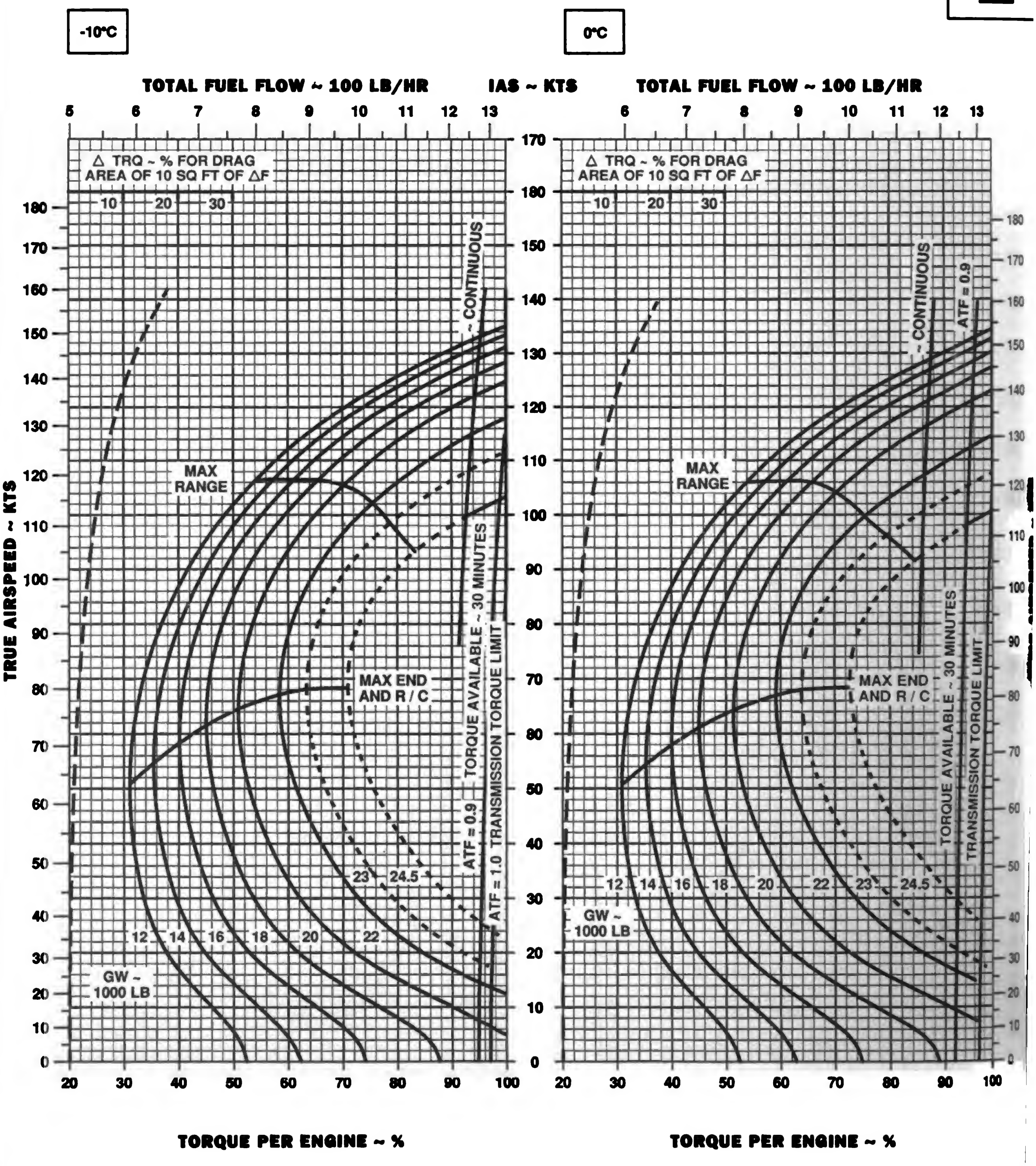
DATA BASE: FLIGHT TEST

Figure 7-19. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



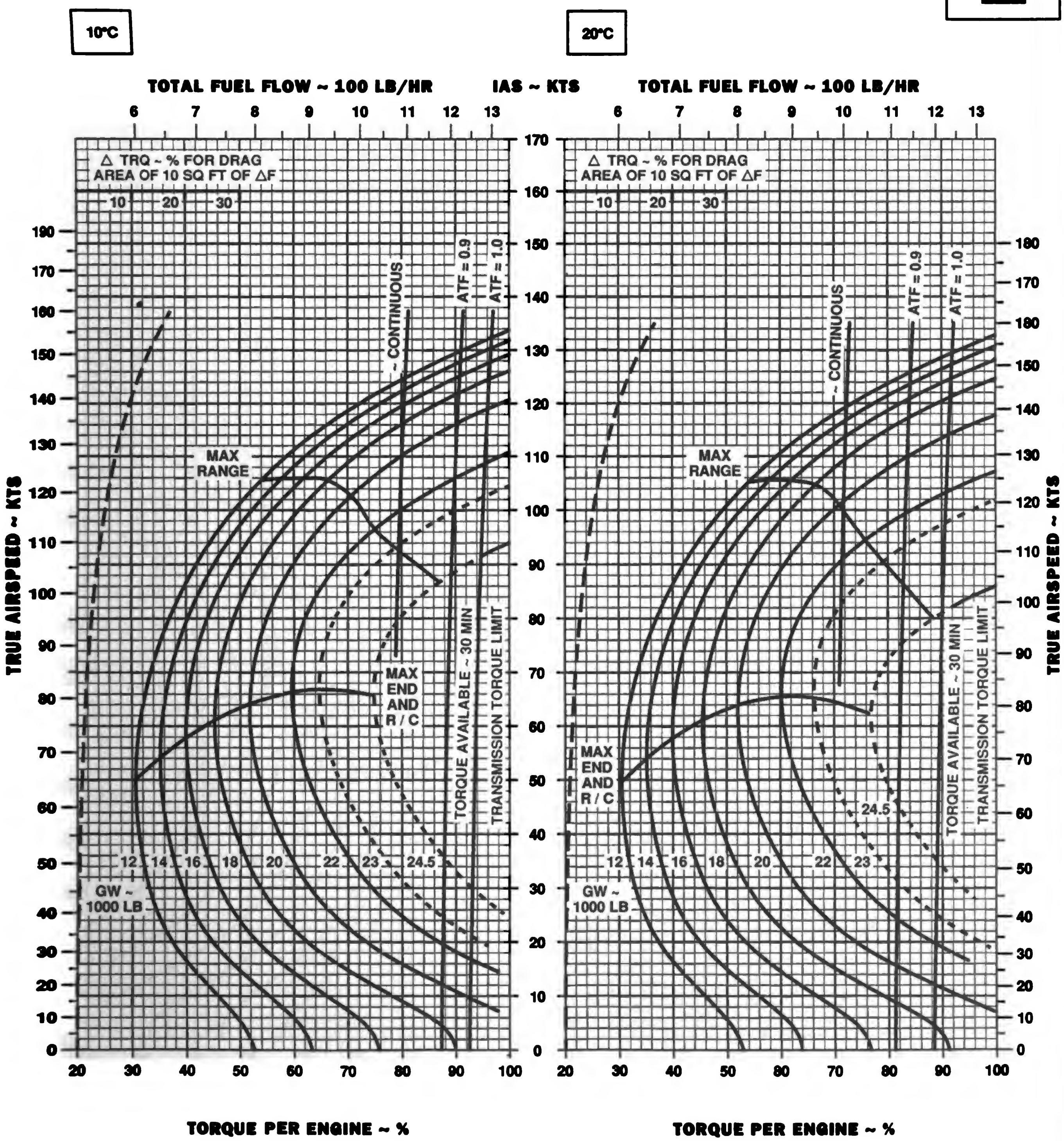
DATA BASE: FLIGHT TEST

Figure 7-19. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 3 of 6)

CRUISE
6000 FT
T700 (2)

CRUISE

PRESS ALT: 6000 FT



DATA BASE: FLIGHT TEST

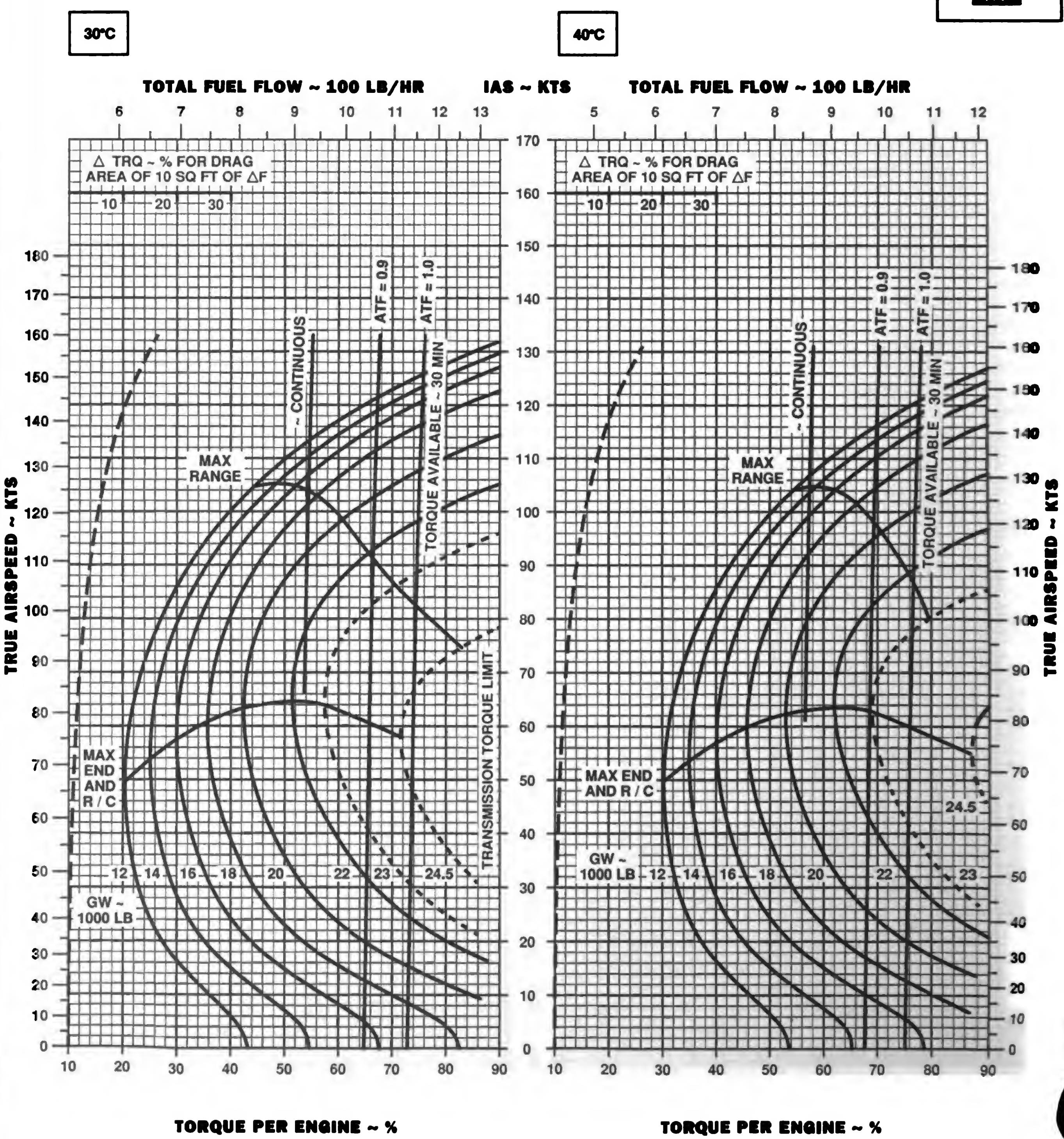
AA0555 SA

Figure 7-19. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0556

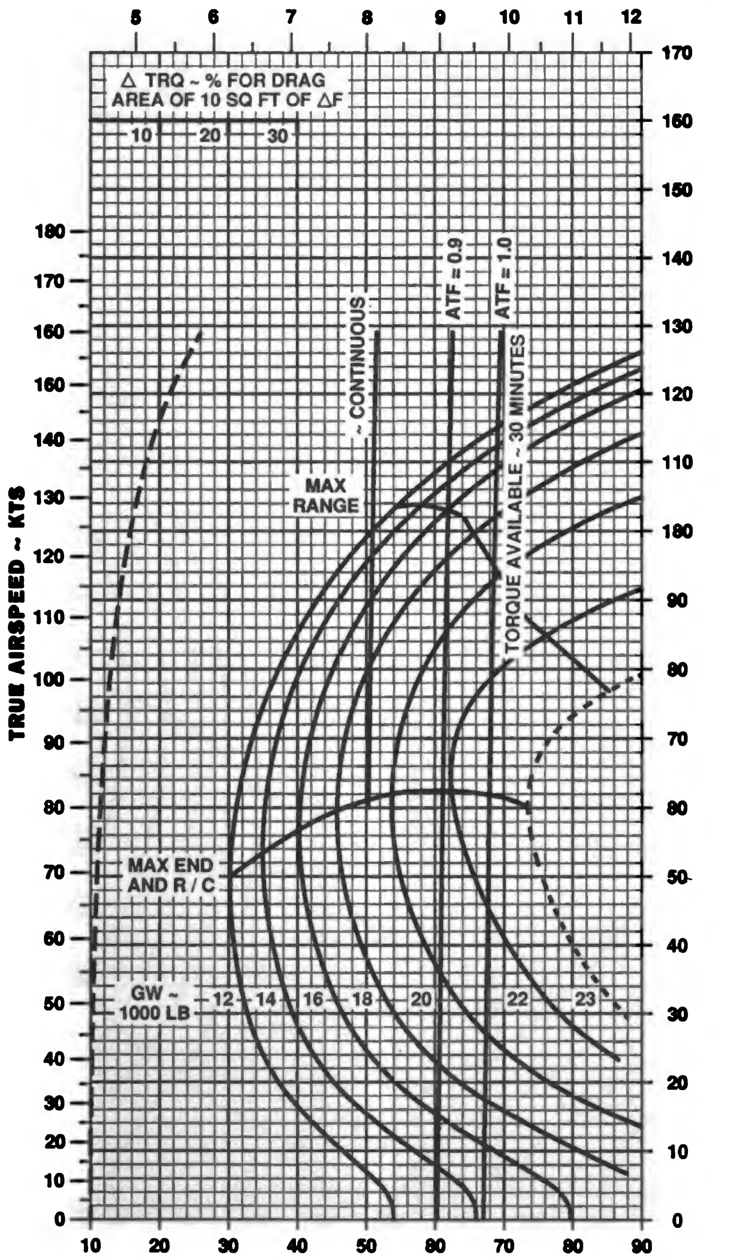
Figure 7-19. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 5 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T700 (2)

50°C



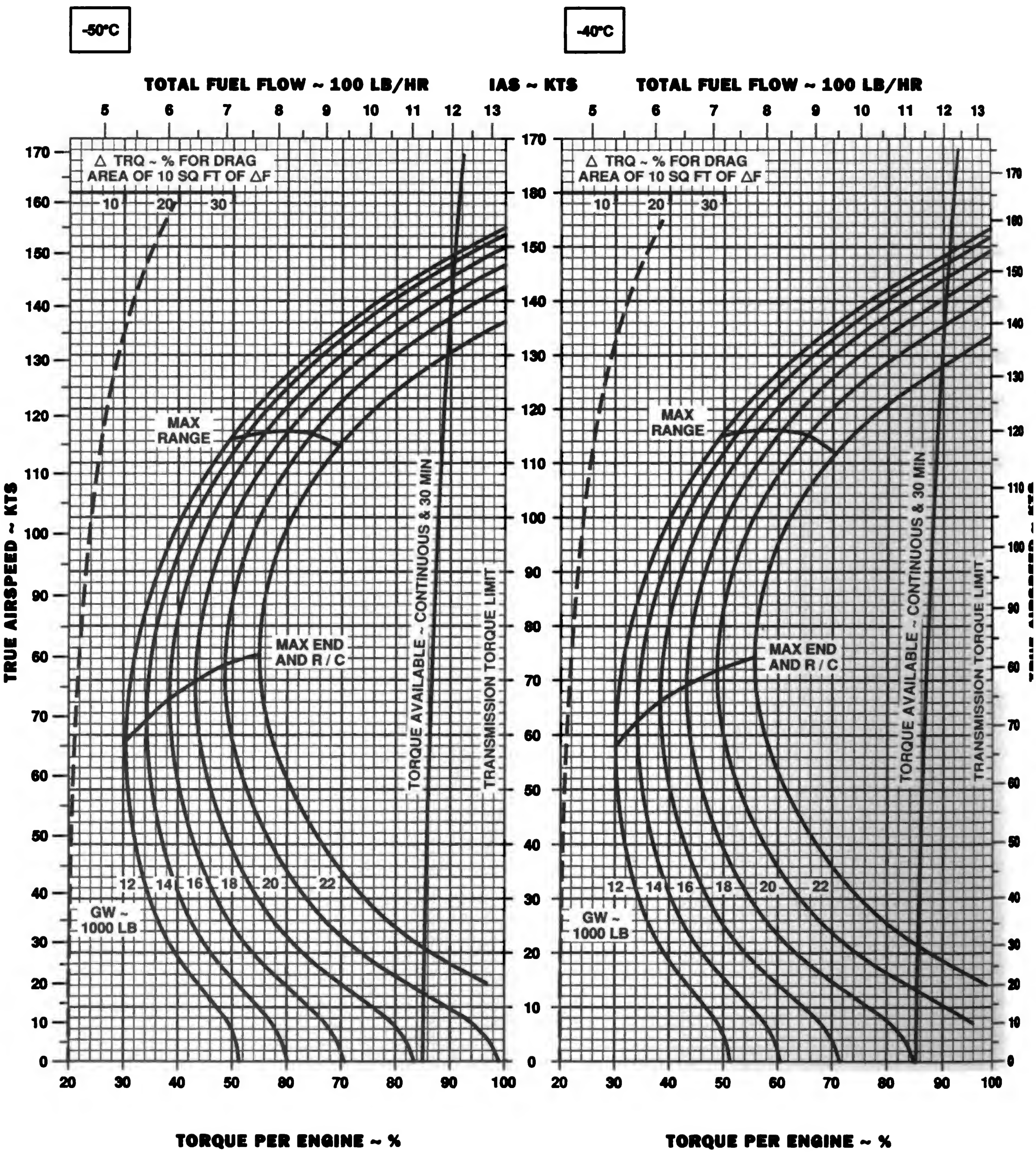
DATA BASE: FLIGHT TEST

AA0557

Figure 7-19. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 6 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 8000 FT

CRUISE
6000 FT
T700 (2)

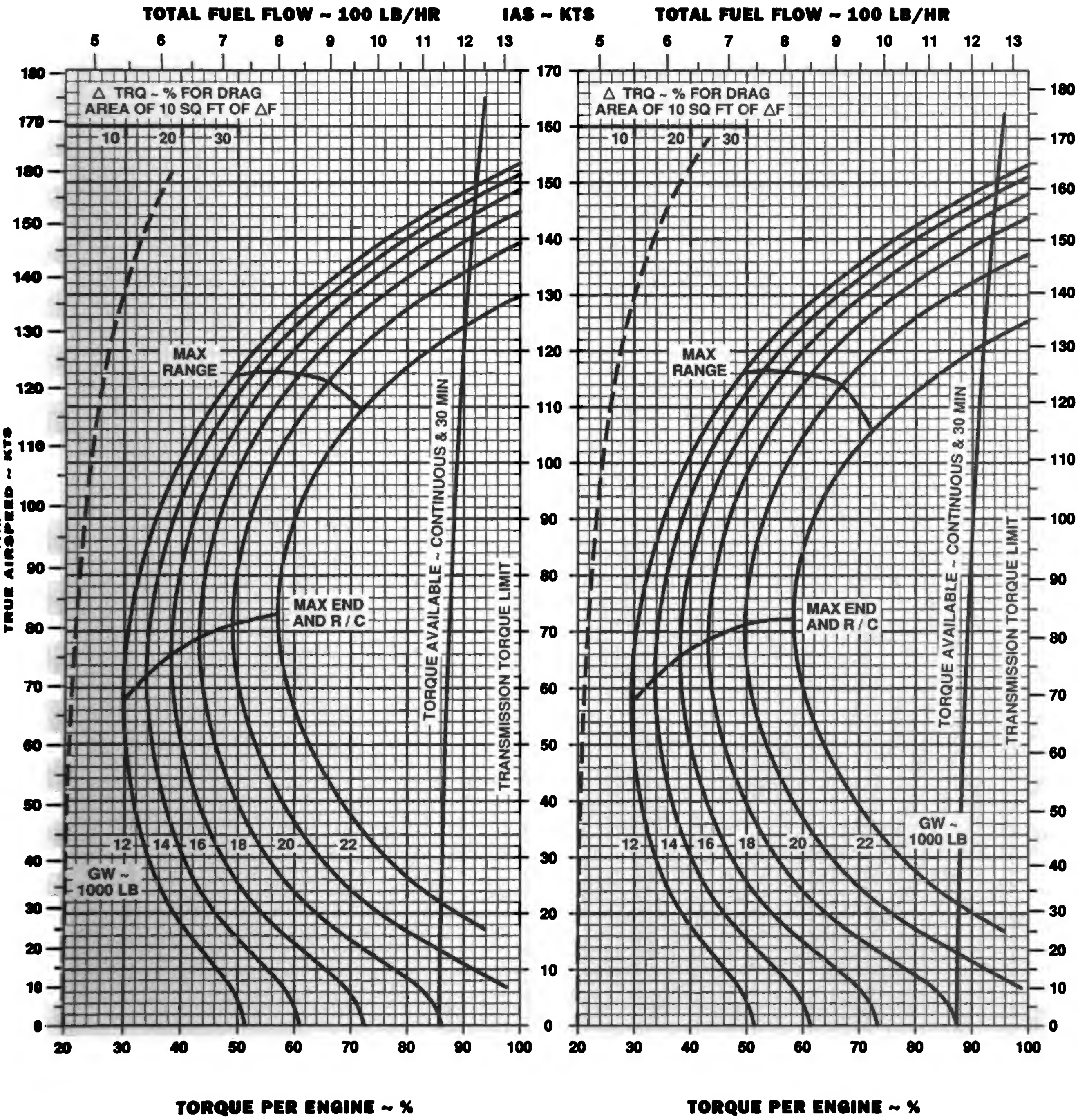


DATA BASE: FLIGHT TEST

Figure 7-20. Cruise - Pressure Altitude 8,000 Feet (Sheet 1 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)



DATA BASE: FLIGHT TEST

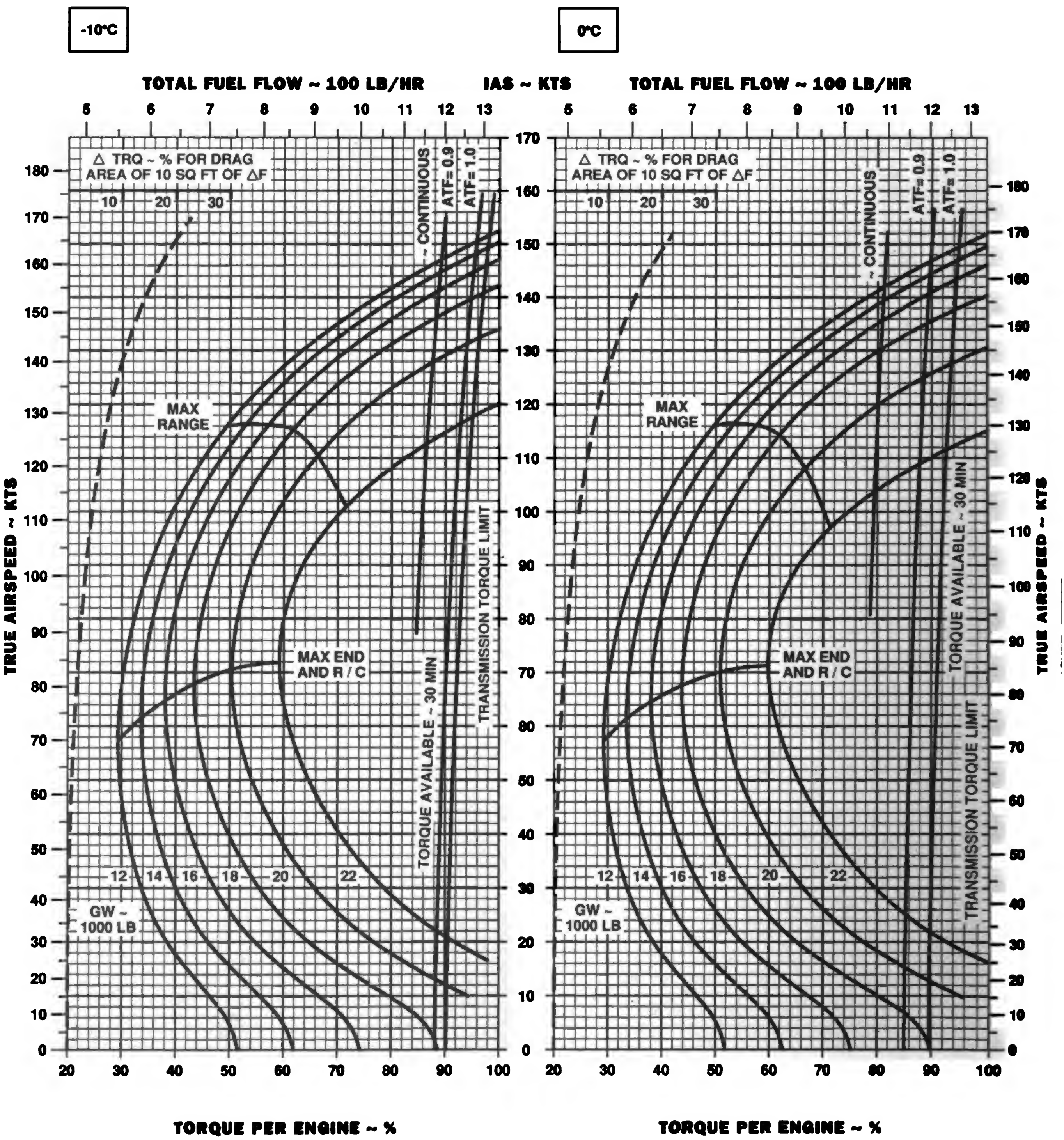
AA0466
SA

Figure 7-20. Cruise - Pressure Altitude 8,000 Feet (Sheet 2 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)



DATA BASE: FLIGHT TEST

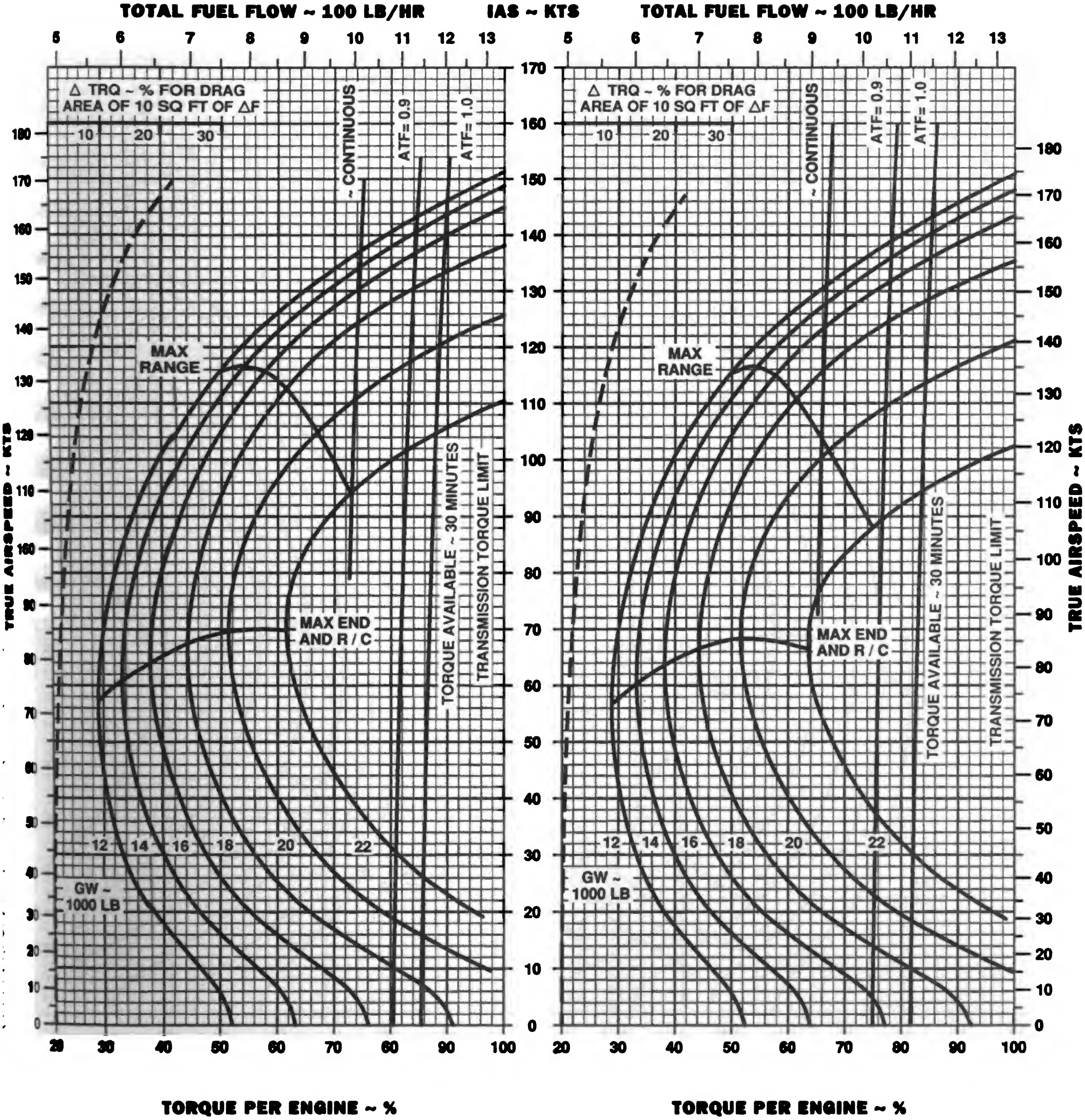
AA0465
9A

Figure 7-20. Cruise - Pressure Altitude 8,000 Feet (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8000 FT

CRUISE
6000 FT
T700 (2)



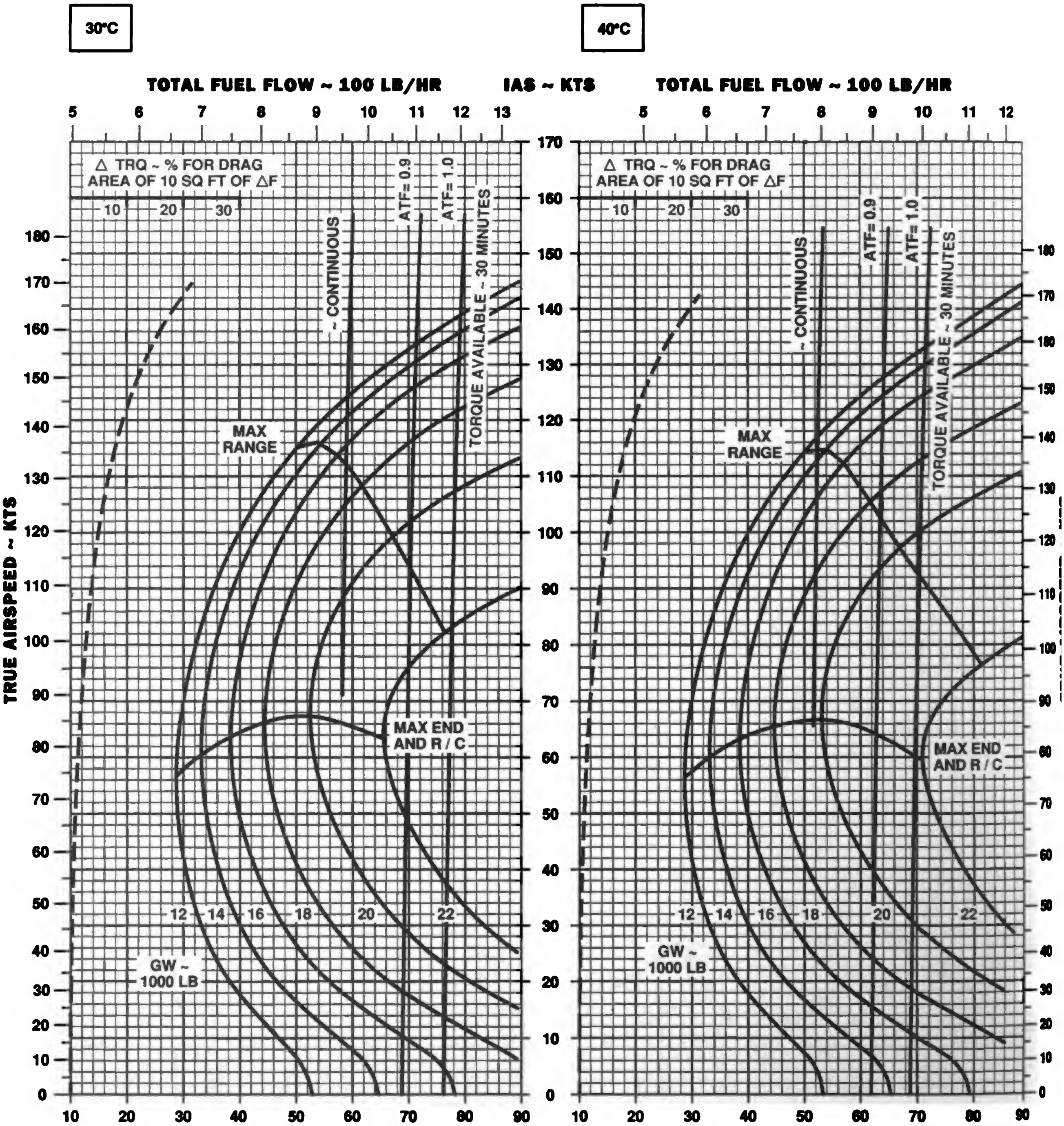
DATA BASE: FLIGHT TEST

AA0468 SA

Figure 7-20. Cruise - Pressure Altitude 8,000 Feet (Sheet 4 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)



DATA BASE: FLIGHT TEST

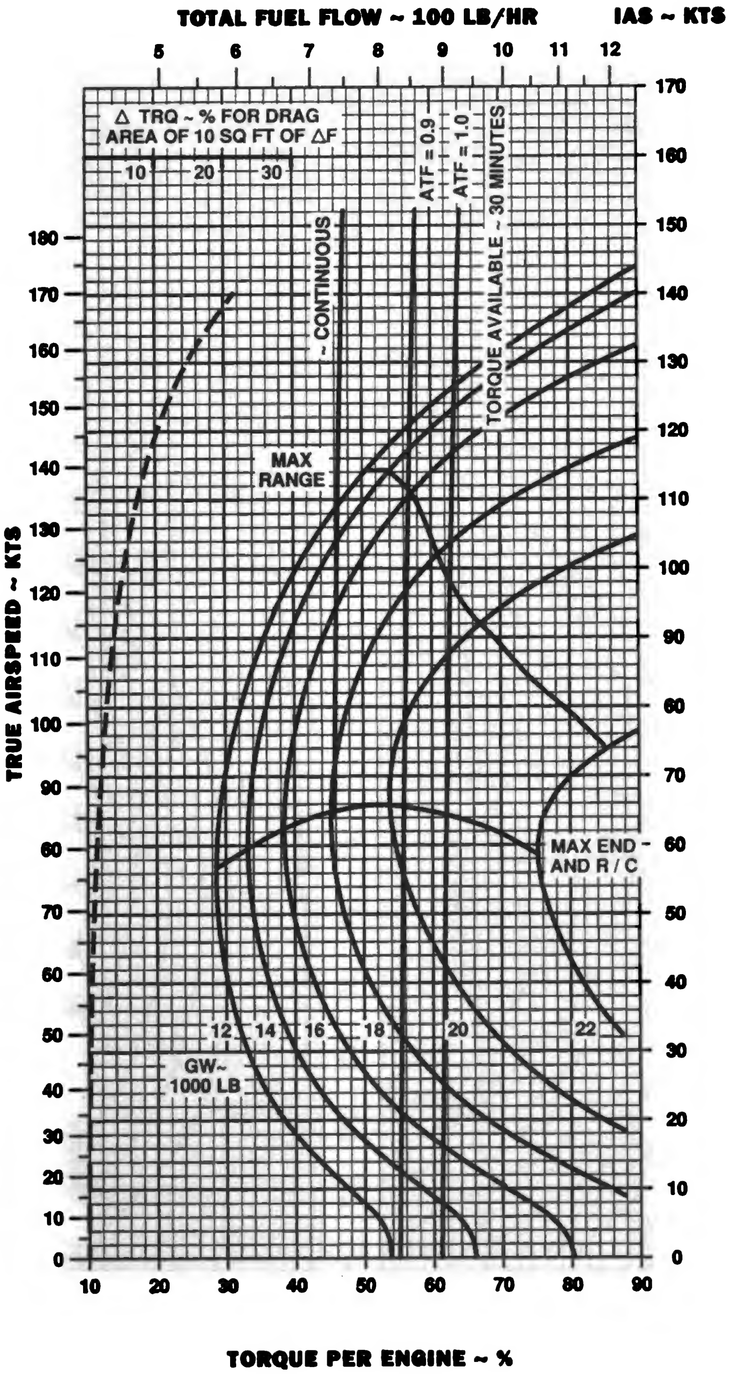
Figure 7-20. Cruise - Pressure Altitude 8,000 Feet (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)

50°C



DATA BASE: FLIGHT TEST

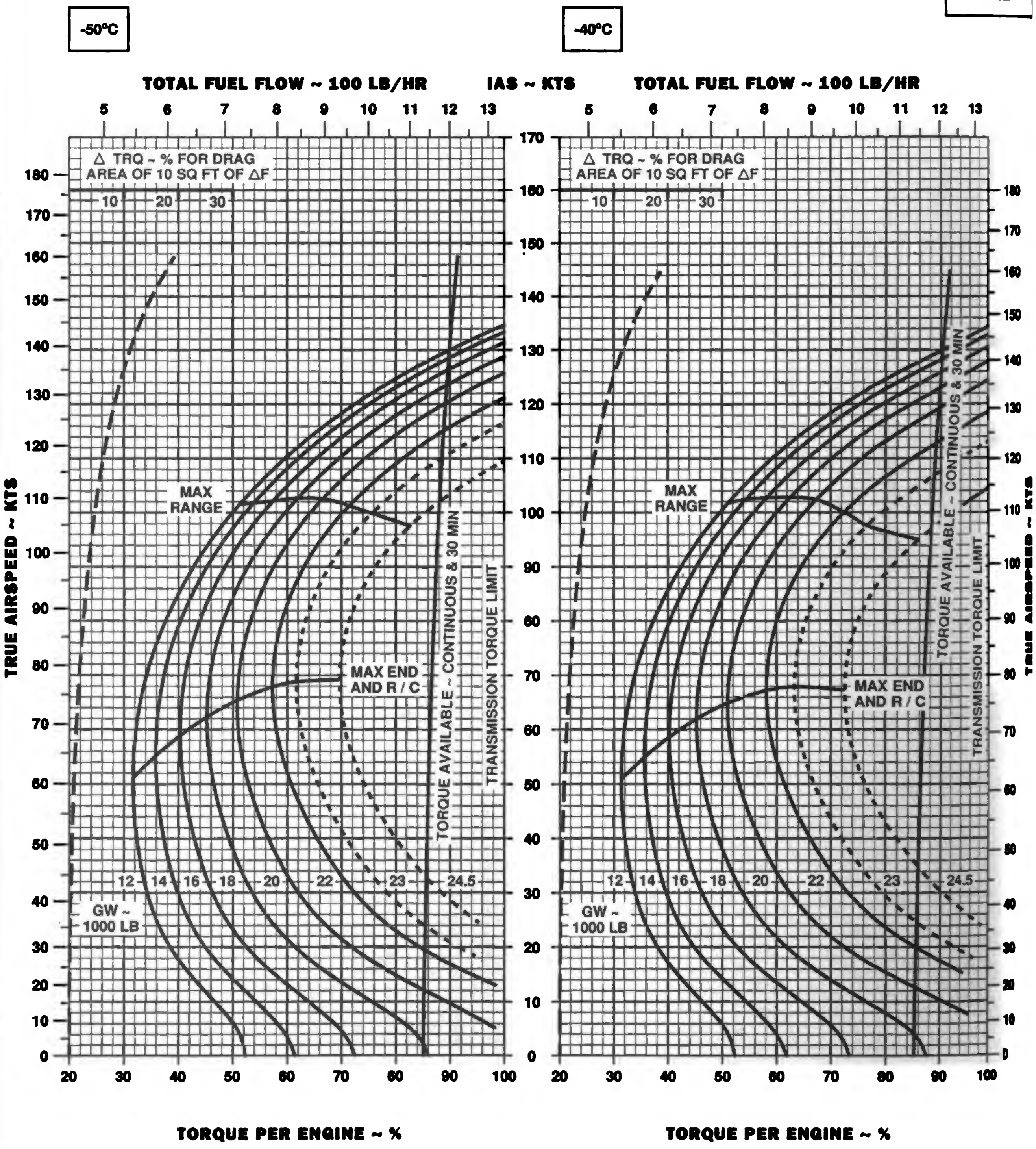
AA0470
SA

Figure 7-20. Cruise - Pressure Altitude 8,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)



DATA BASE: FLIGHT TEST

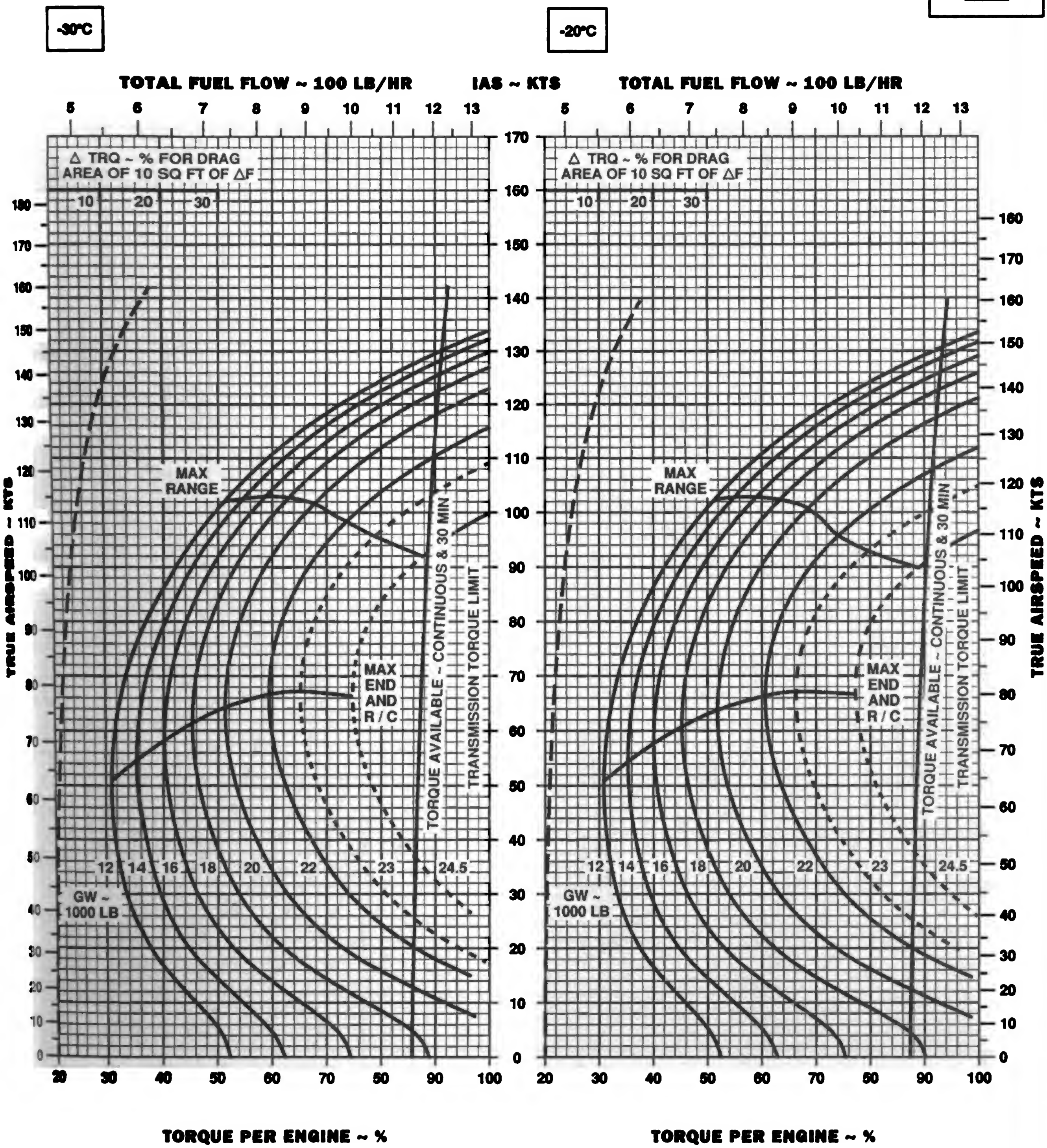
AA0558

Figure 7-21. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)



DATA BASE: FLIGHT TEST

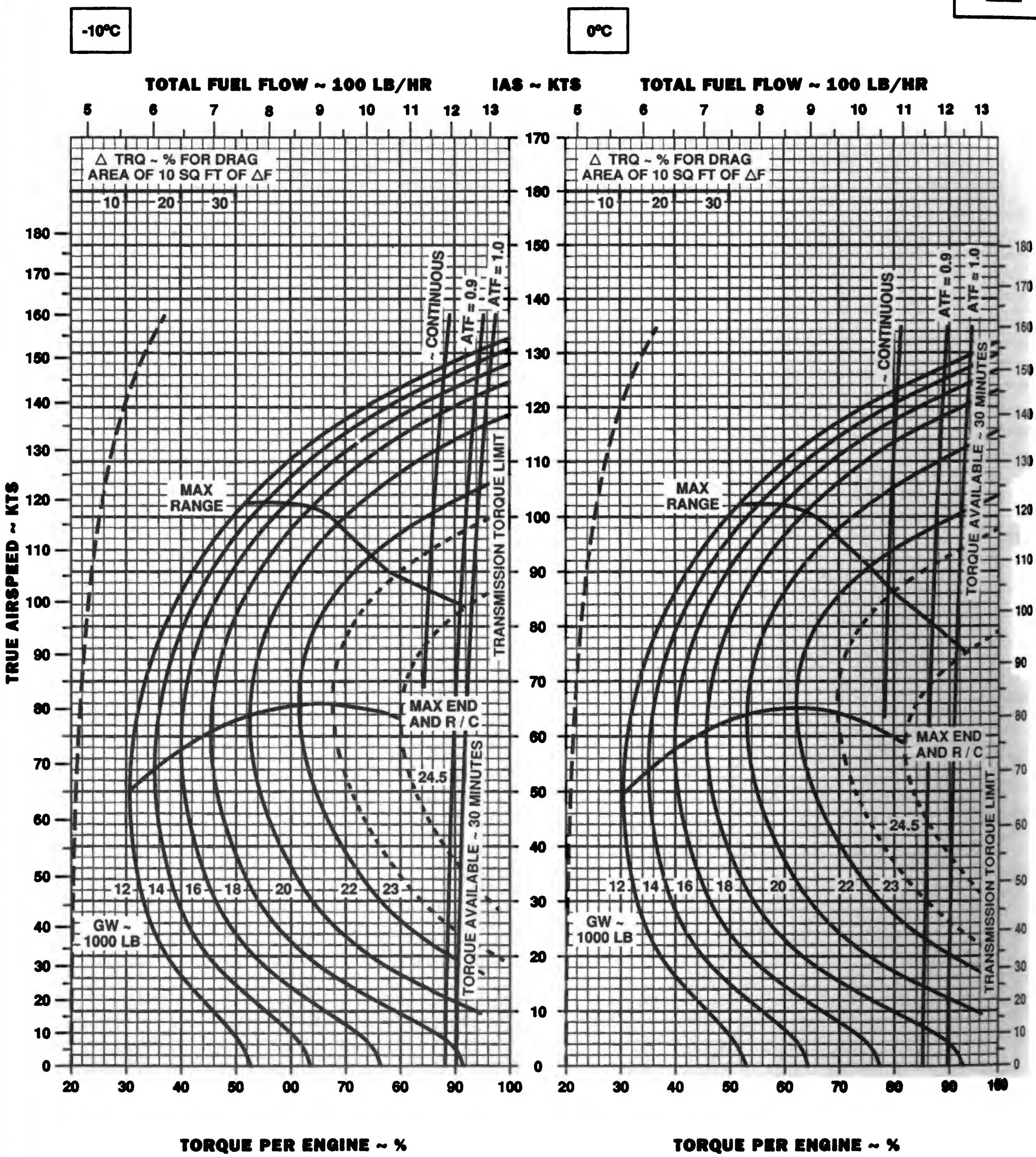
AA0559
8A

Figure 7-21. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)



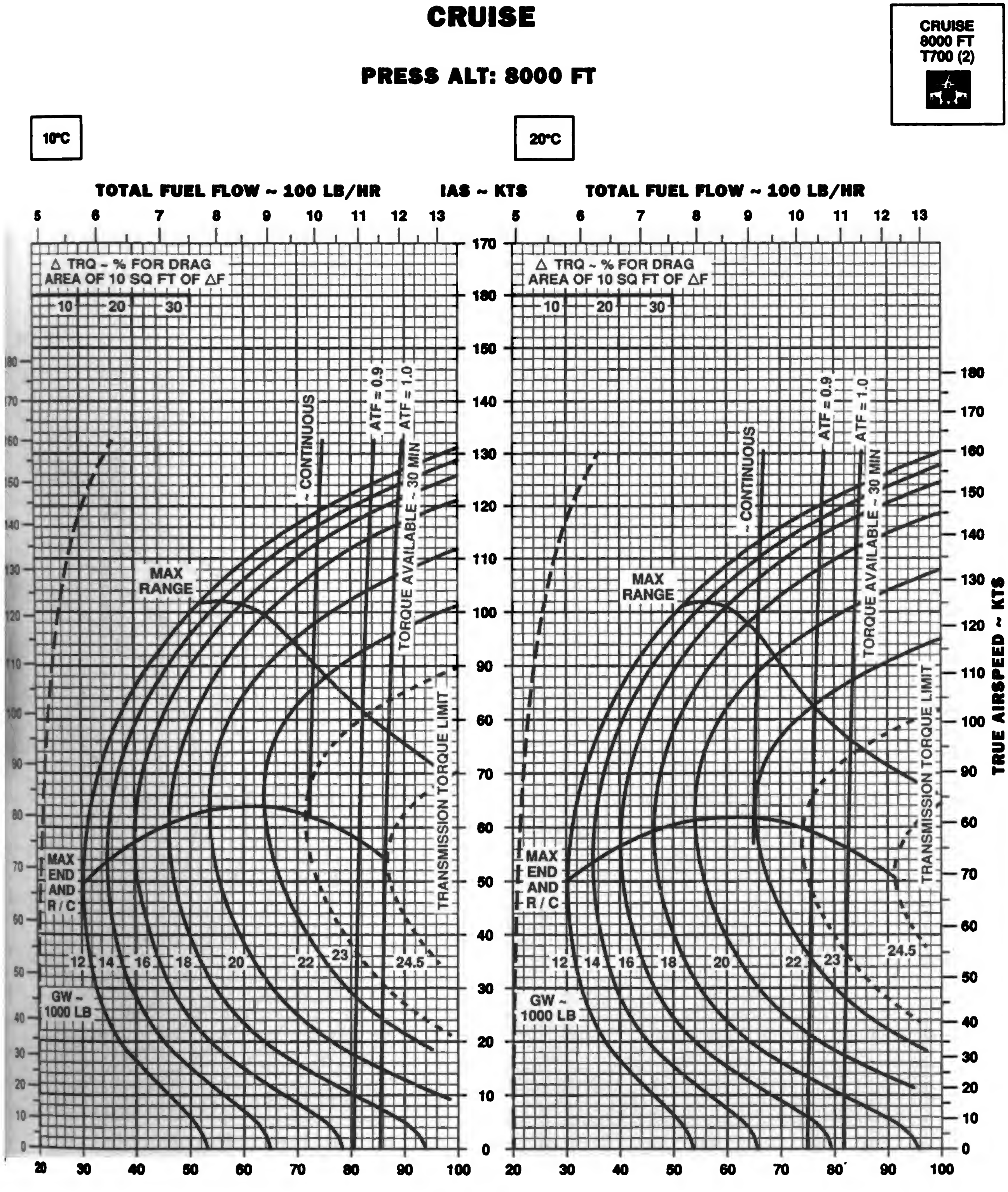
DATA BASE: FLIGHT TEST

AA0680

Figure 7-21. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 3 of 6)

CRUISE

PRESS ALT: 8000 FT



DATA BASE: FLIGHT TEST

AA0561 SA

Figure 7-21. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE 8000 FT T700 (2)

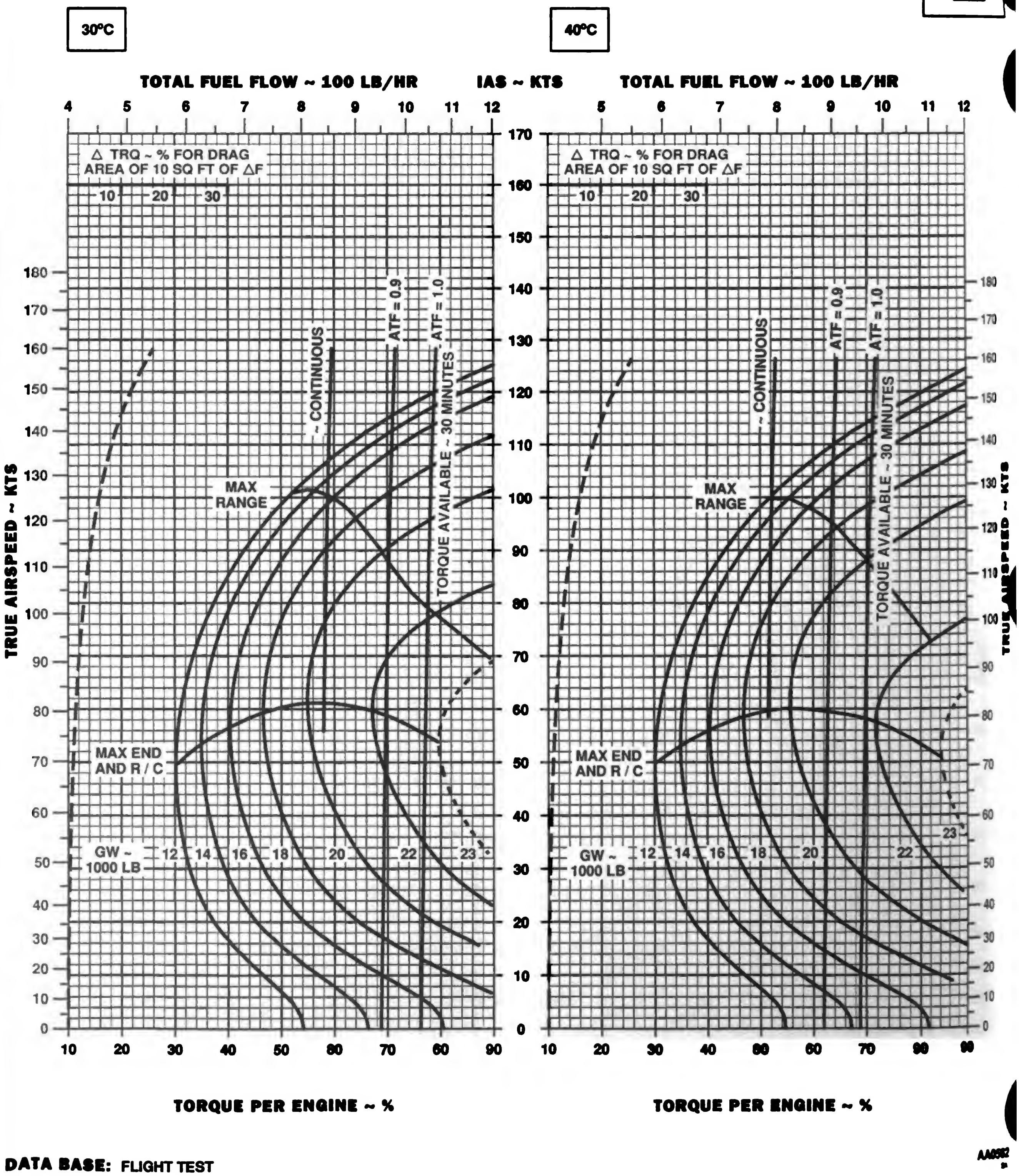


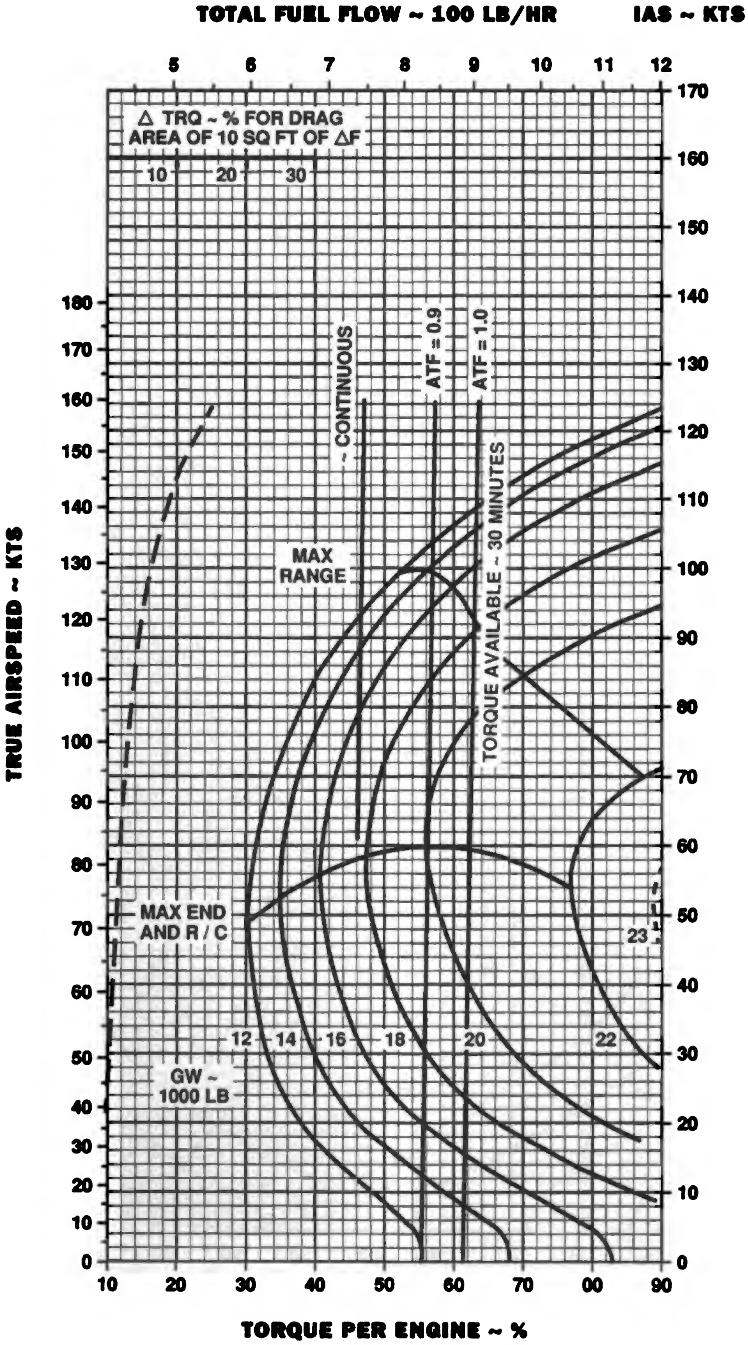
Figure 7-21. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 5 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE
8000 FT
T700 (2)

50°C



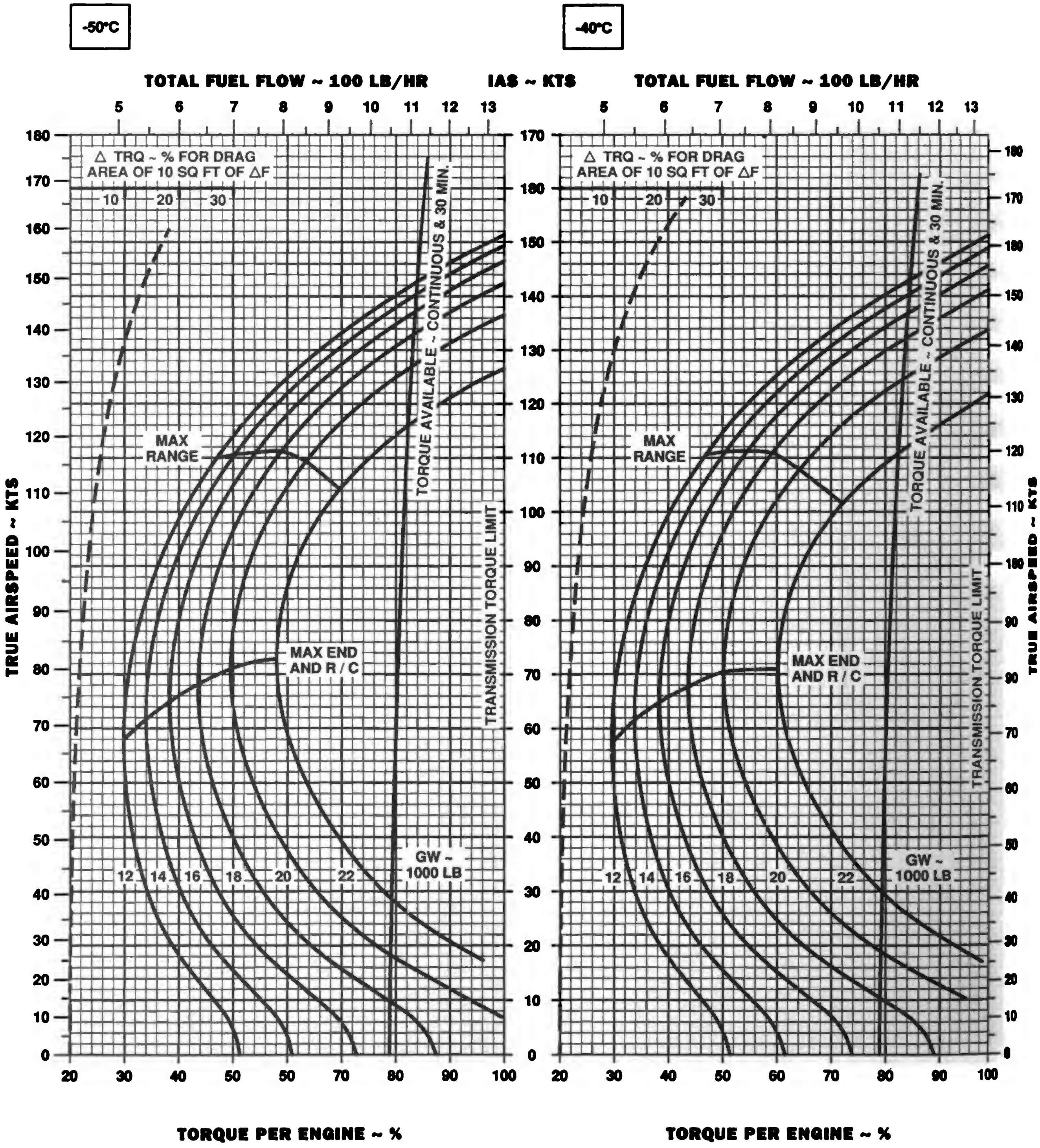
DATA BASE: FLIGHT TEST

AA0563

Figure 7-21. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 6 of 6)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 10000 FT

CRUISE
10000 FT
T700 (2)



DATA BASE: FLIGHT TEST

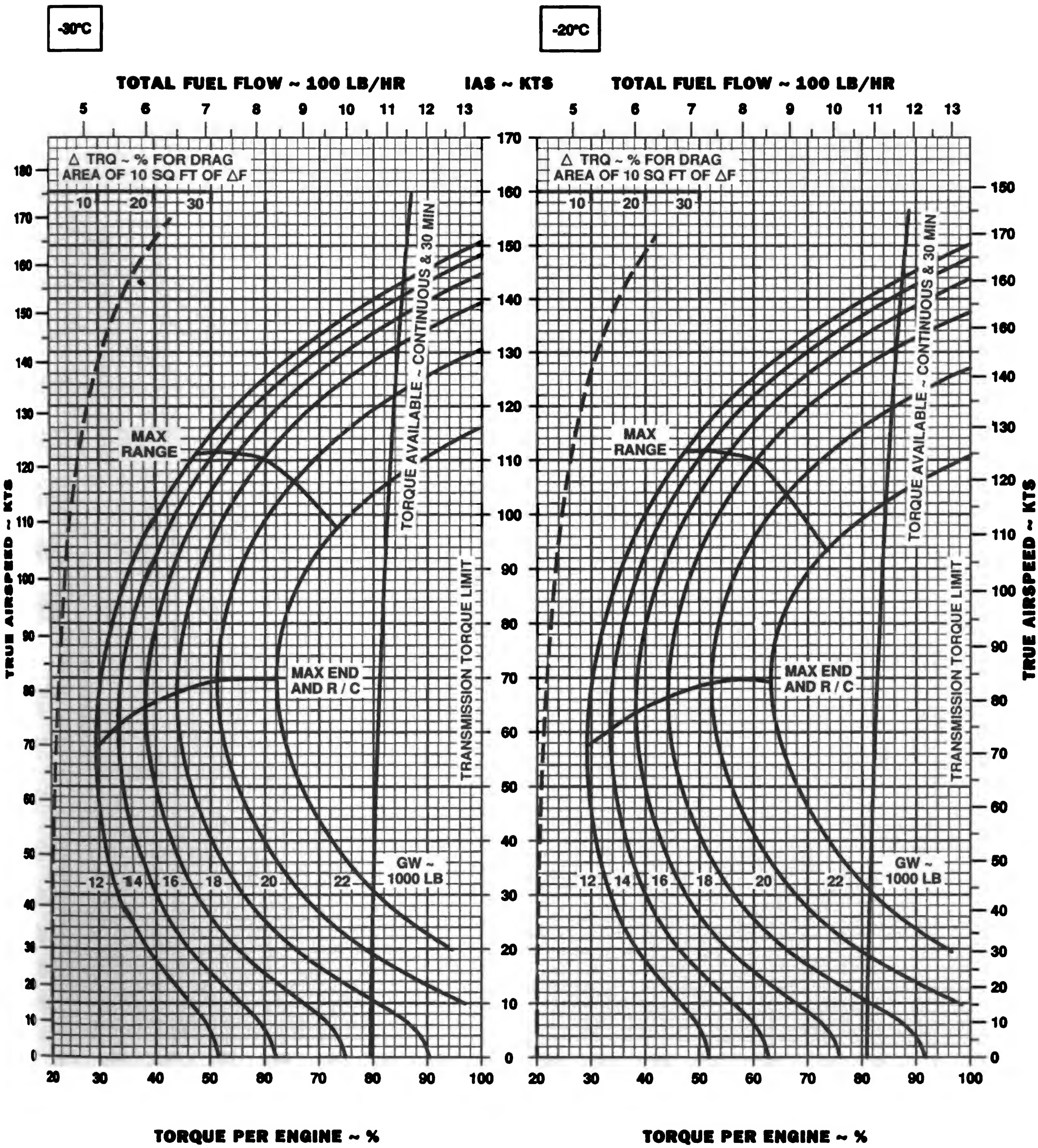
AA0420

Figure 7-22. Cruise - Pressure Altitude 10,000 Feet (Sheet 1 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 10000 FT

CRUISE
18000 FT
T700 (2)



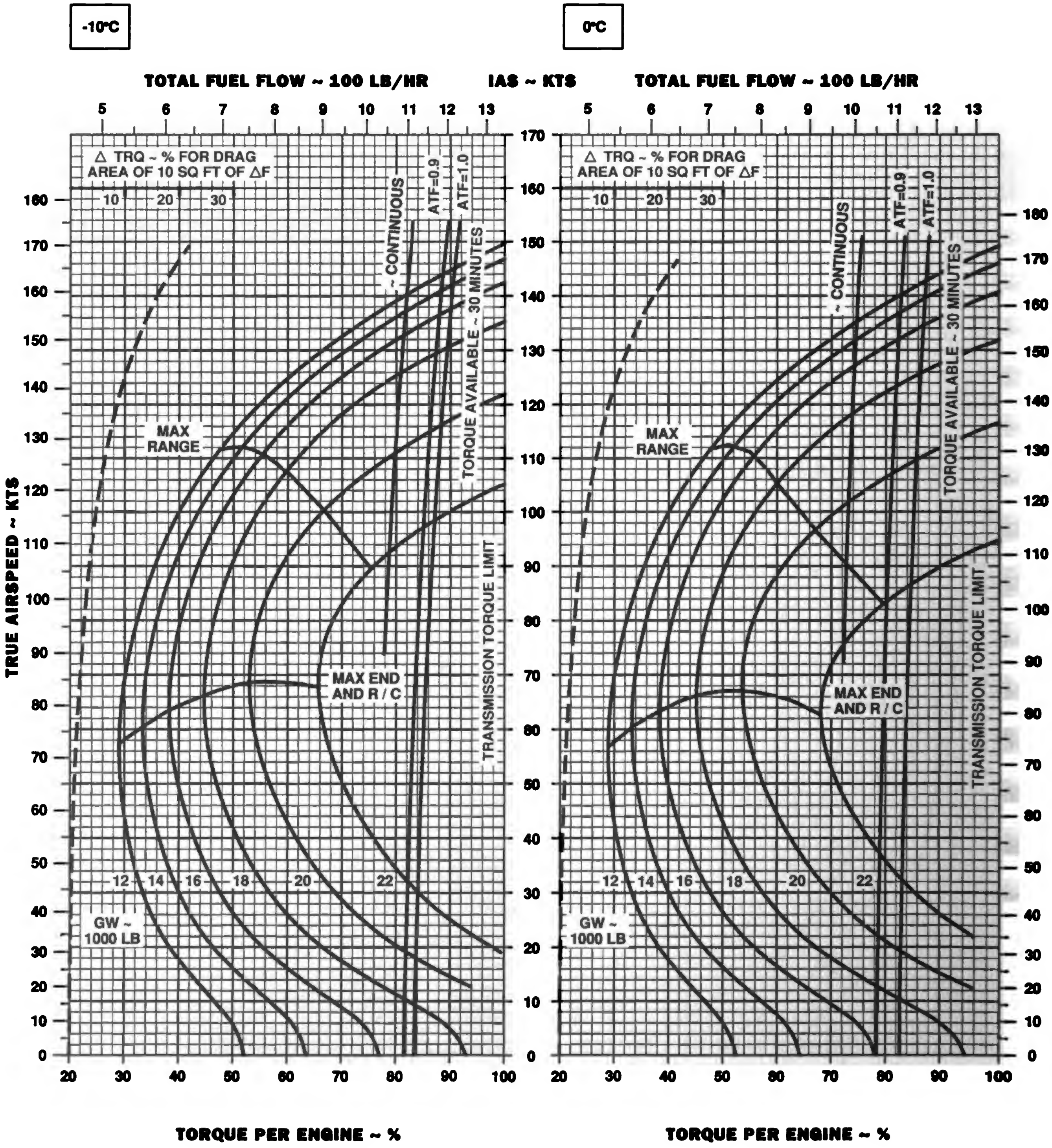
DATA BASE: FLIGHT TEST

AA0419
SA

Figure 7-22. Cruise - Pressure Altitude 10,000 Feet (Sheet 2 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 10000 FT

CRUISE
10000 FT
T700 (2)



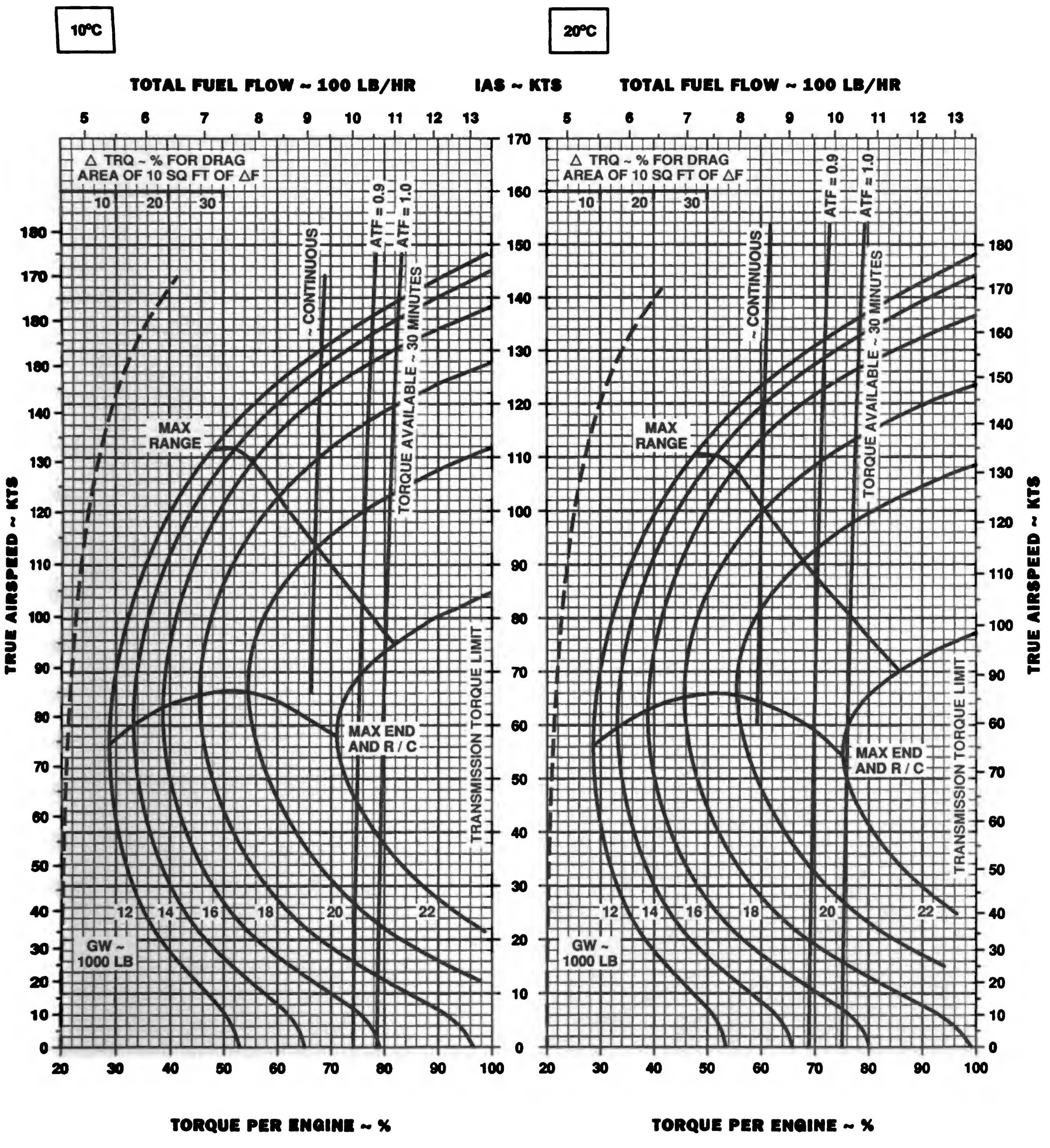
DATA BASE: FLIGHT TEST

AA0418
9A

Figure 7-22. Cruise - Pressure Altitude 10,000 Feet (Sheet 3 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 10000 FT



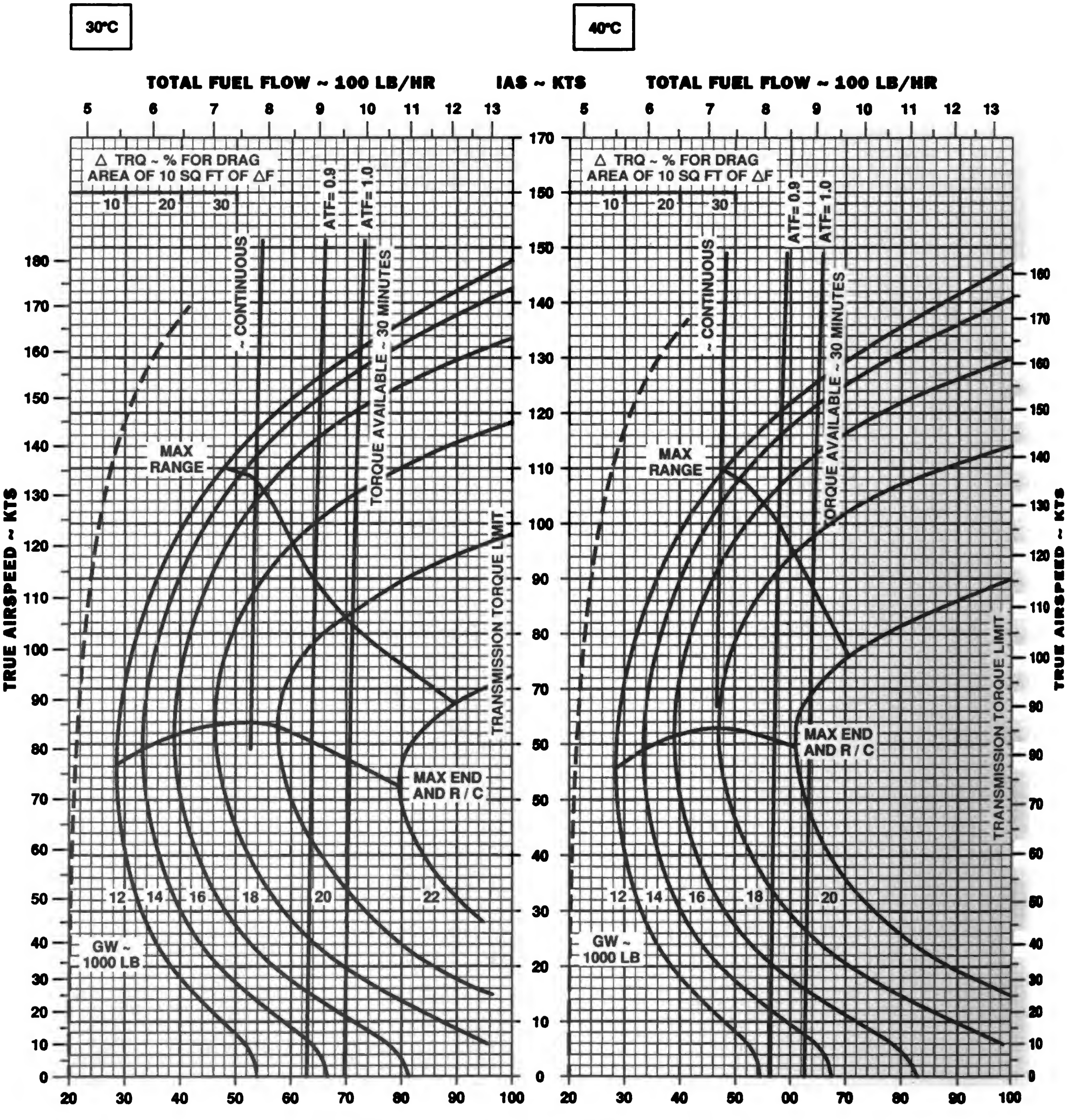
DATA BASE: FLIGHT TEST

AA0421
SA

Figure 7-22. Cruise - Pressure Altitude 10,000 Feet (Sheet 4 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 10000 FT

CRUISE
10000 FT
T700 (2)



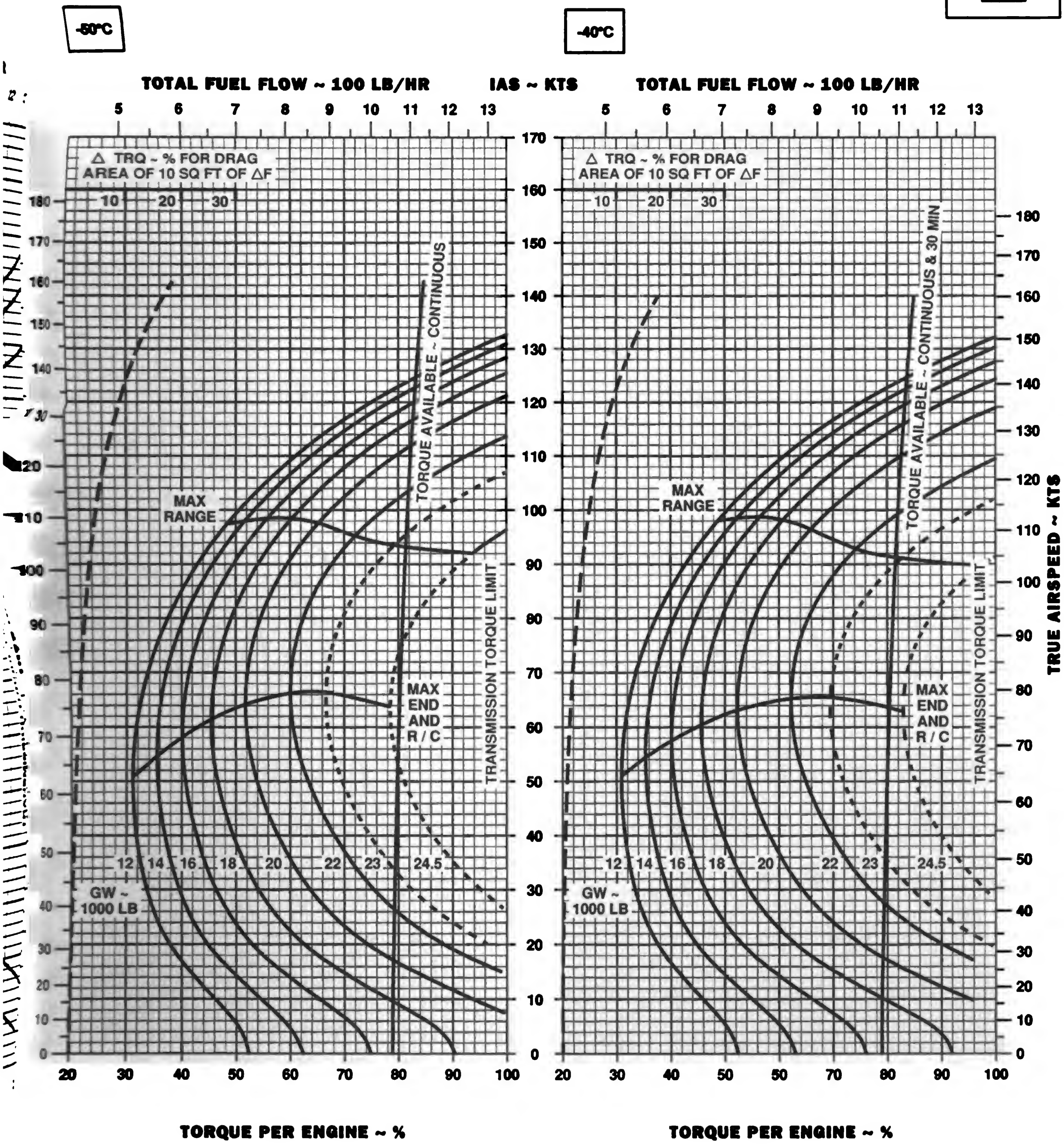
DATA BASE: FLIGHT TEST

Figure 7-22. Cruise - Pressure Altitude 10,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T700 (2)



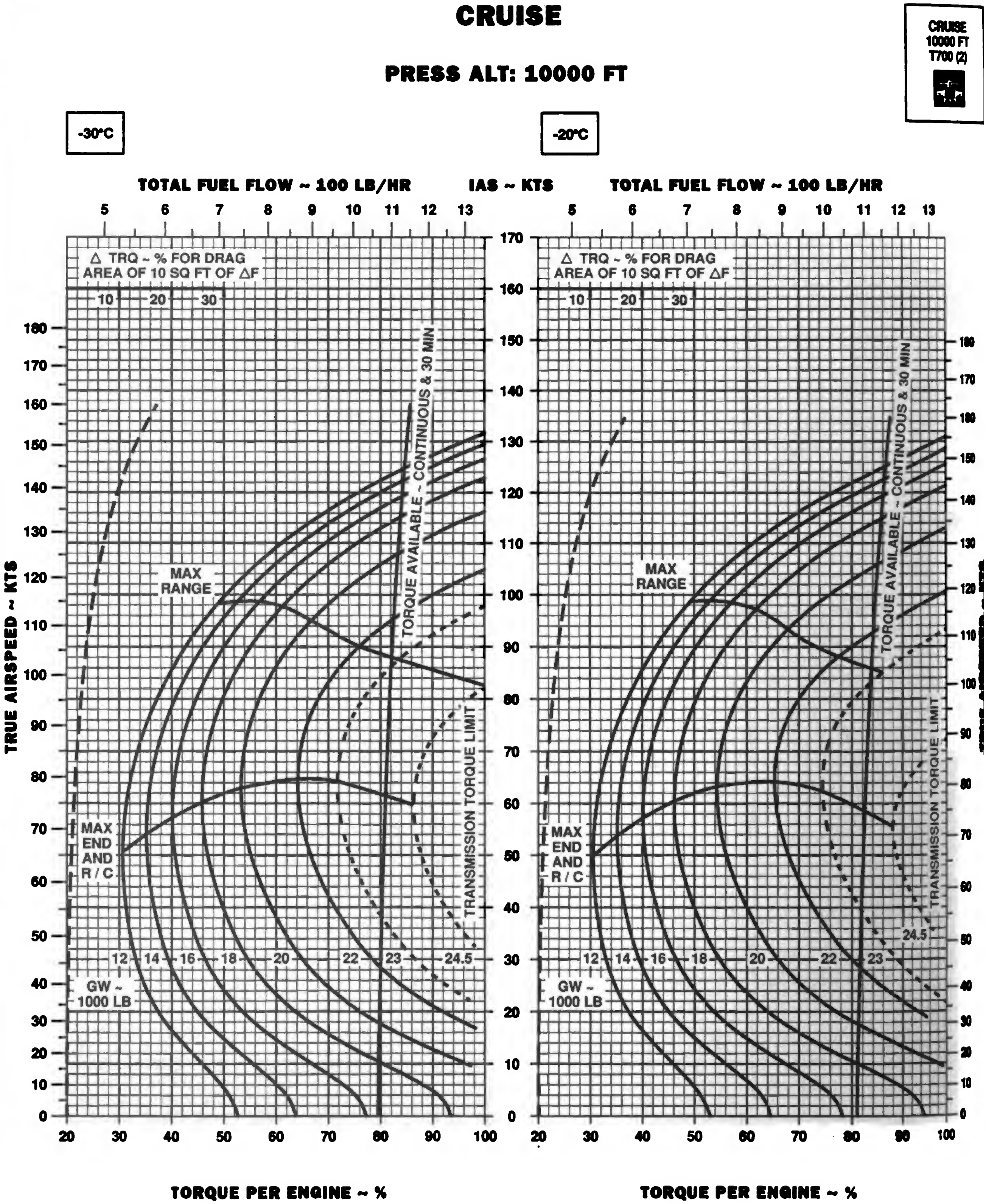
DATA BASE: FLIGHT TEST

AA0564
8A

Figure 7-23. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 1 of 5)

CRUISE

PRESS ALT: 10000 FT



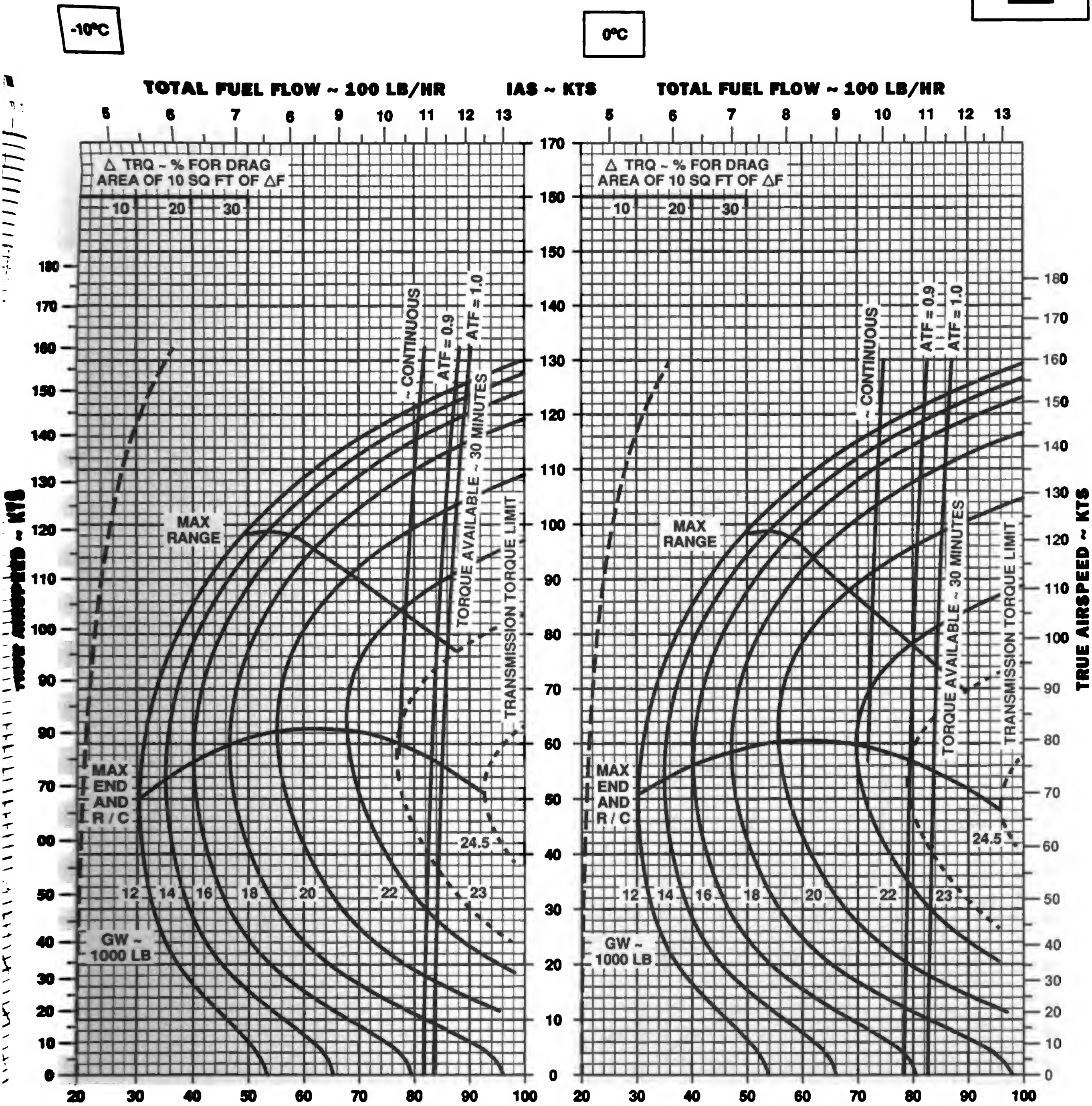
DATA BASE: FLIGHT TEST

Figure 7-23. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 2 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T700 (2)



DATA BASE: FLIGHT TEST

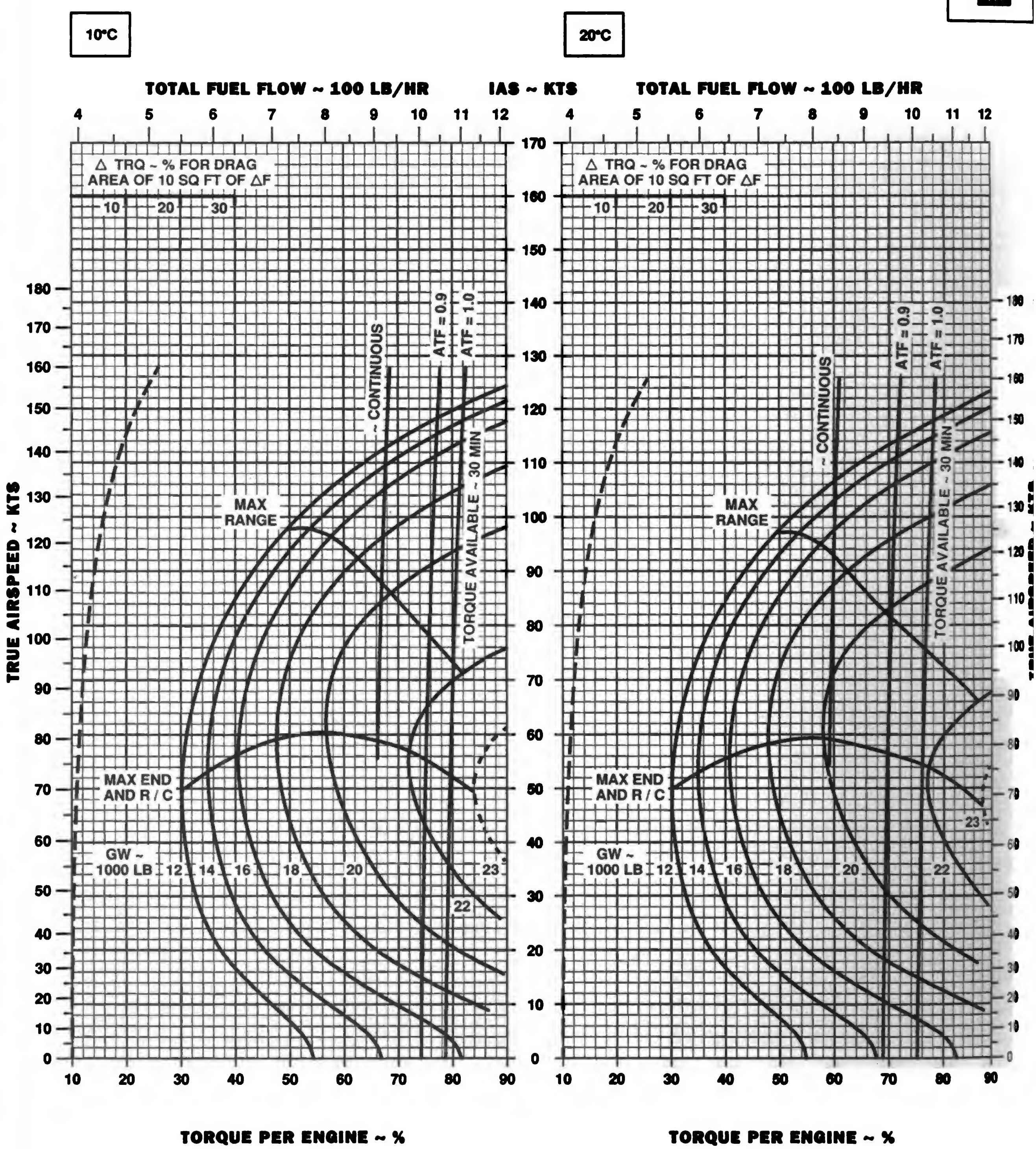
AA0566
SA

Figure 7-23. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 3 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T700 (2)



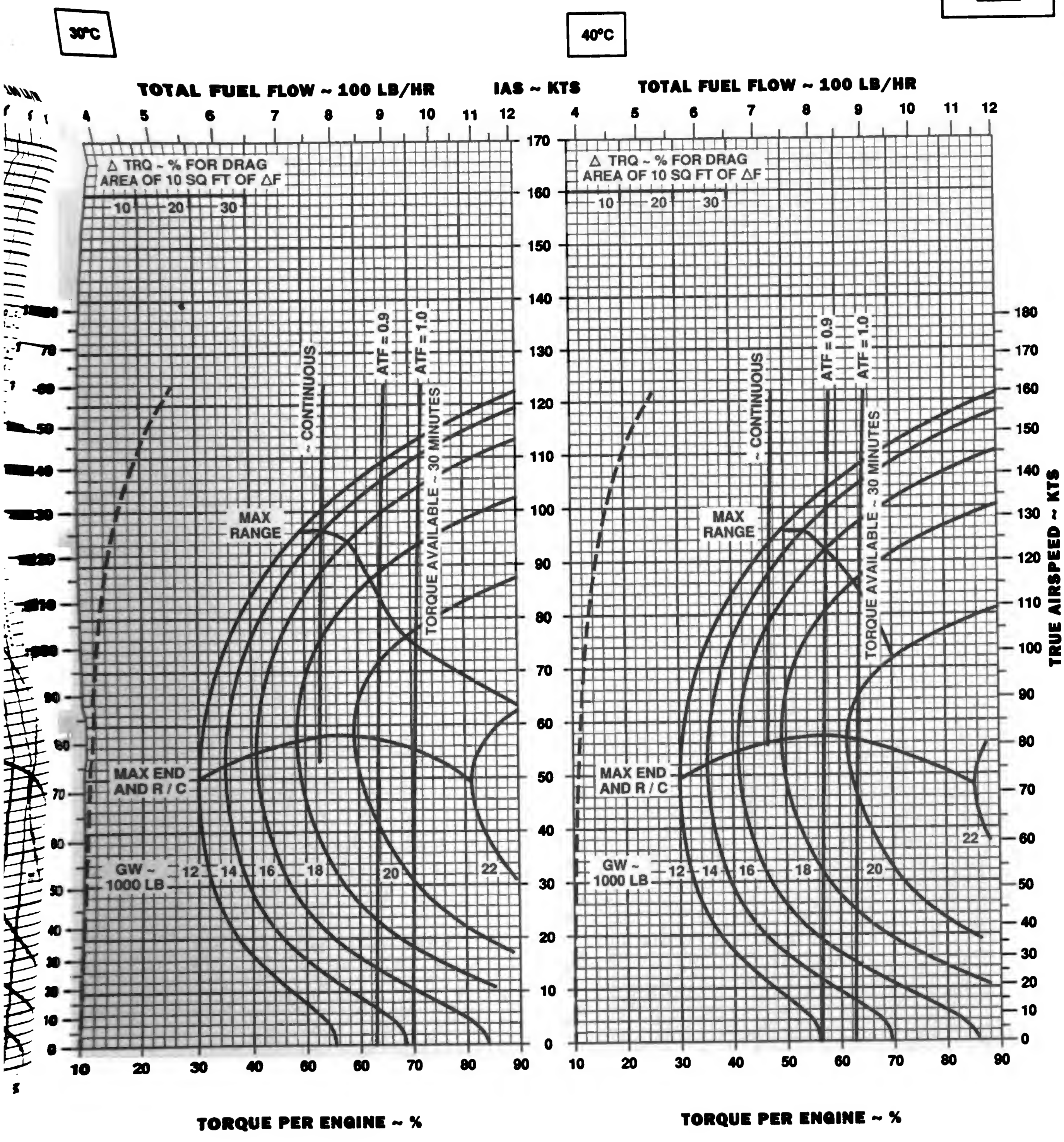
DATA BASE: FLIGHT TEST

Figure 7-23. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 4 of 5)

CRUISE
10000 FT
T700 (2)

CRUISE

PRESS ALT: 10000 FT



AA0568
SA

DATA BASE: FLIGHT TEST

Figure 7-23. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 5 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)

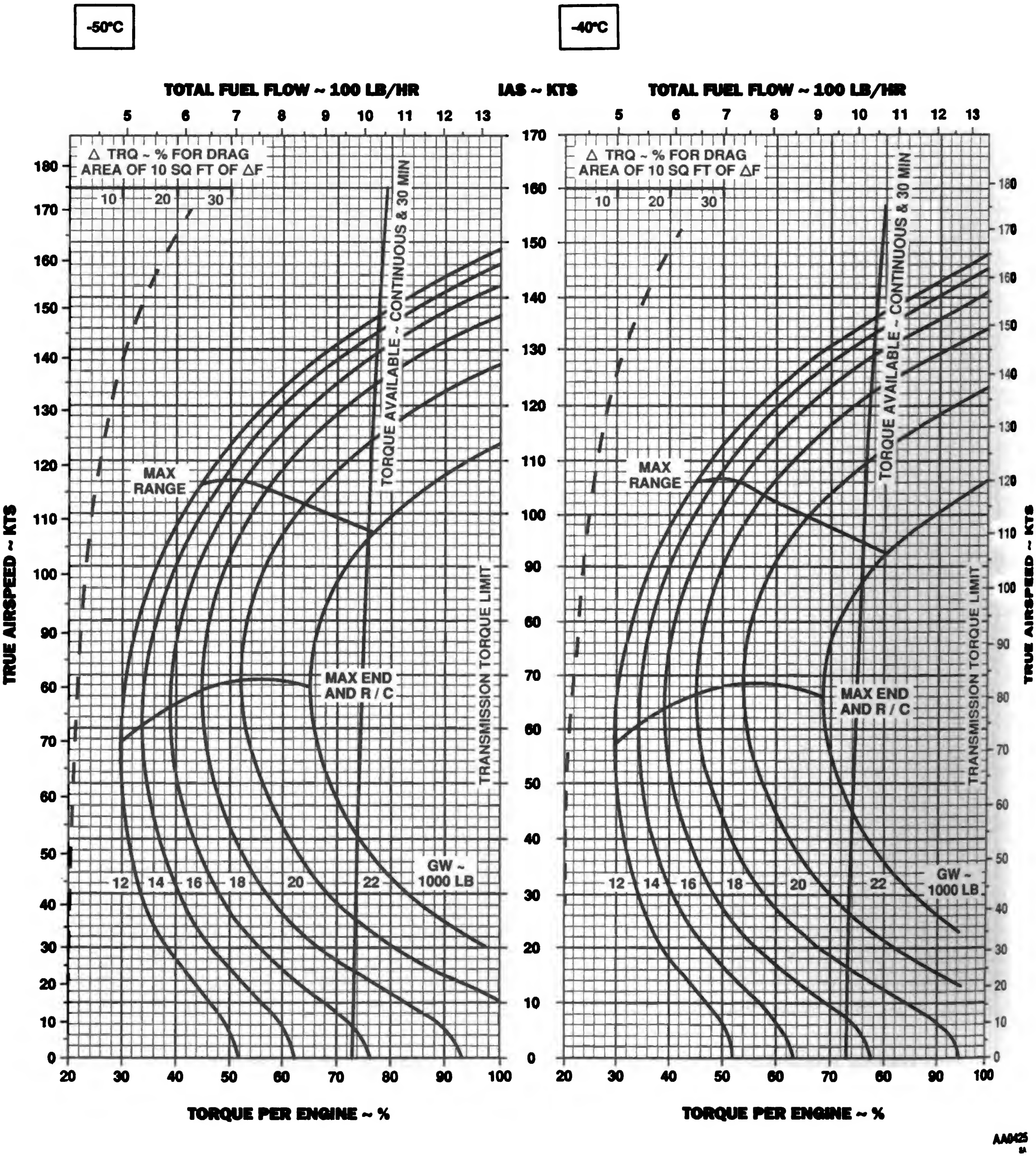
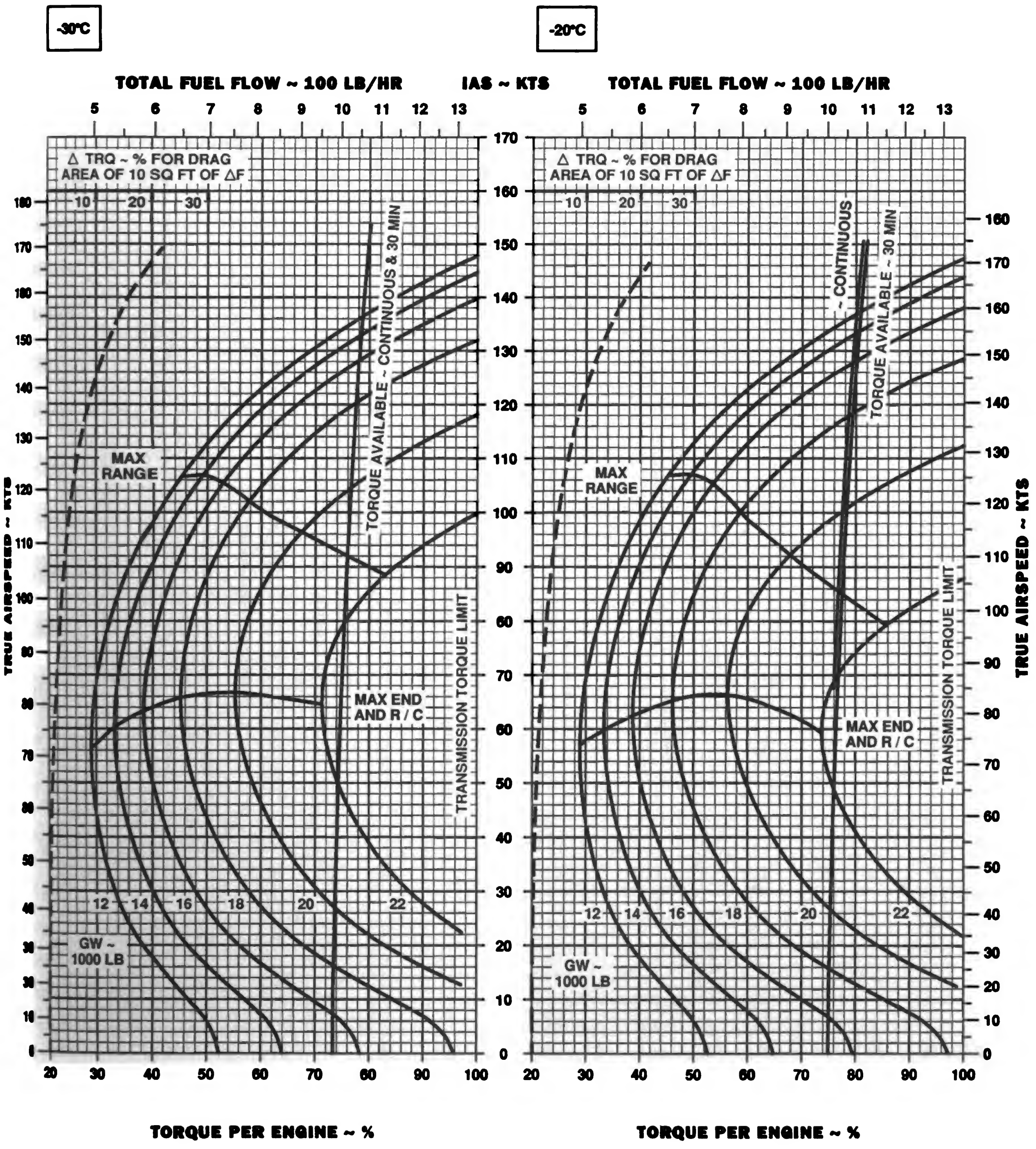


Figure 7-24. Cruise - Pressure Altitude 12,000 Feet (Sheet 1 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)



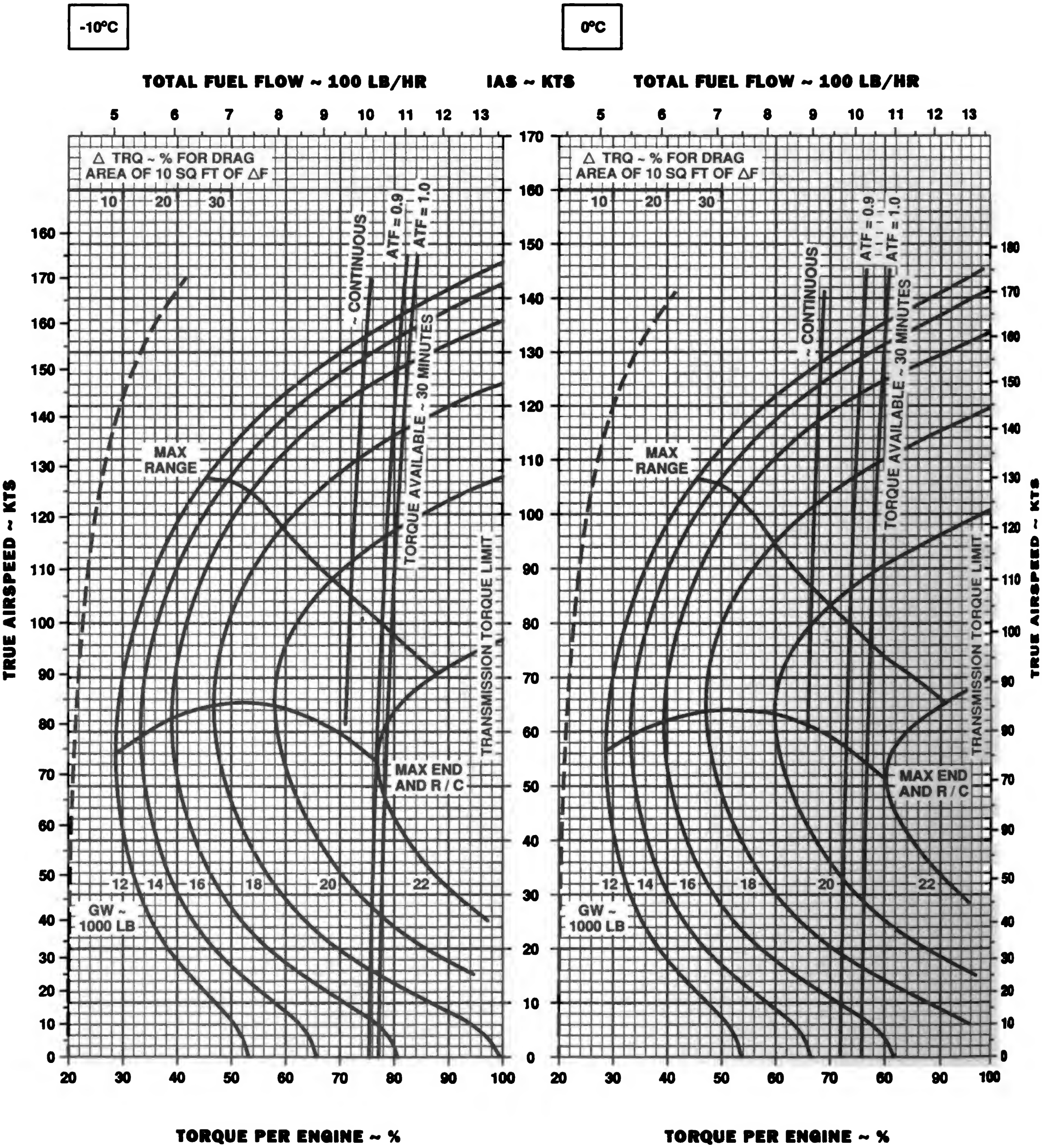
DATA BASE: FLIGHT TEST

AA0424
8A

Figure 7-24. Cruise - Pressure Altitude 12,000 Feet (Sheet 2 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)



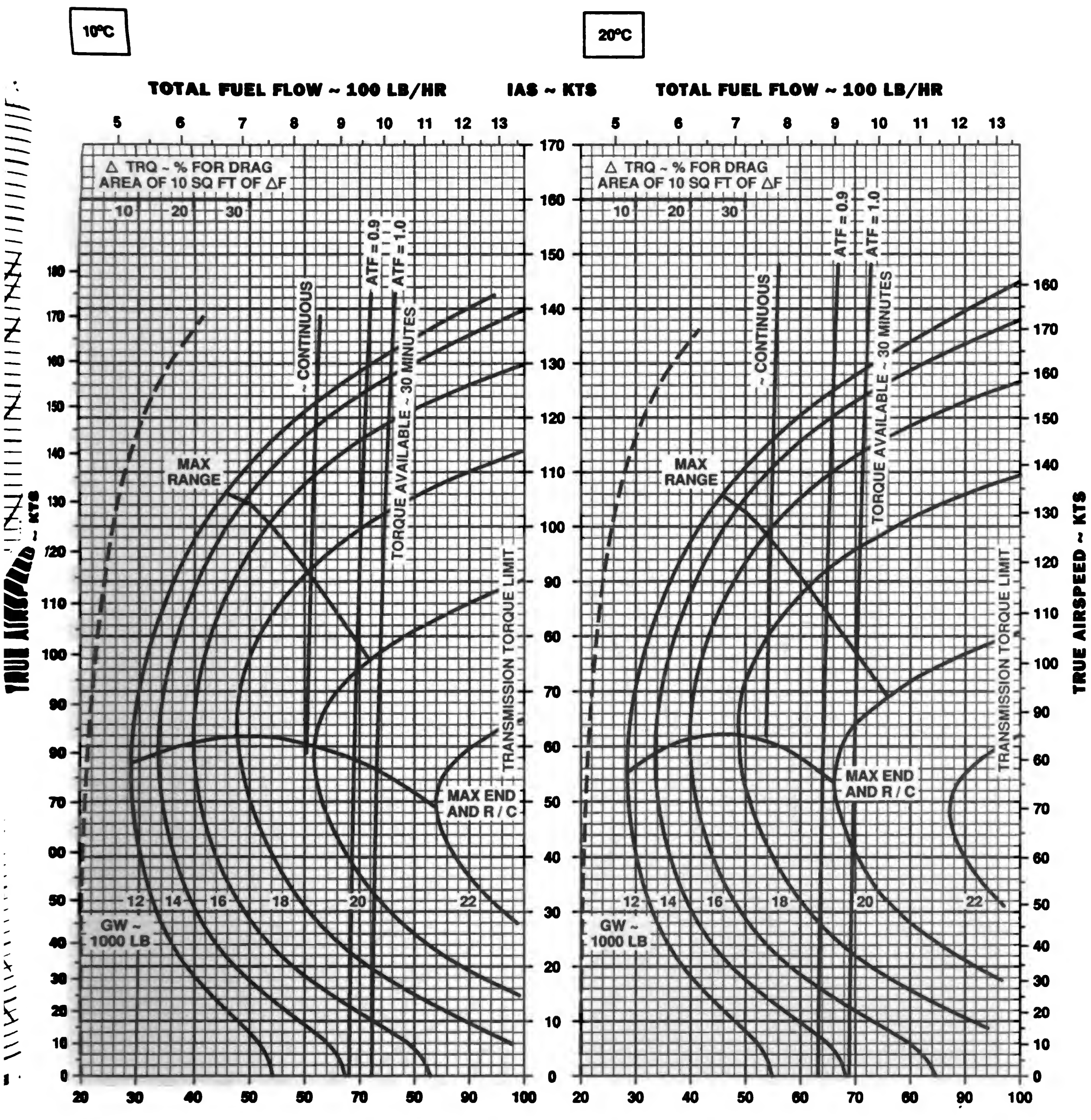
DATA BASE: FLIGHT TEST

AA0423

Figure 7-24. Cruise - Pressure Altitude 12,000 Feet (Sheet 3 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)



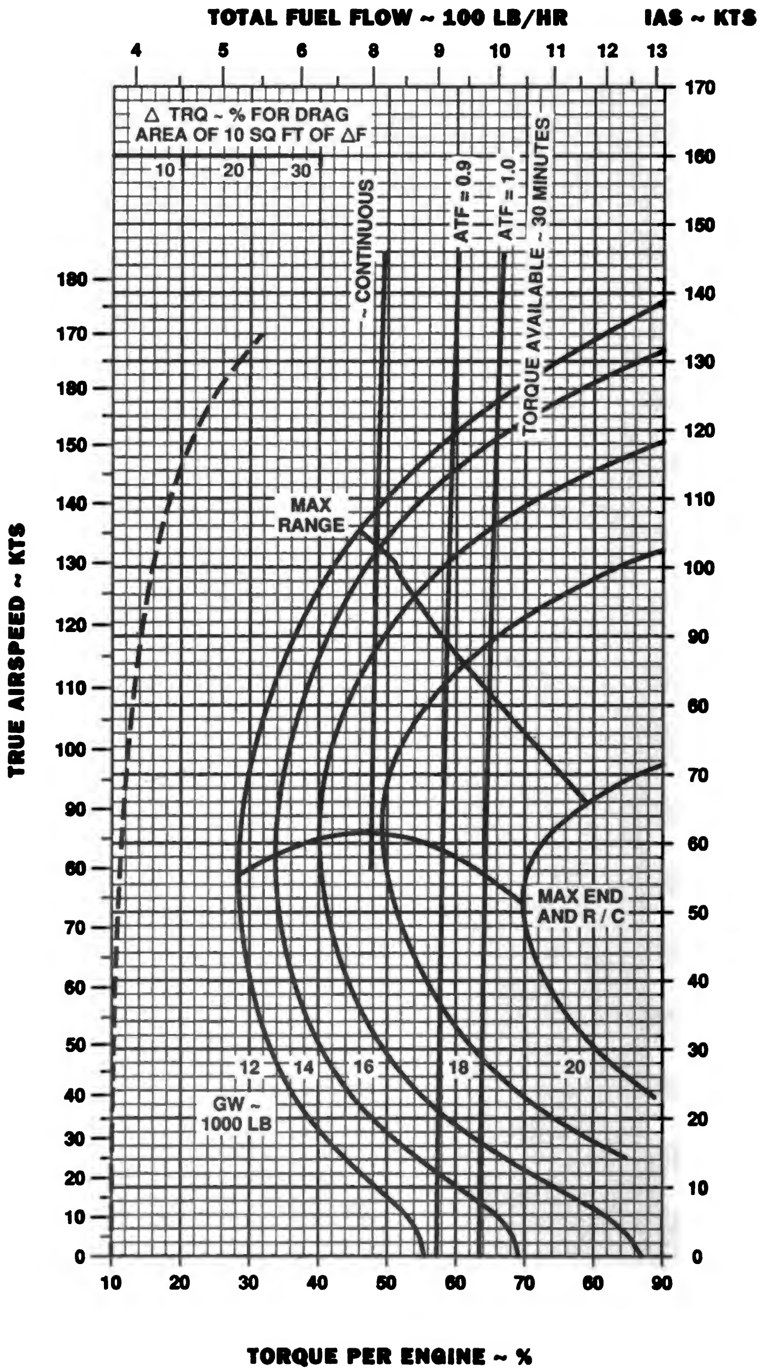
DATA BASE: FLIGHT TEST

AA0426
SA

Figure 7-24. Cruise - Pressure Altitude 12,000 Feet (Sheet 4 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 12000 FT

30°C



DATA BASE: FLIGHT TEST

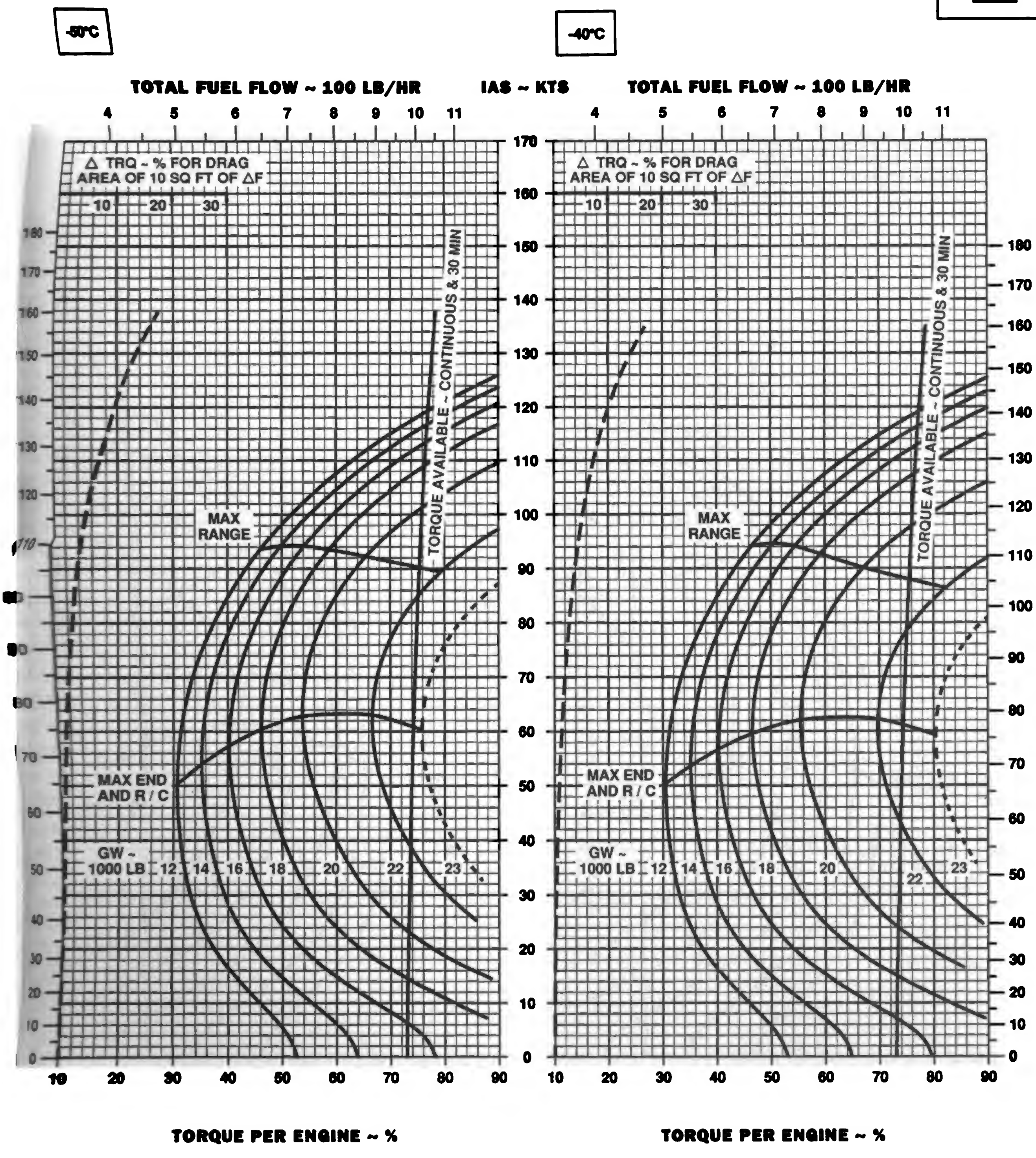
AA0427

Figure 7-24. Cruise - Pressure Altitude 12,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)



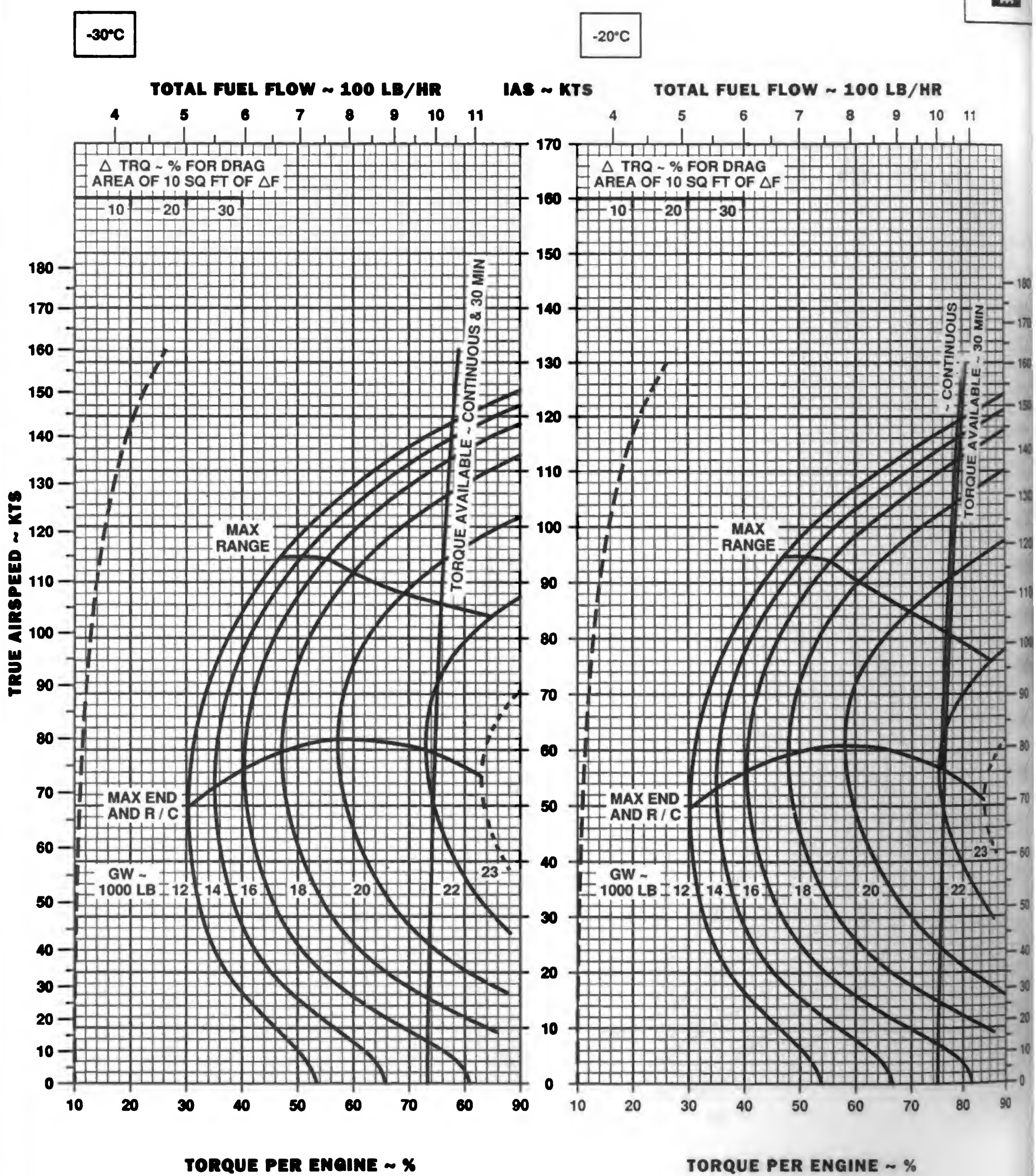
DATA BASE: FLIGHT TEST

AA0569
8A

Figure 7-25. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 1 of 5)

CRUISE

PRESS ALT: 12000 FT



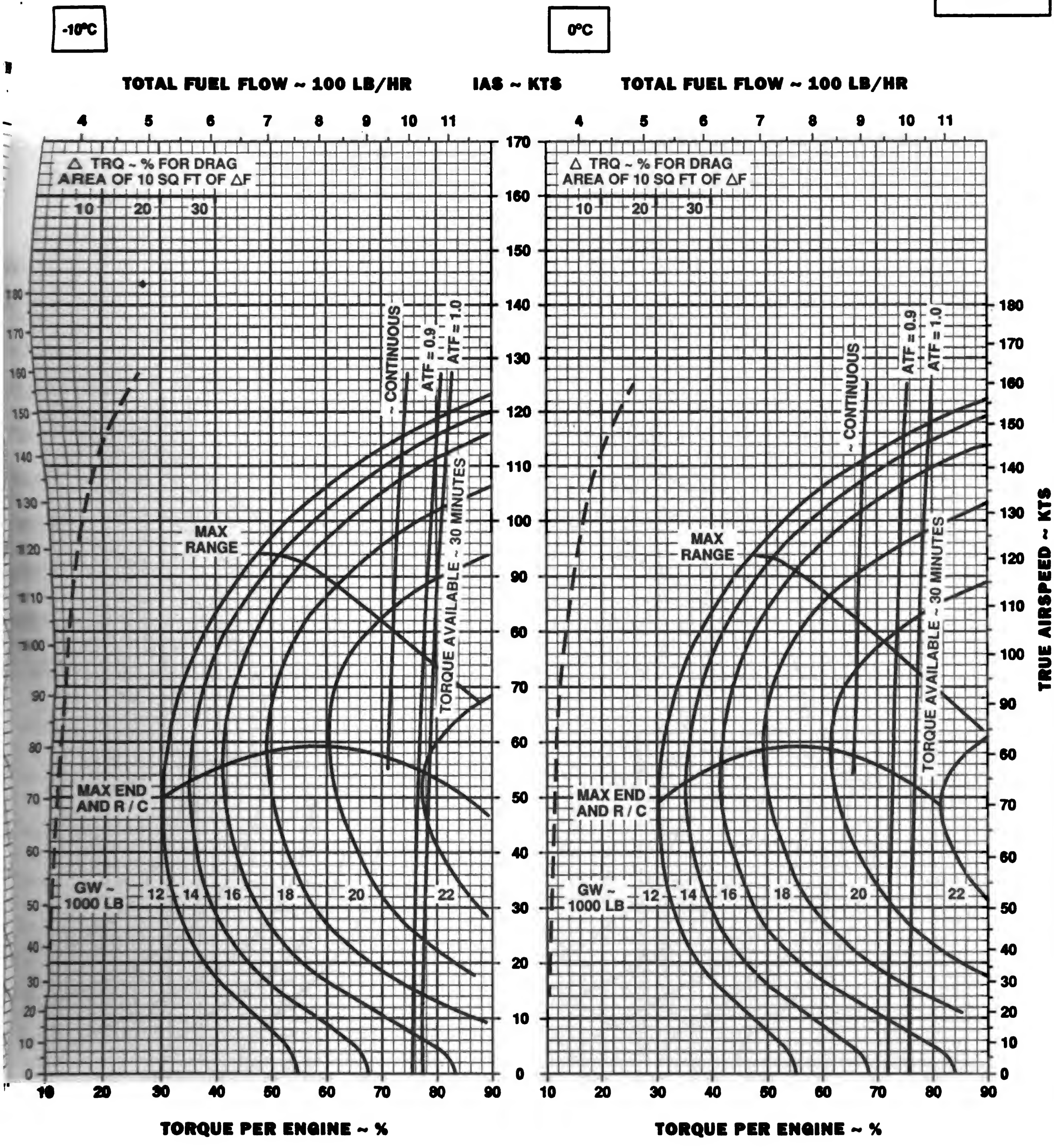
DATA BASE: FLIGHT TEST

Figure 7-25. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 2 of 5)

CRUISE

PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)



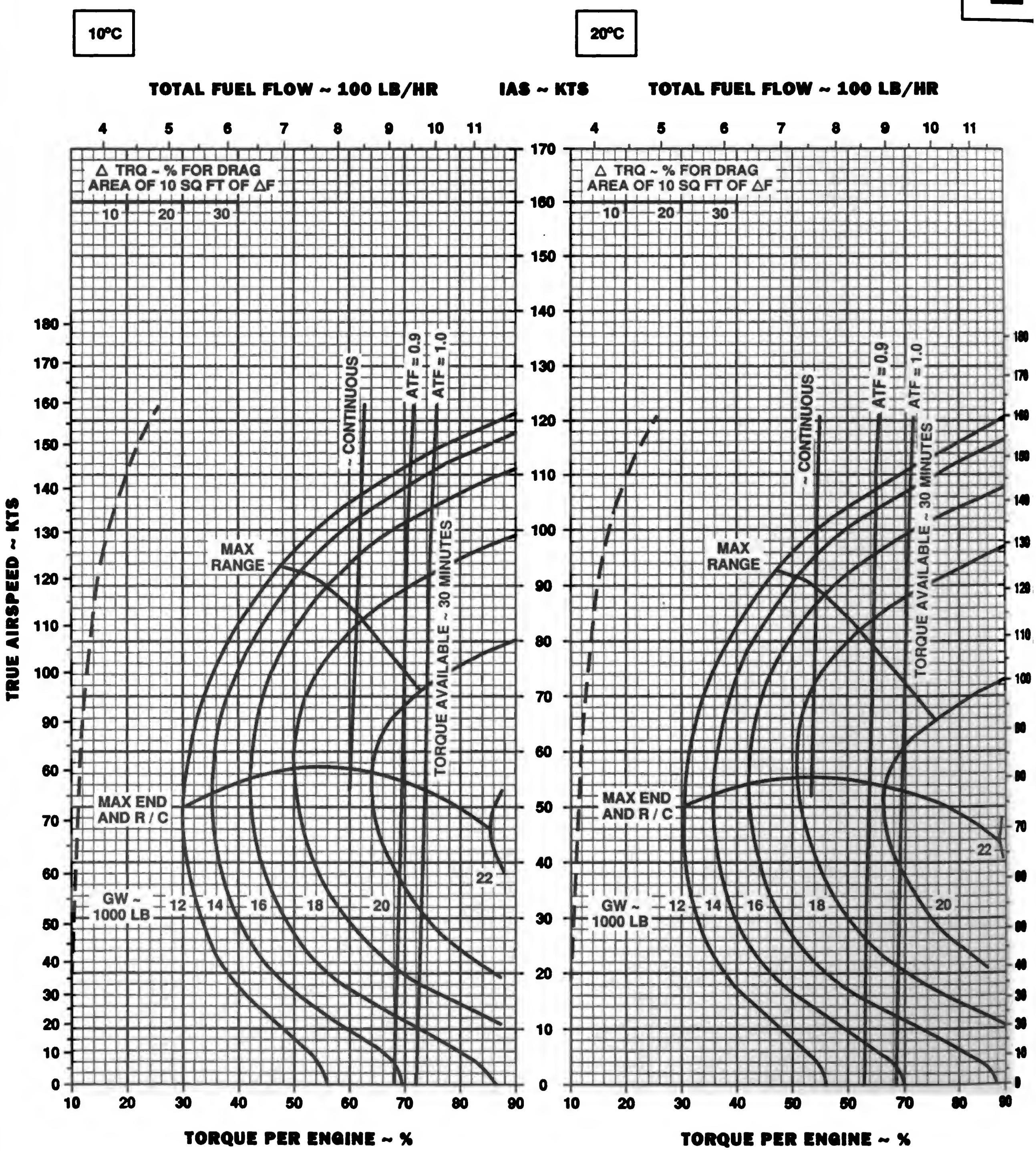
ATA BASE: FLIGHT TEST

AA0571
8A

Figure 7-25. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 3 of 5)

CRUISE

PRESS ALT: 12000 FT



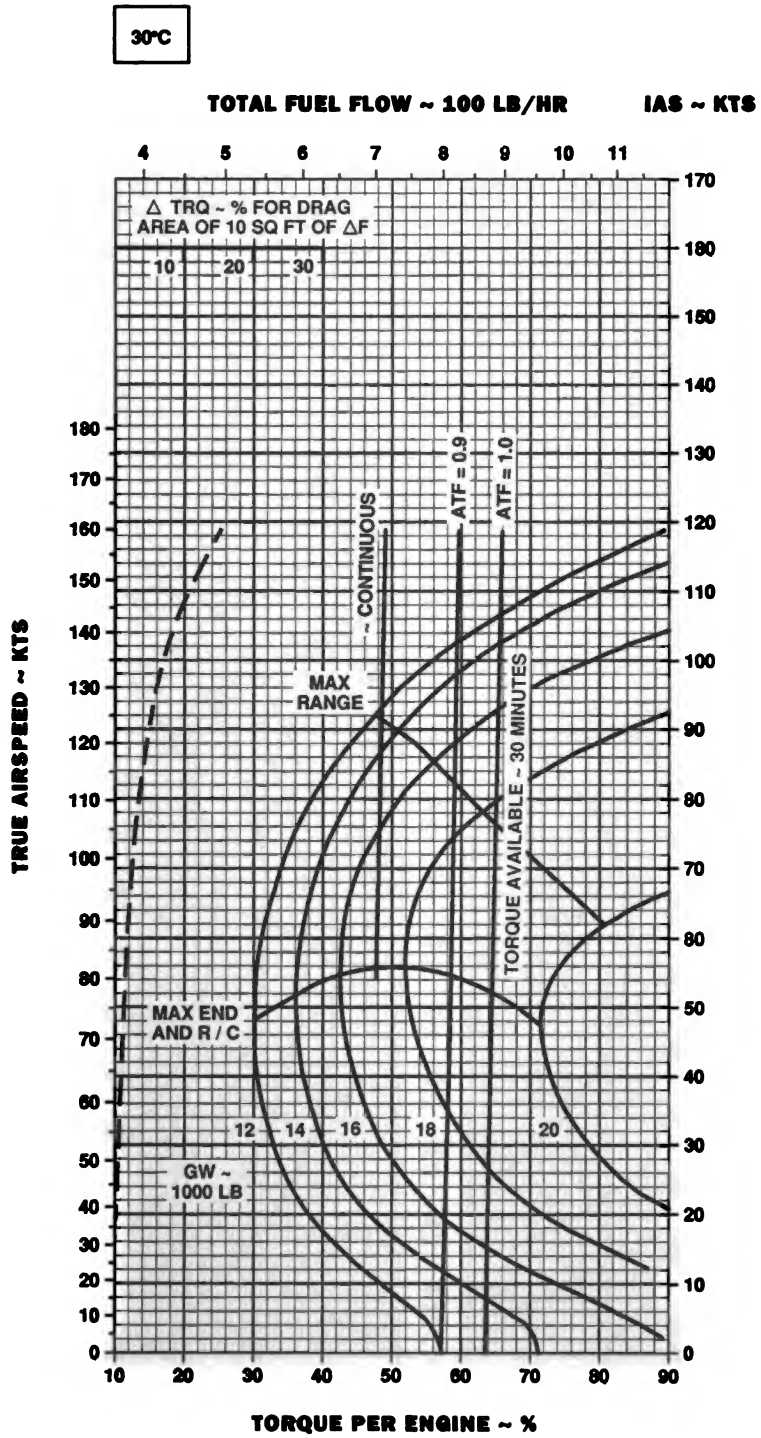
DATA BASE: FLIGHT TEST

Figure 7-25. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 4 of 5)

CRUISE

PRESS ALT: 12000 FT

CRUISE
12000 FT
T700 (2)



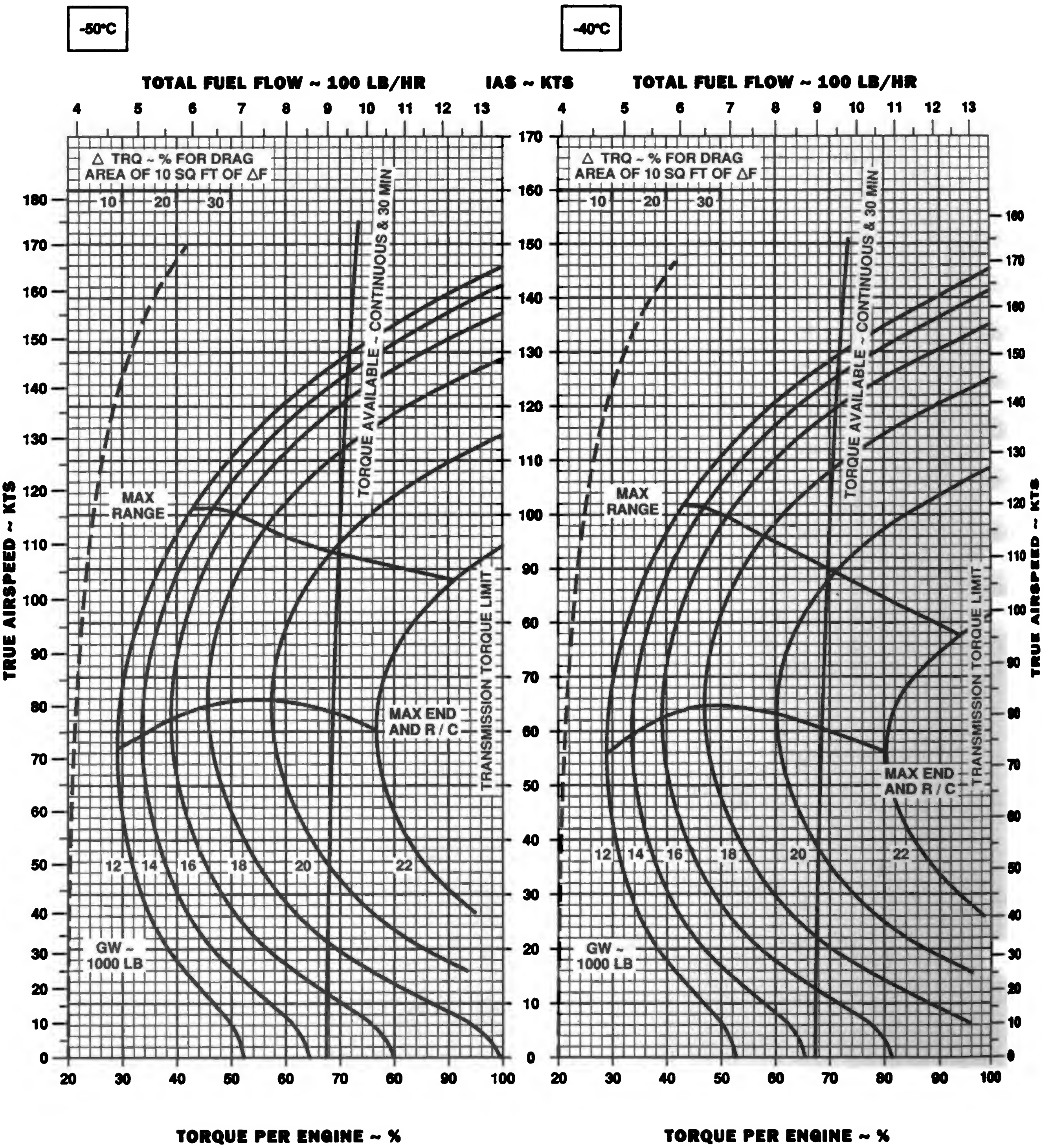
DATA BASE: FLIGHT TEST

AA0573
8A

Figure 7-25. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 5 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0430

Figure 7-26. Cruise - Pressure Altitude 14,000 Feet (Sheet 1 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)

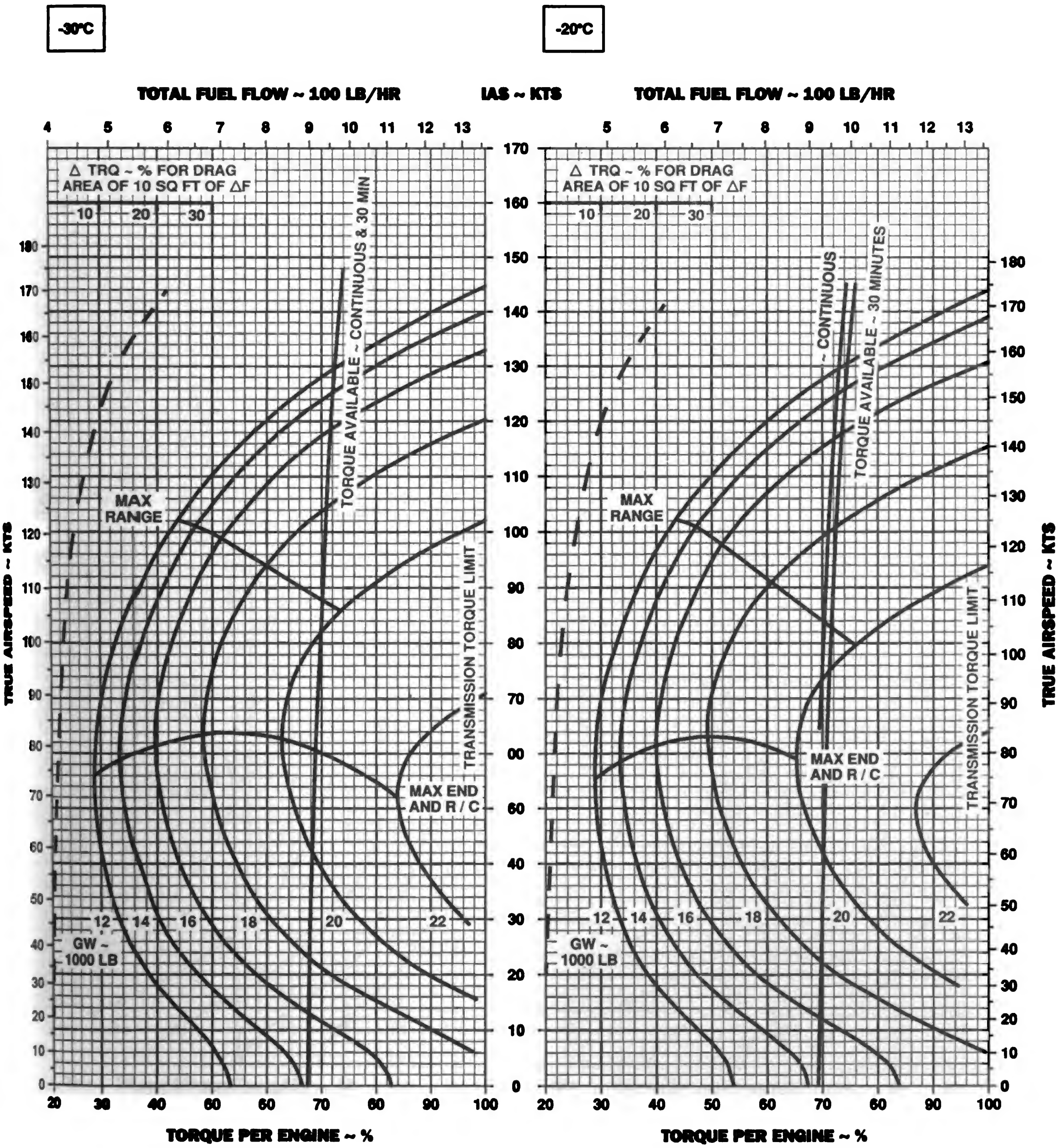


Figure 7-26. Cruise - Pressure Altitude 14,000 Feet (Sheet 2 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)

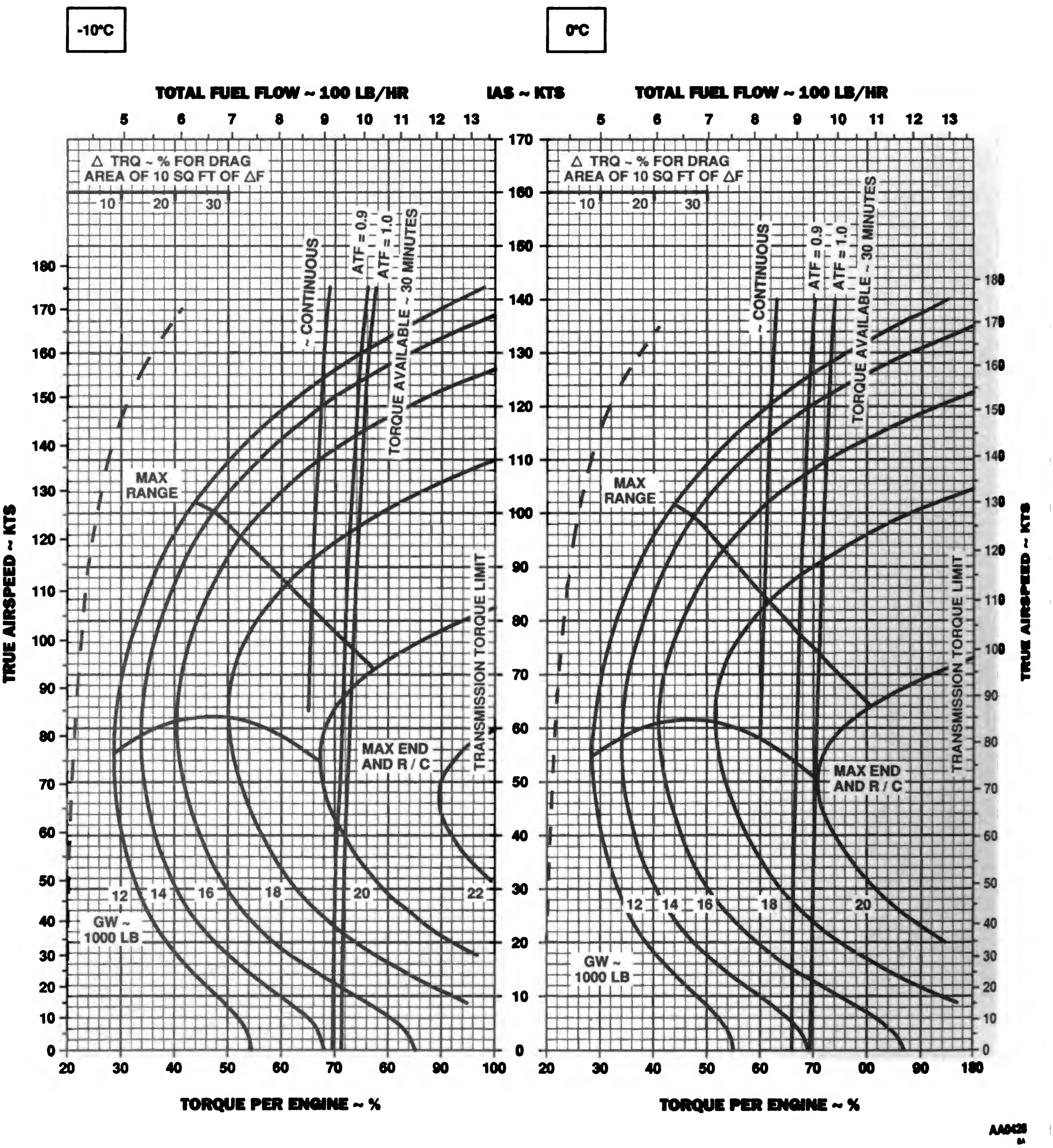
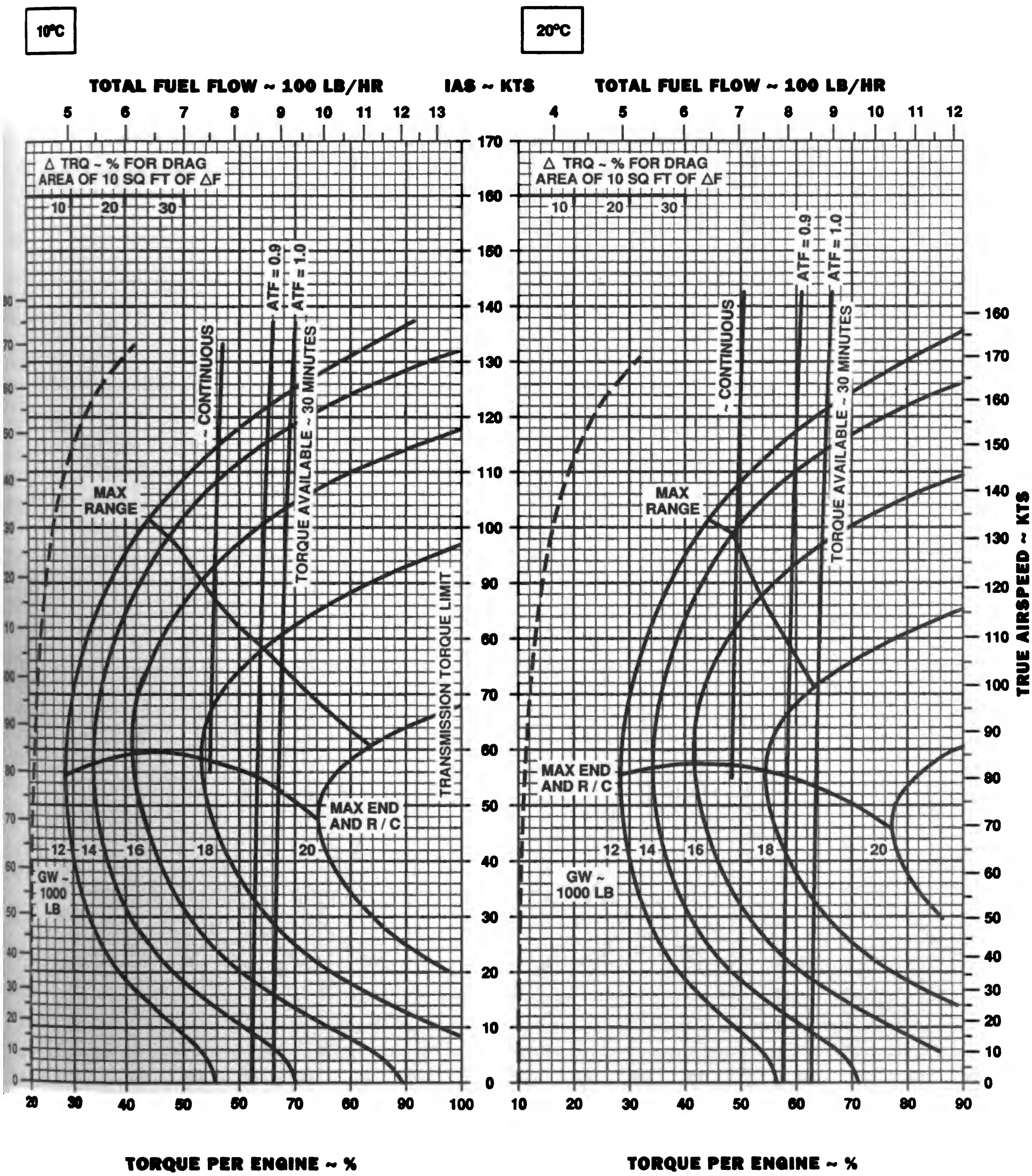


Figure 7-26. Cruise - Pressure Altitude 14,000 Feet (Sheet 3 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)



DATA BASE: FLIGHT TEST

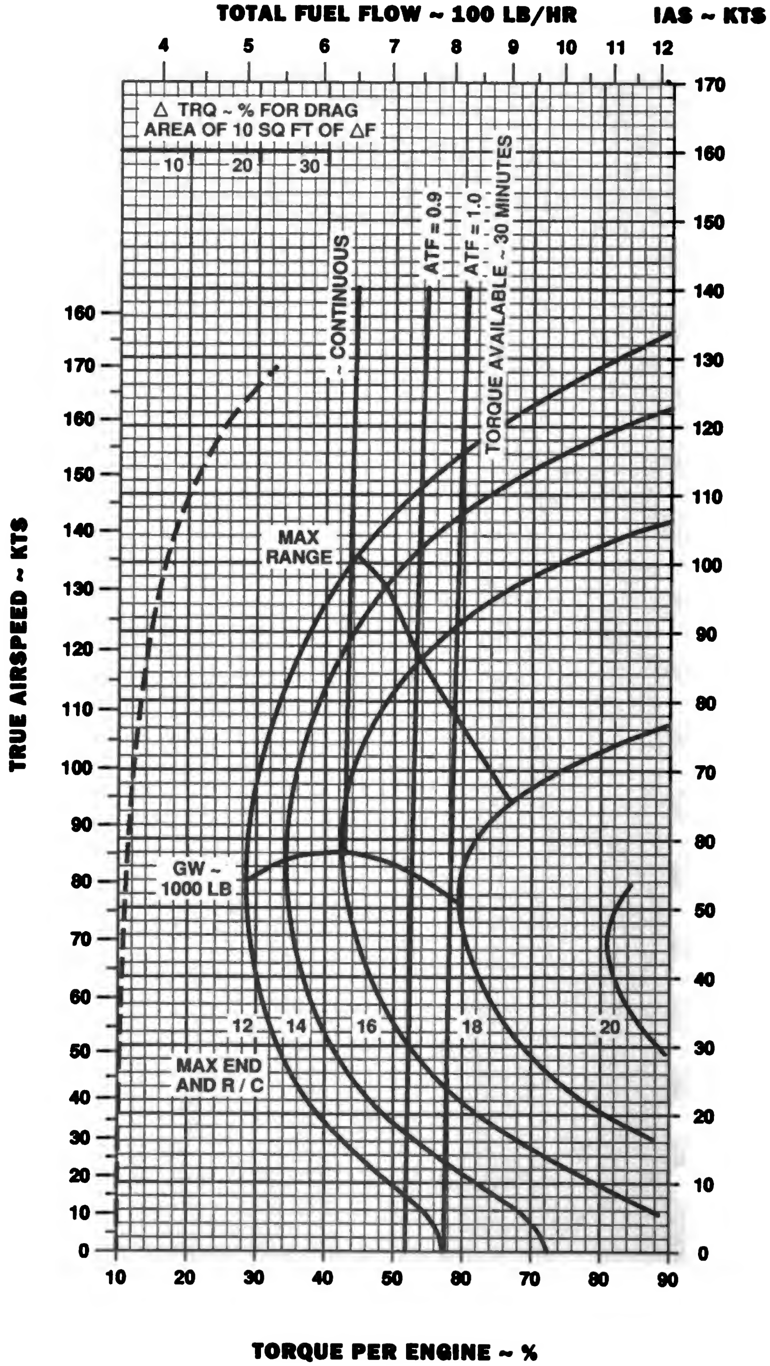
AA0431
8A

Figure 7-26. Cruise - Pressure Altitude 14,000 Feet (Sheet 4 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 14000 FT

CRUISE 14000 FT T700 (2)

30°C



DATA BASE: FLIGHT TEST

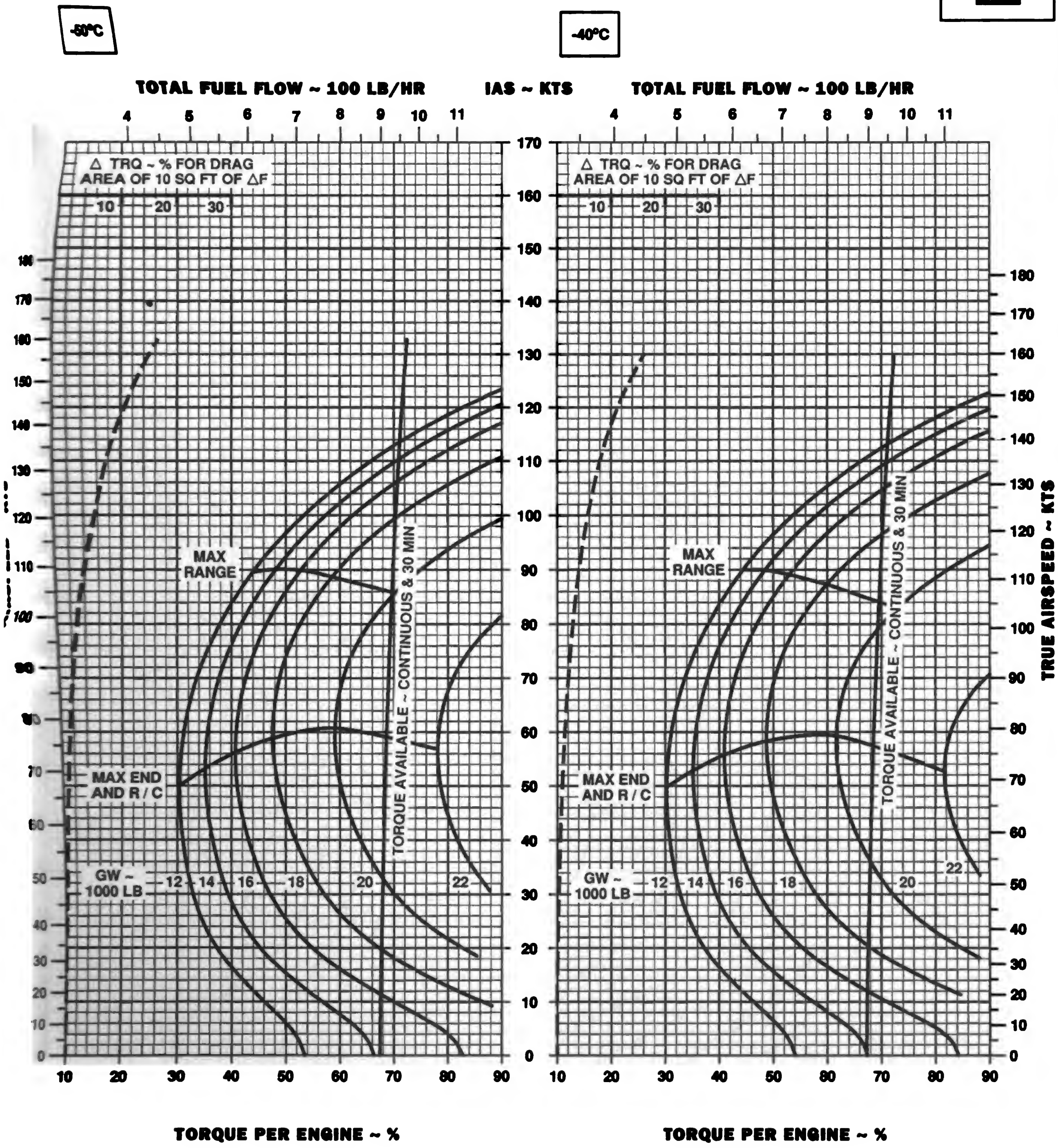
AA0432

Figure 7-26. Cruise - Pressure Altitude 14,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)



DATA BASE: *FLIGHT TEST*

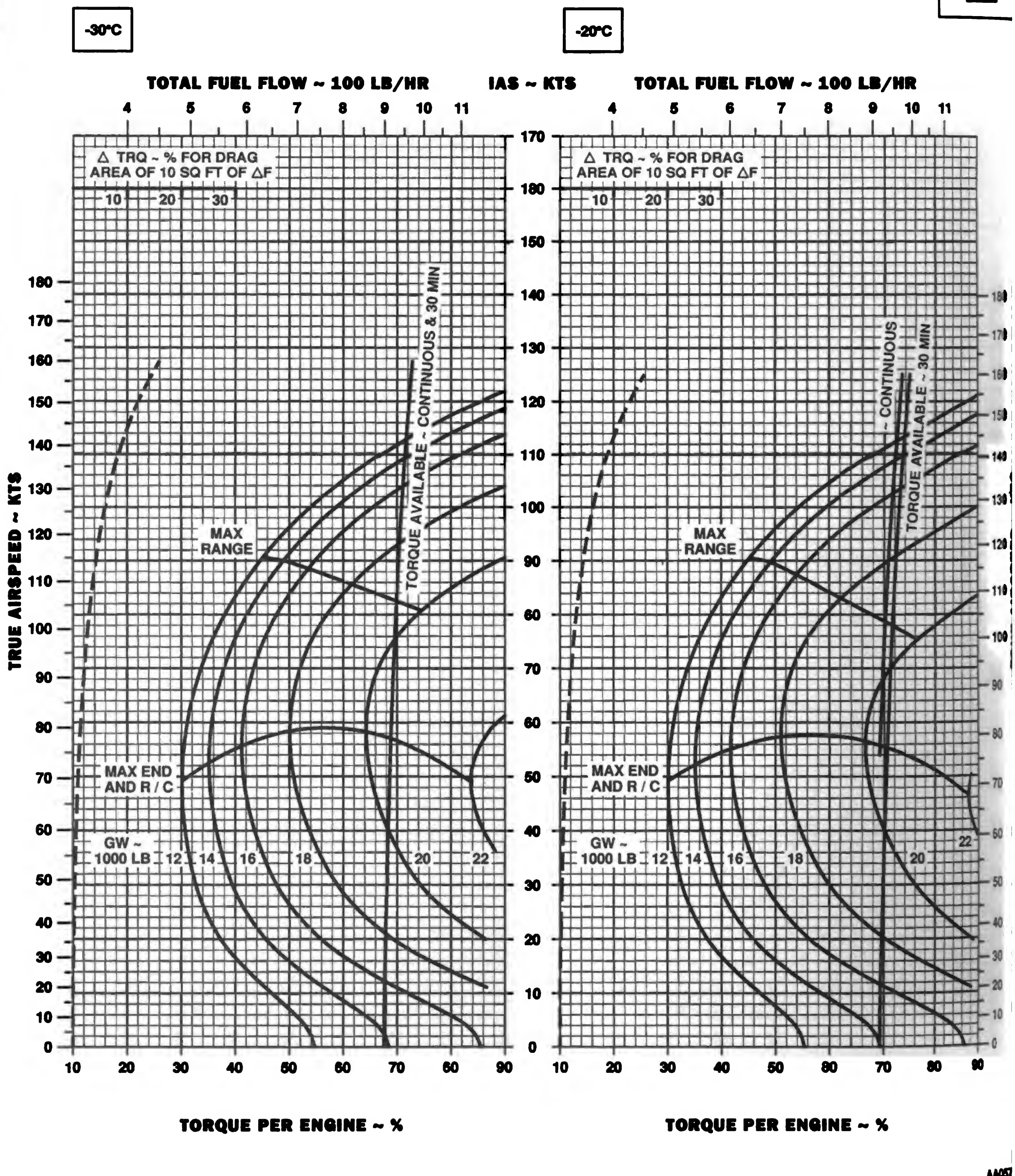
AA0574
8A

Figure 7-27. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 1 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)



DATA BASE: FLIGHT TEST

Figure 7-27. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 2 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)

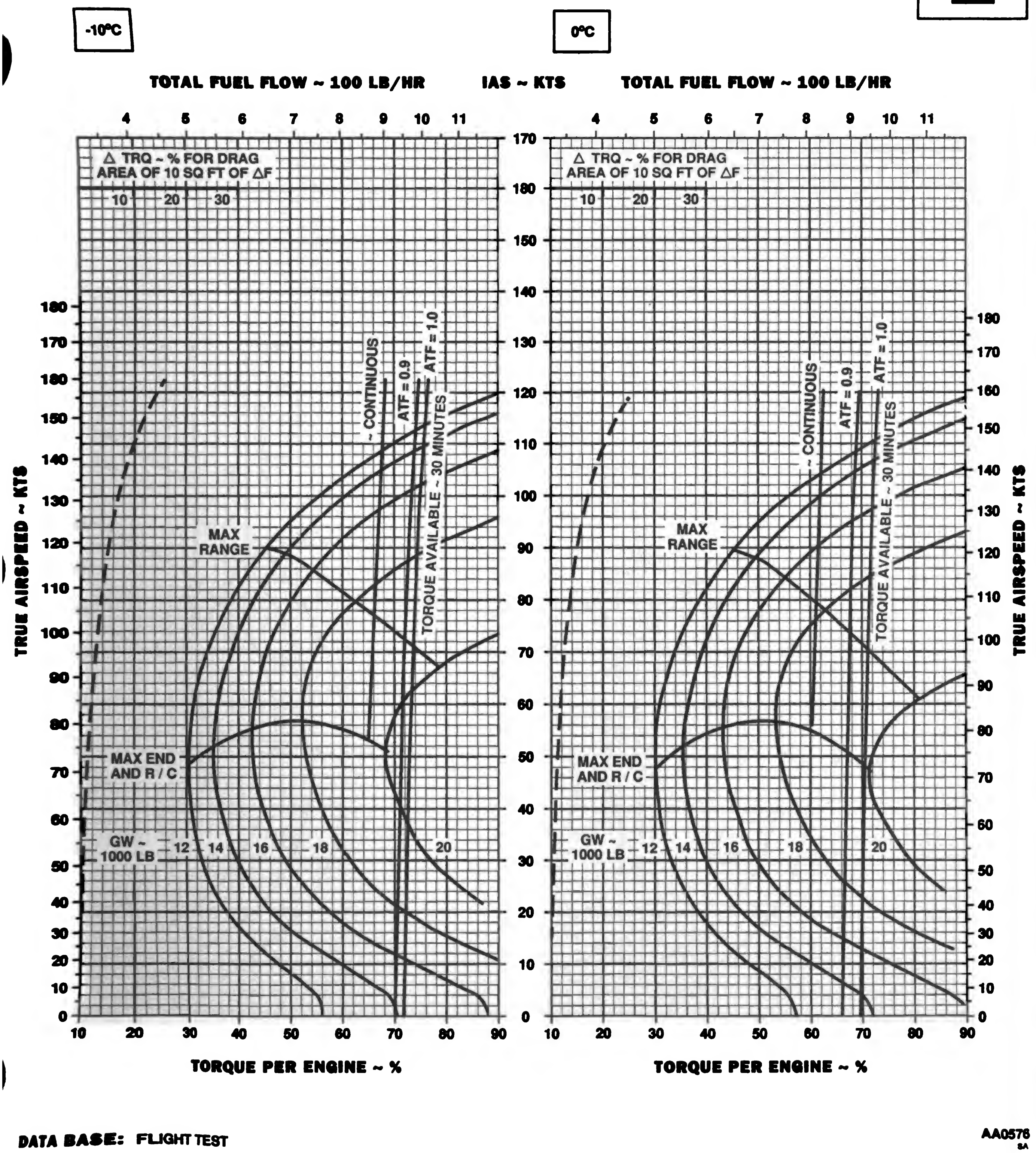
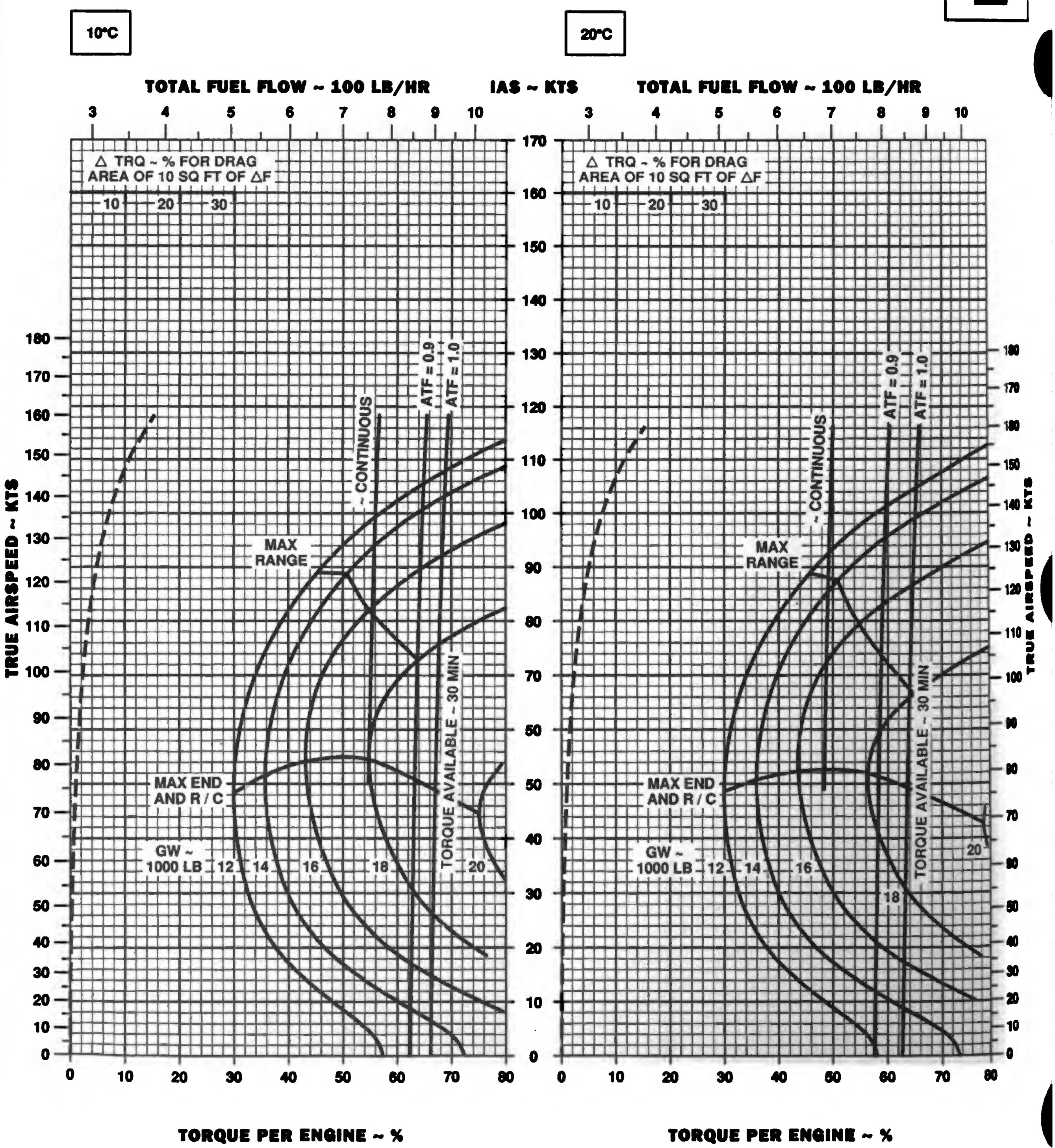


Figure 7-27. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 3 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0577

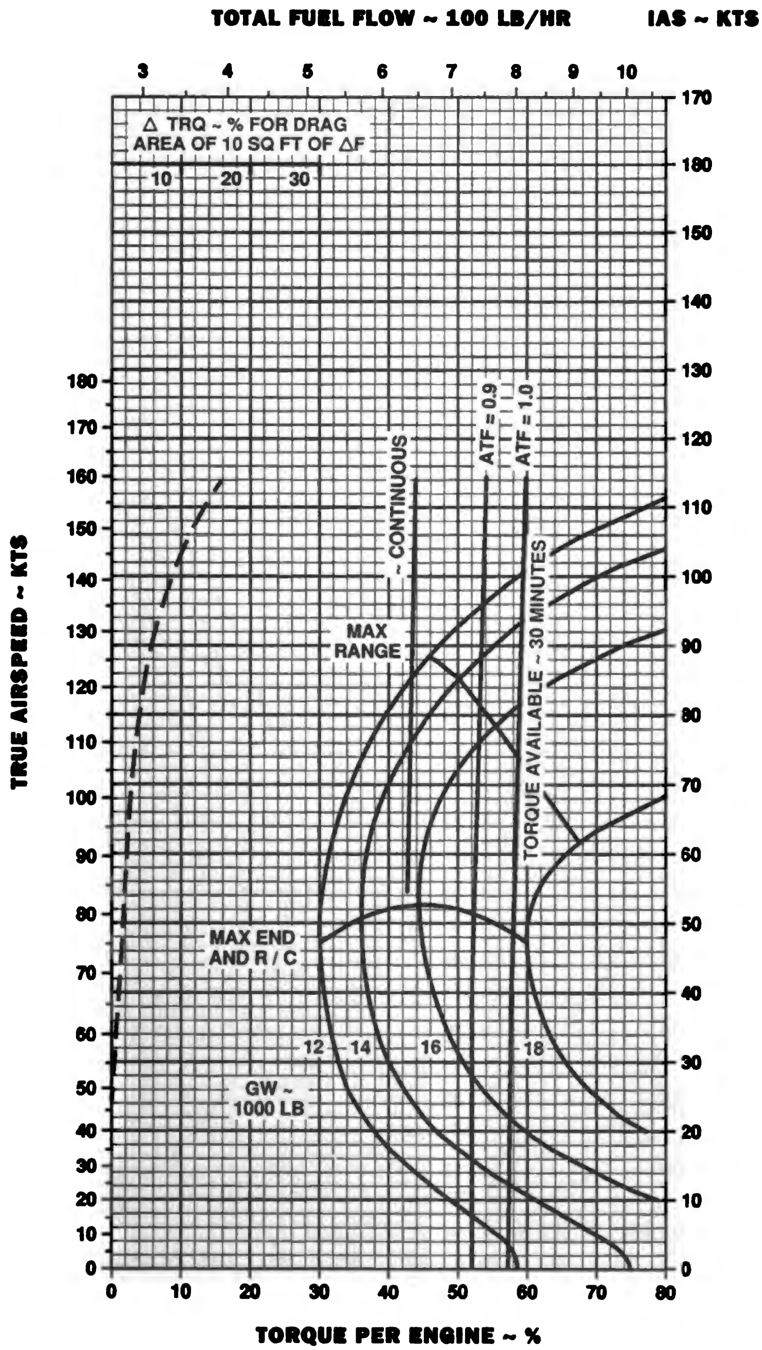
Figure 7-27. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 4 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T700 (2)

30°C



DATA BASE: FLIGHT TEST

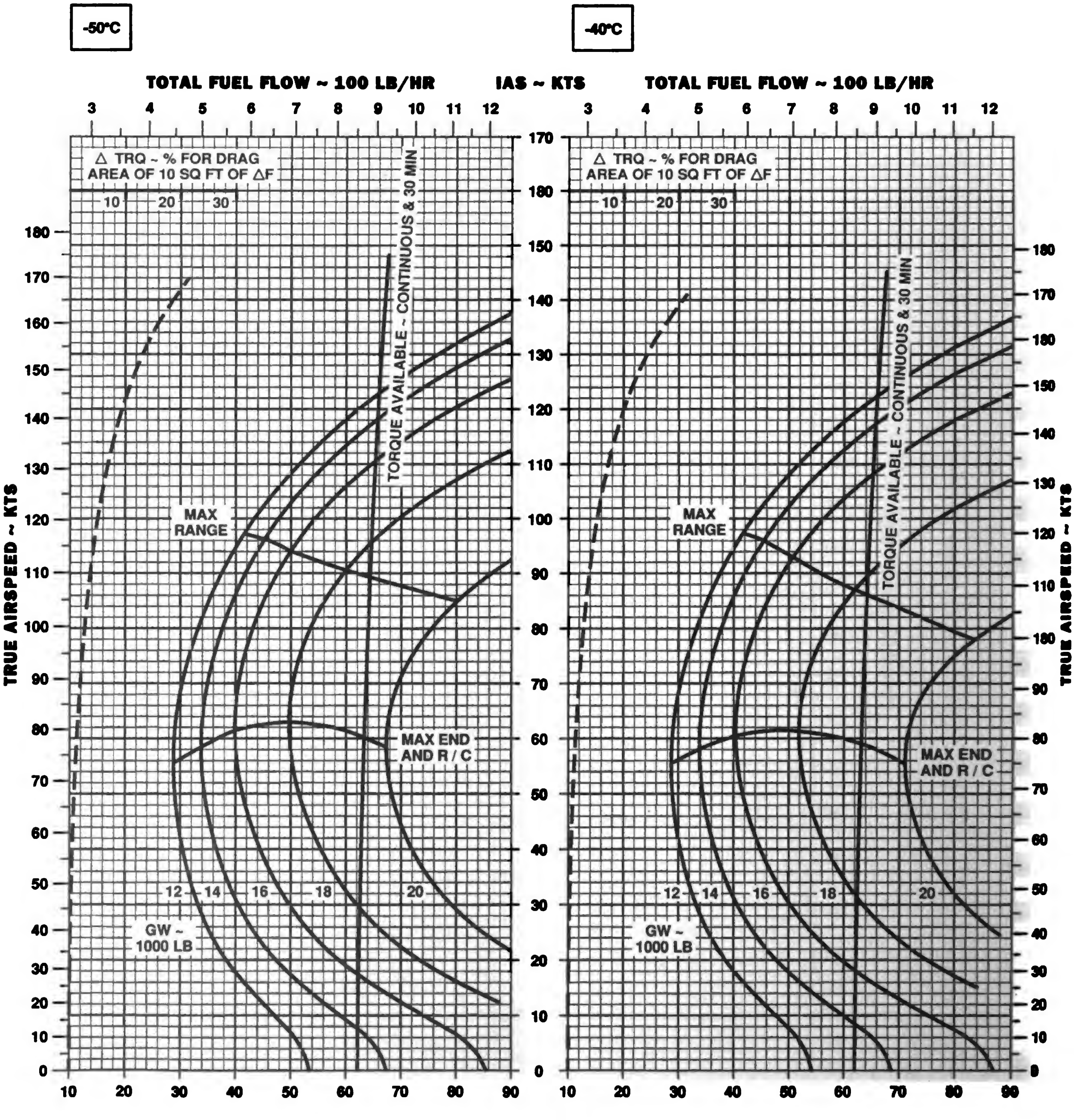
AA0578
8A

Figure 7-27. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 5 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)



DATA BASE: FLIGHT TEST

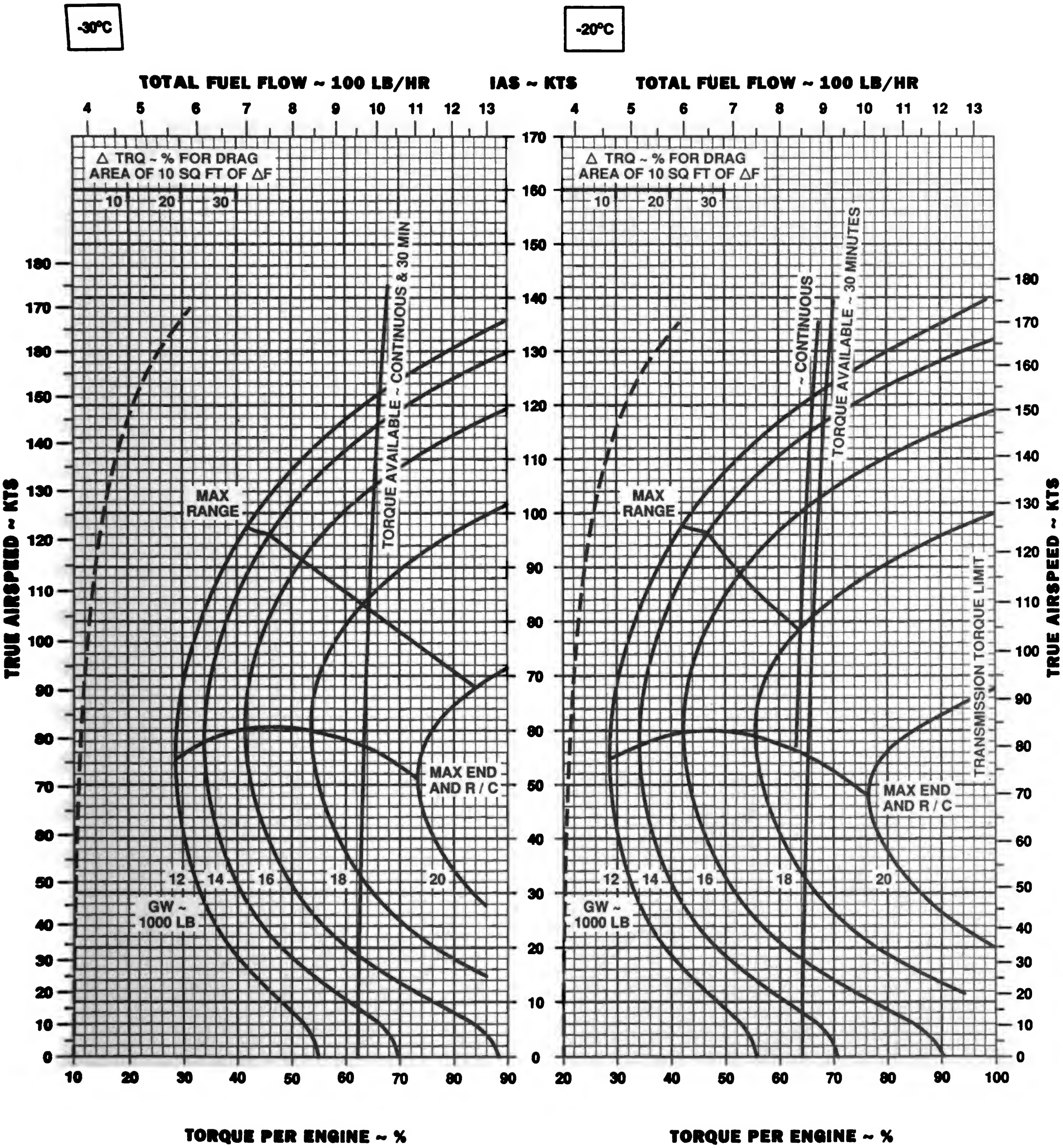
AA0435
SA

Figure 7-28. Cruise - Pressure Altitude 16,000 Feet (Sheet 1 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0434
SA

Figure 7-28. Cruise - Pressure Altitude 16,000 Feet (Sheet 2 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)

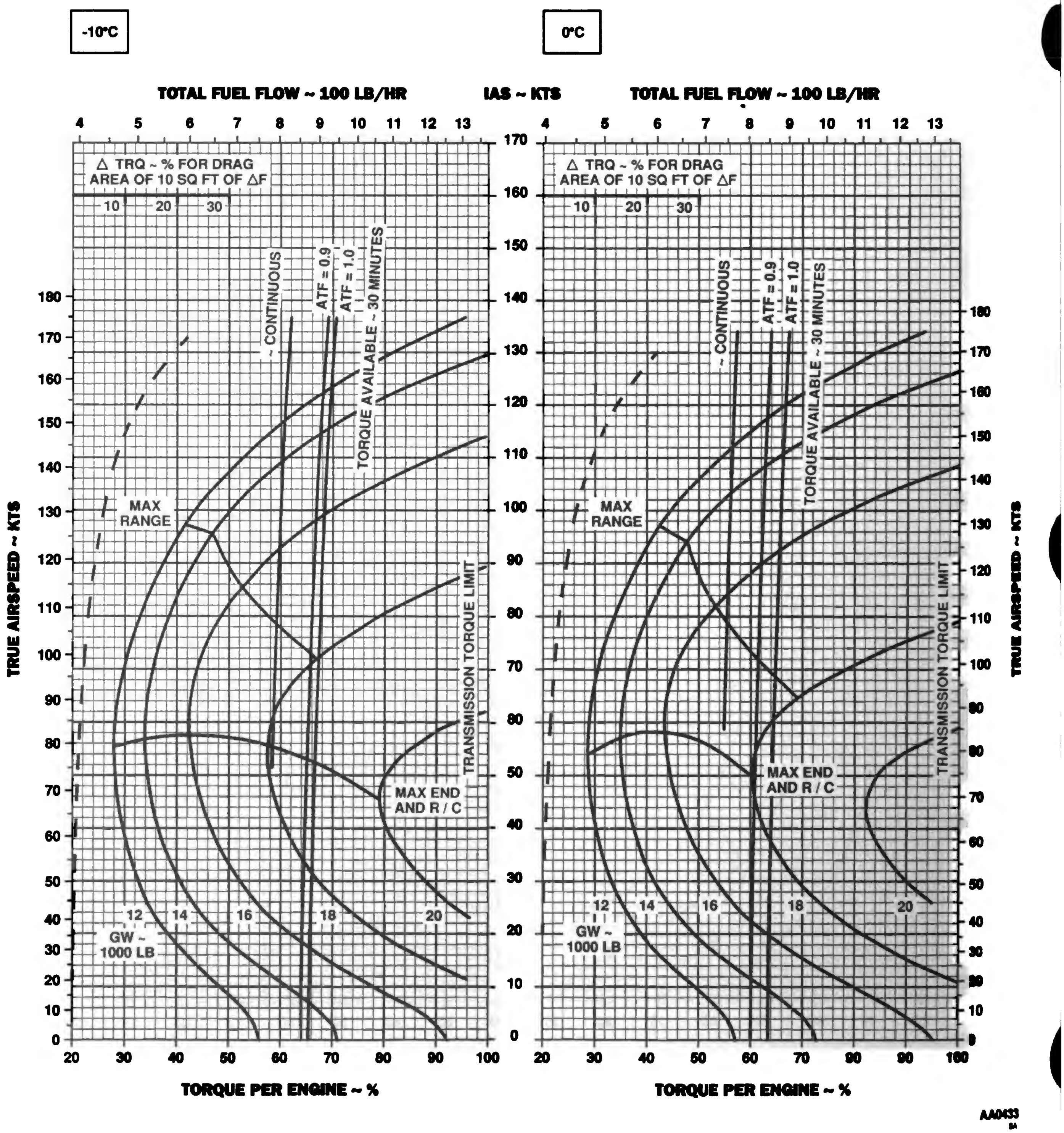


Figure 7-28. Cruise - Pressure Altitude 16,000 Feet (Sheet 3 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)

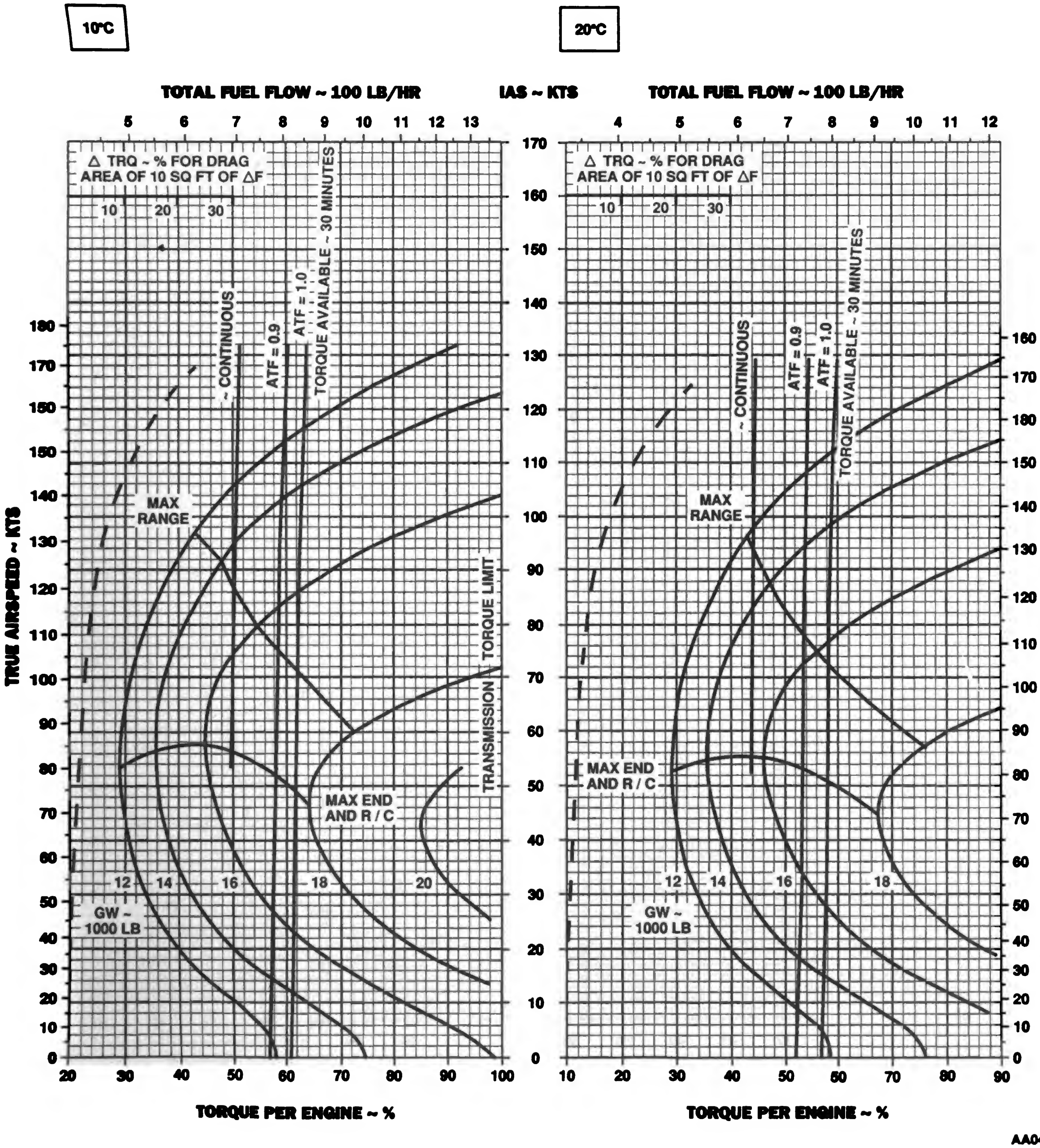
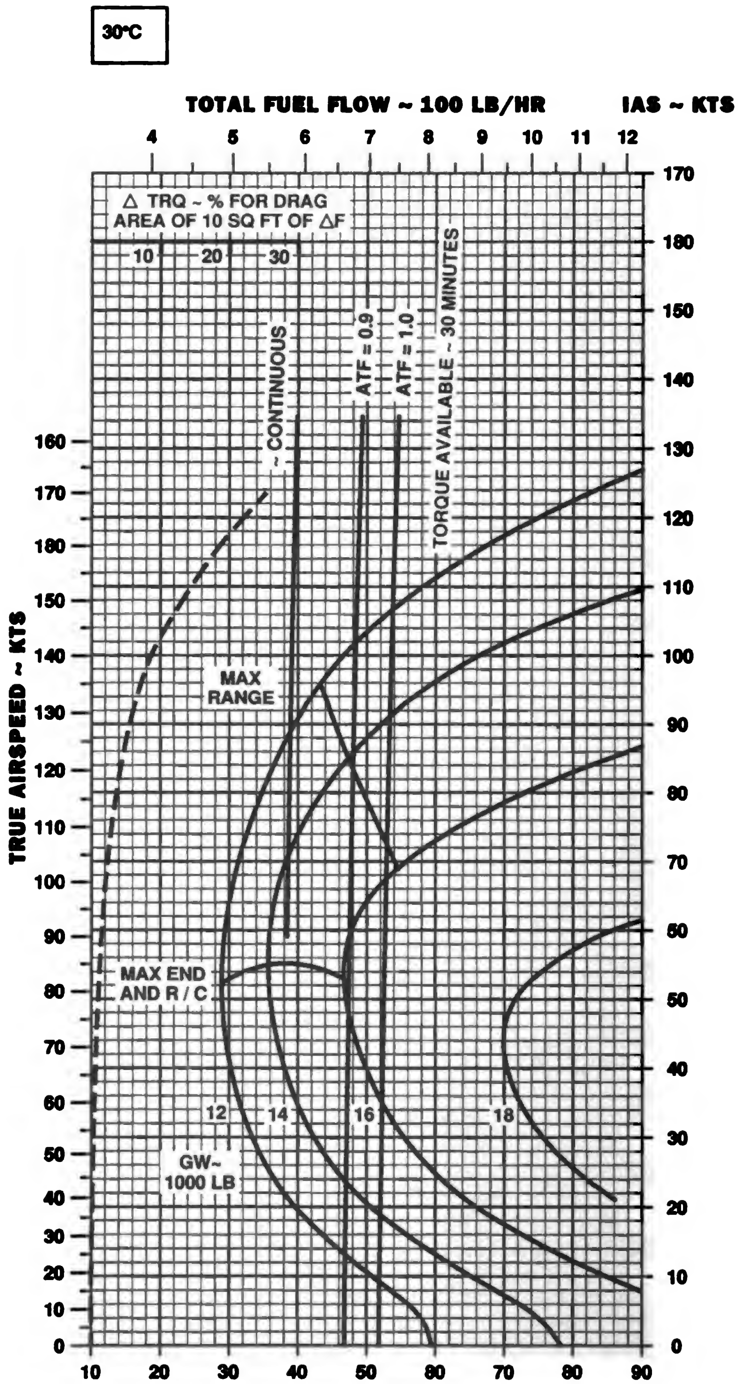


Figure 7-28. Cruise - Pressure Altitude 16,000 Feet (Sheet 4 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)



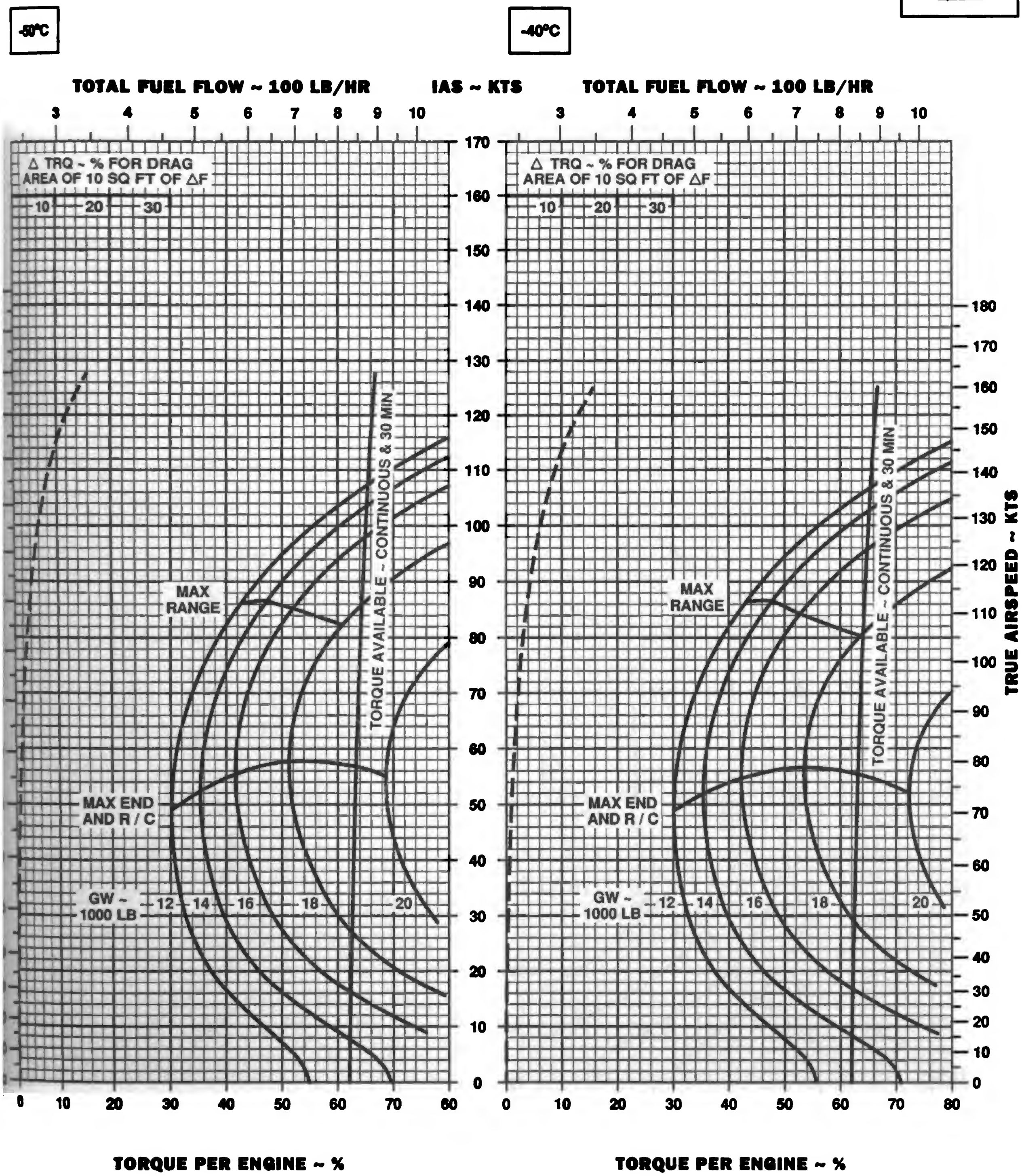
DATA BASE: FLIGHT TEST

Figure 7-28. Cruise - Pressure Altitude 16,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)



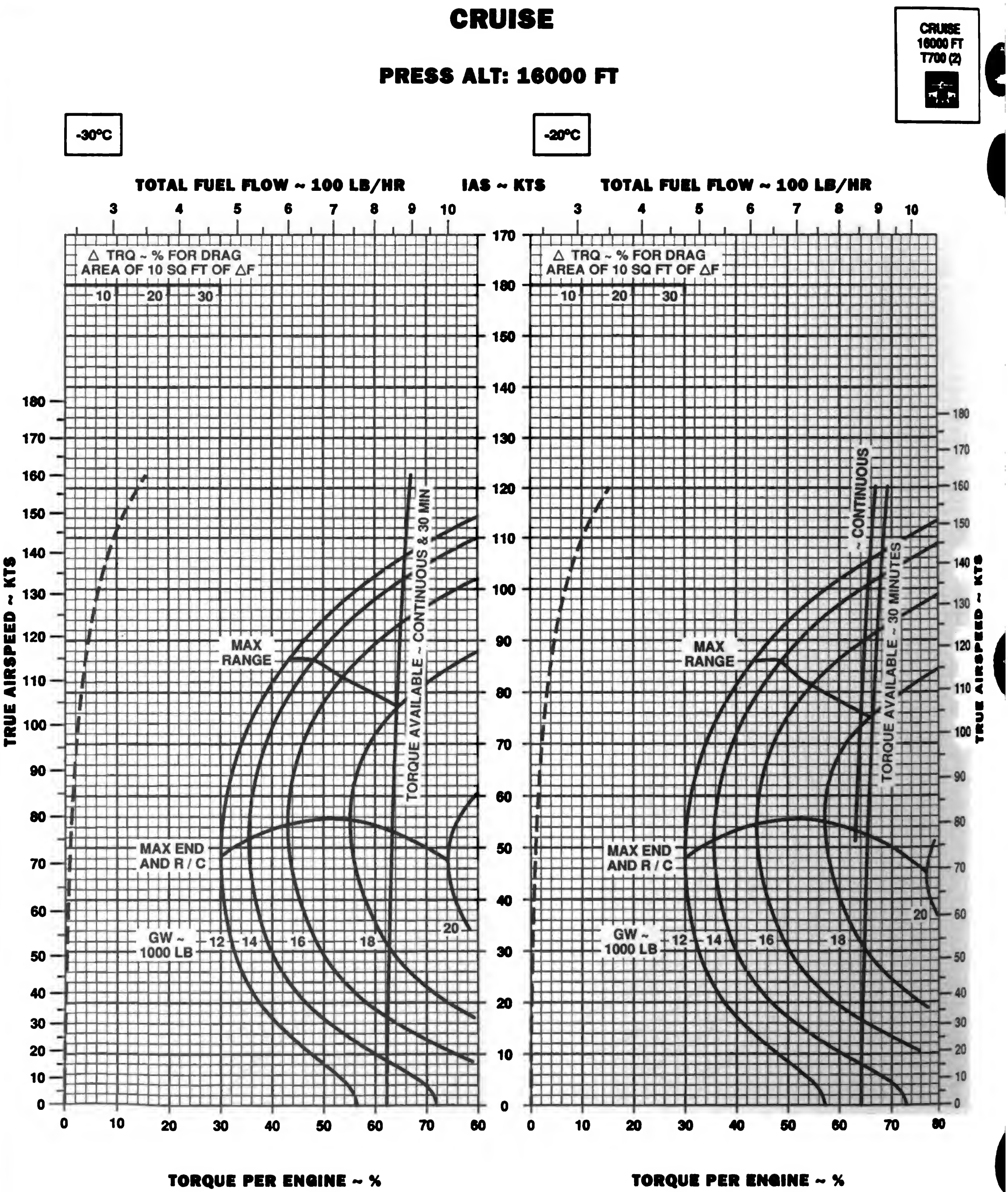
DATA BASE: FLIGHT TEST

AA0579

Figure 7-29. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 1 of 4)

CRUISE

PRESS ALT: 16000 FT



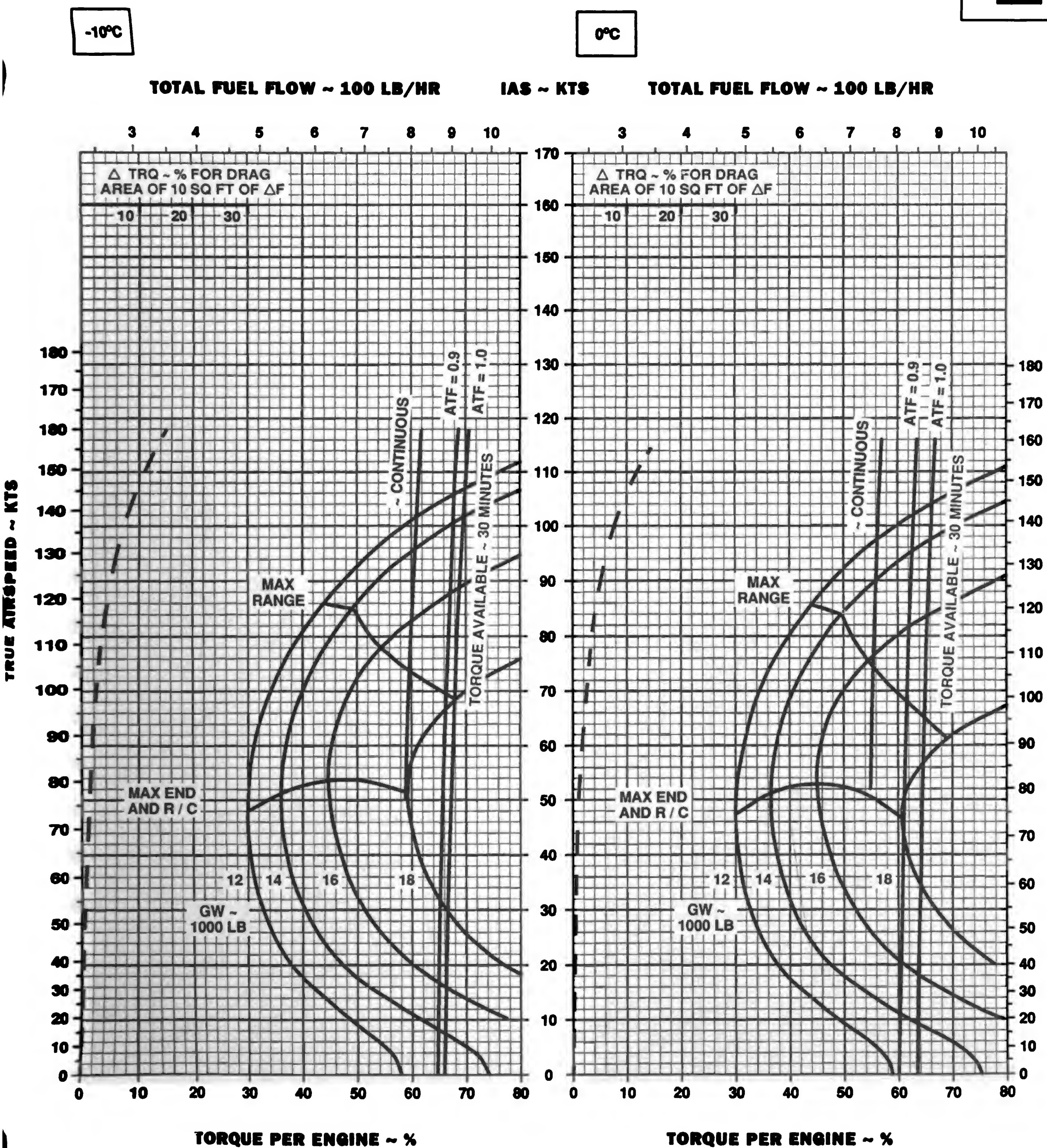
DATA BASE: FLIGHT TEST

Figure 7-29. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 2 of 4)

CRUISE

PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)



DATA BASE: FLIGHT TEST

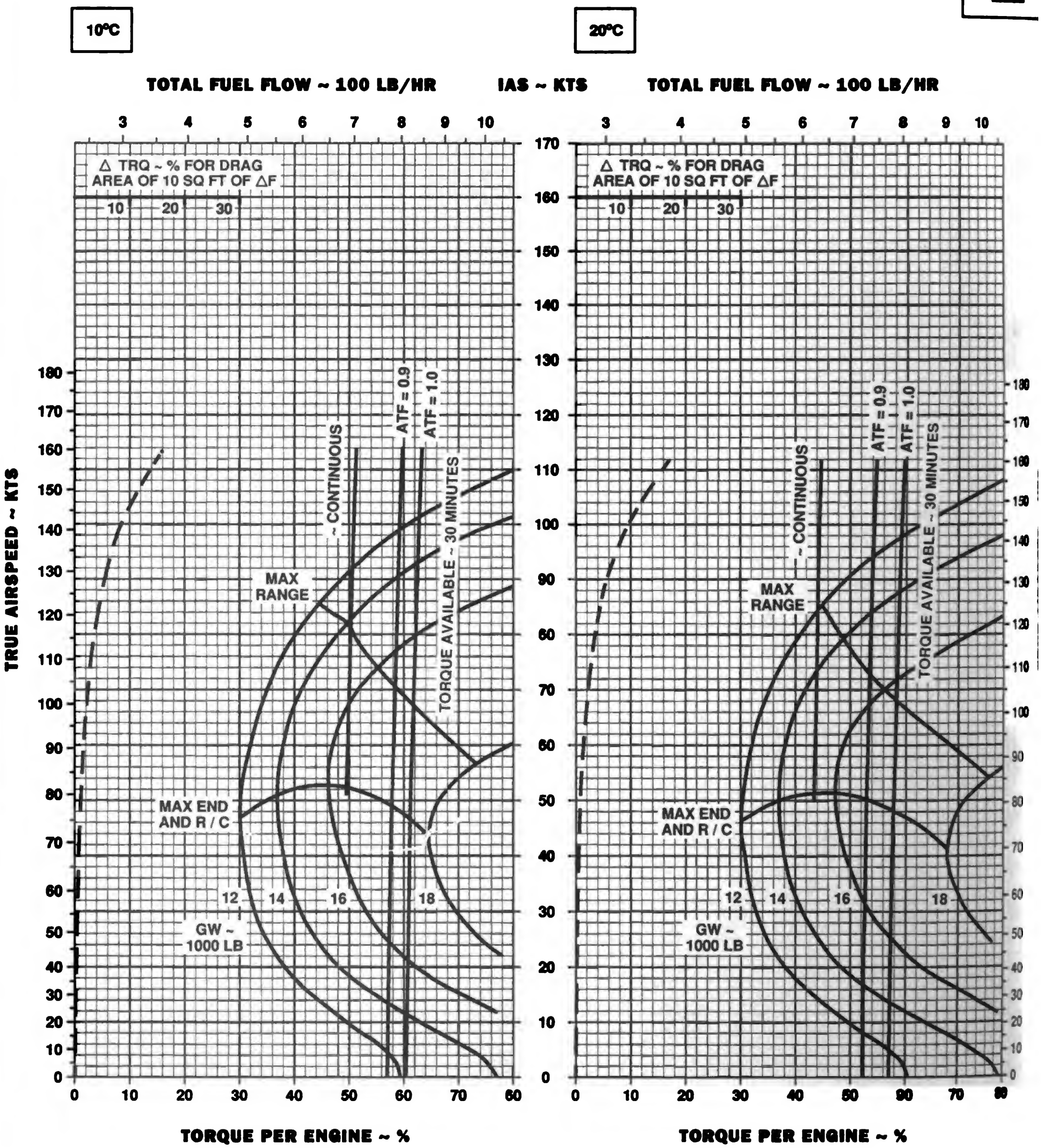
AA0581
SA

Figure 7-29. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 3 of 4)

CRUISE

PRESS ALT: 16000 FT

CRUISE
16000 FT
T700 (2)



DATA BASE: FLIGHT TEST

Figure 7-29. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 4 of 4)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)

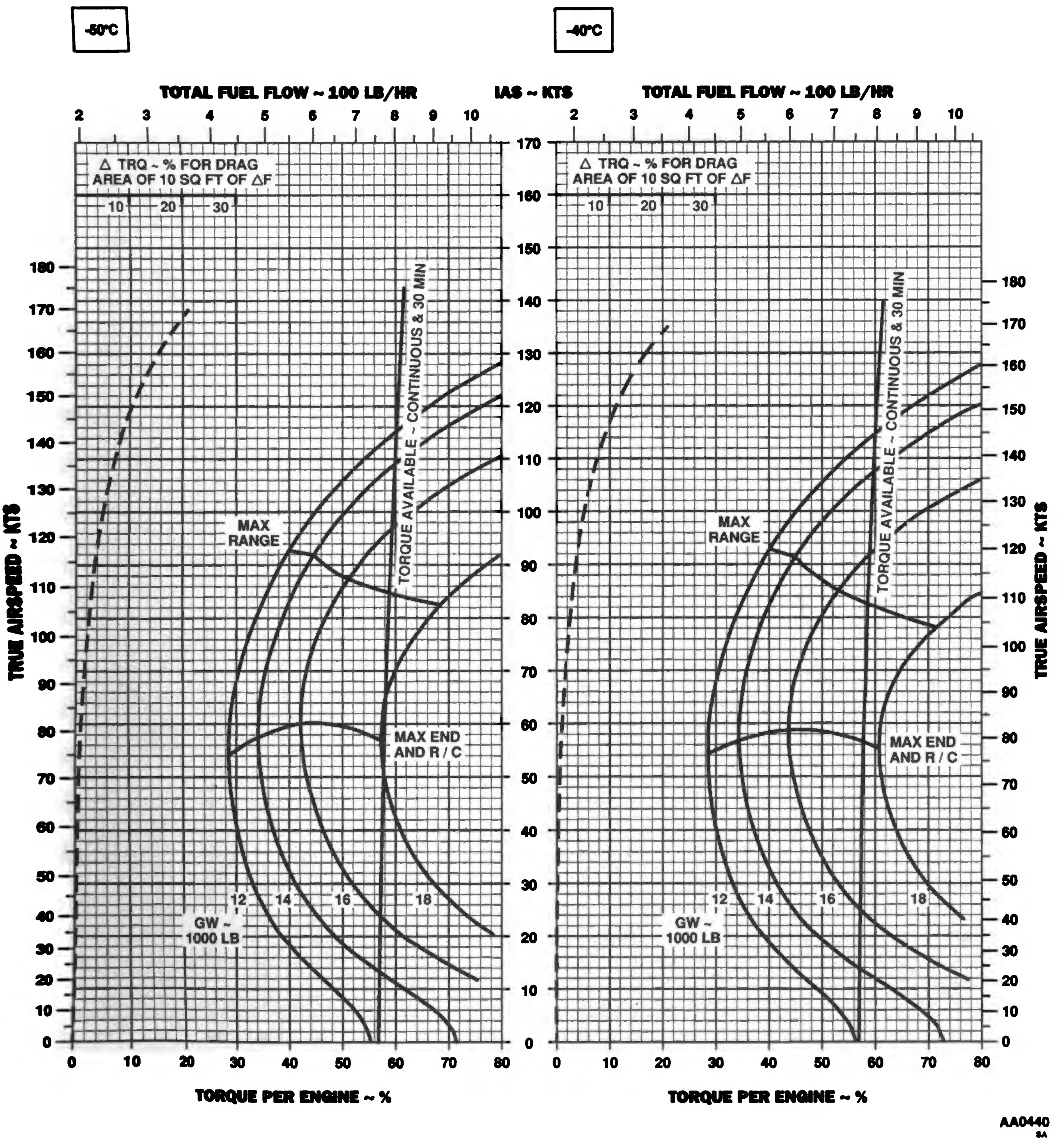


Figure 7-30. Cruise - Pressure Altitude 18,000 Feet (Sheet 1 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)

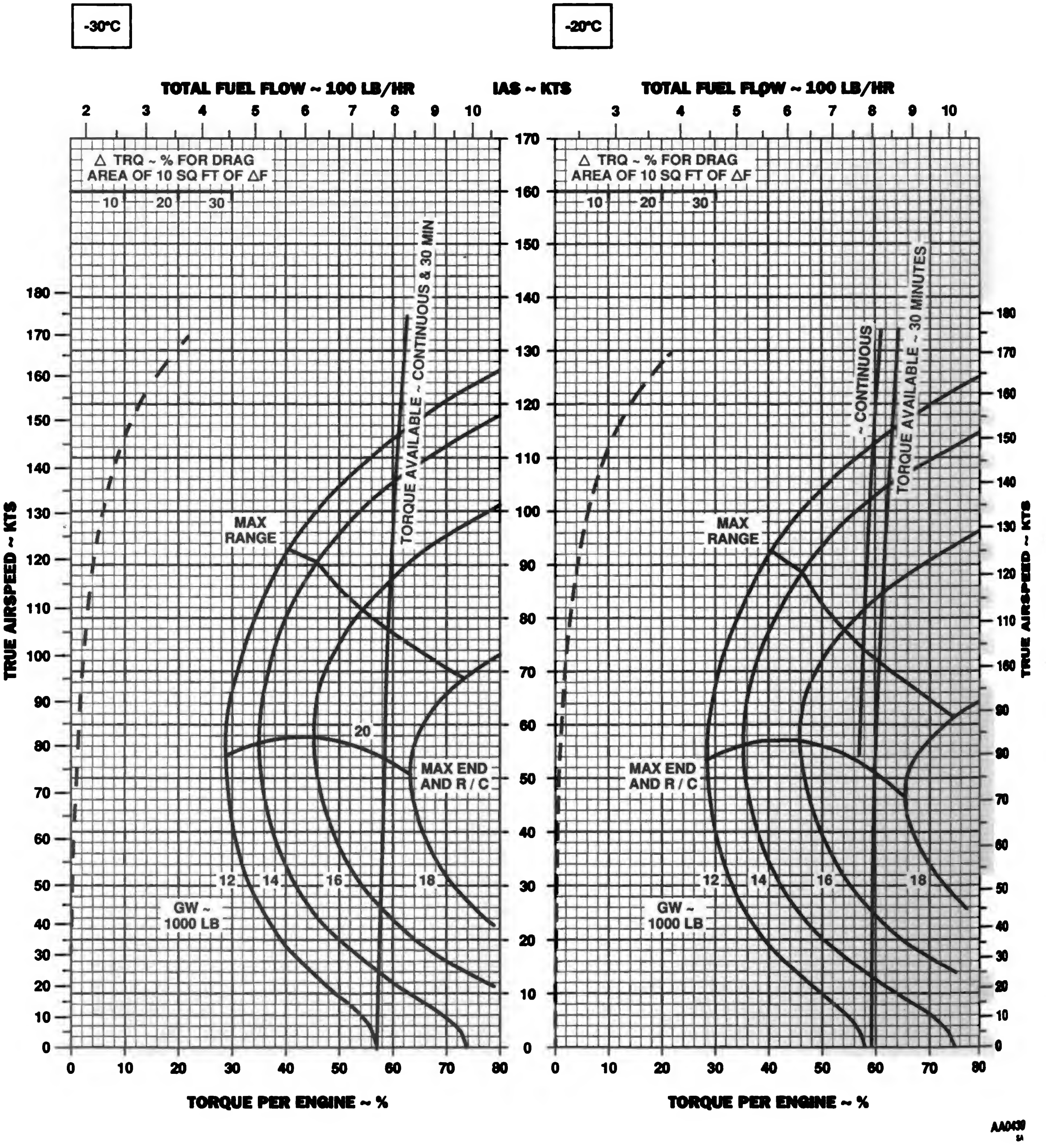


Figure 7-30. Cruise - Pressure Altitude 18,000 Feet (Sheet 2 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)

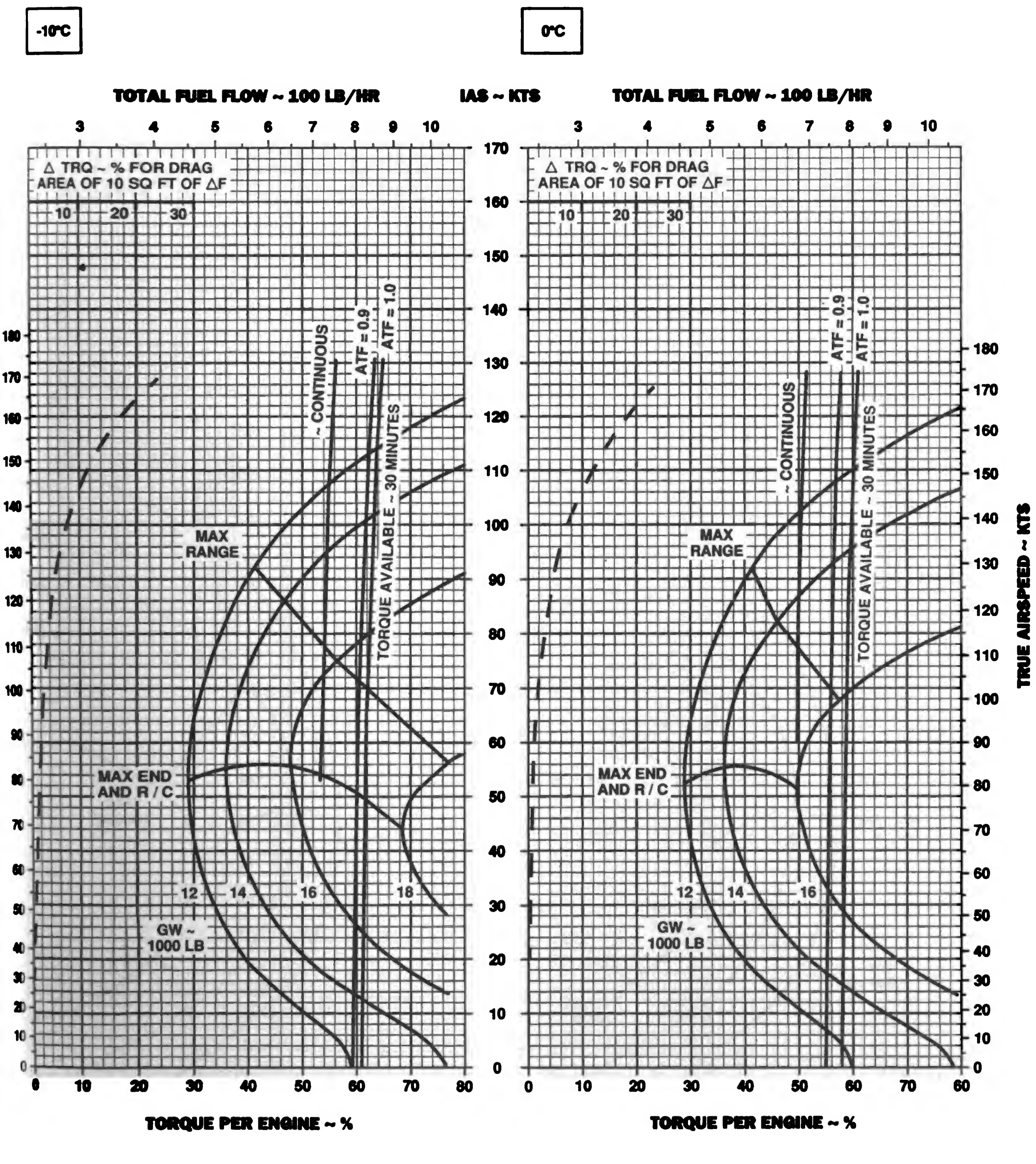


Figure 7-30. Cruise - Pressure Altitude 18,000 Feet (Sheet 3 of 5)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)

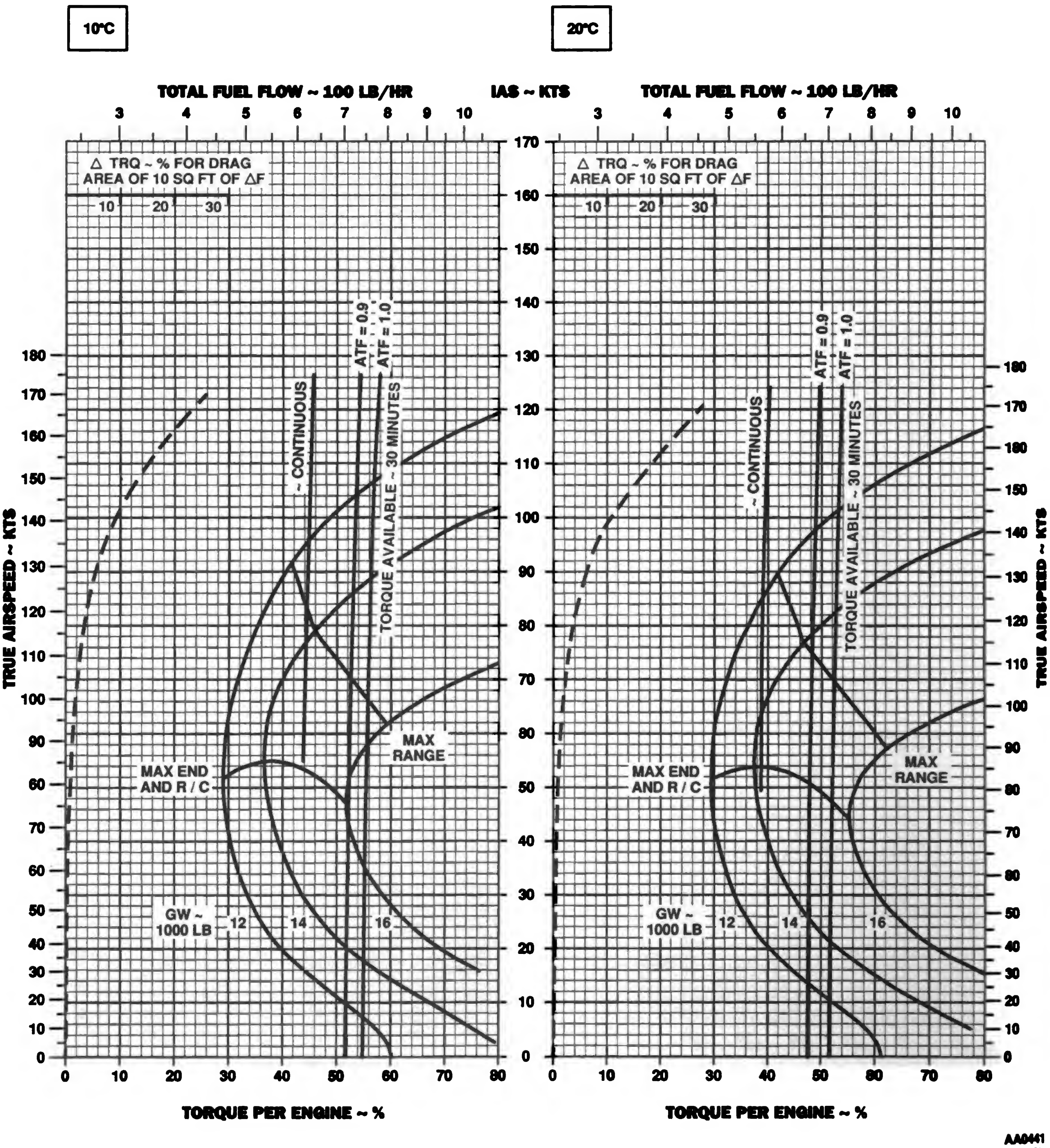


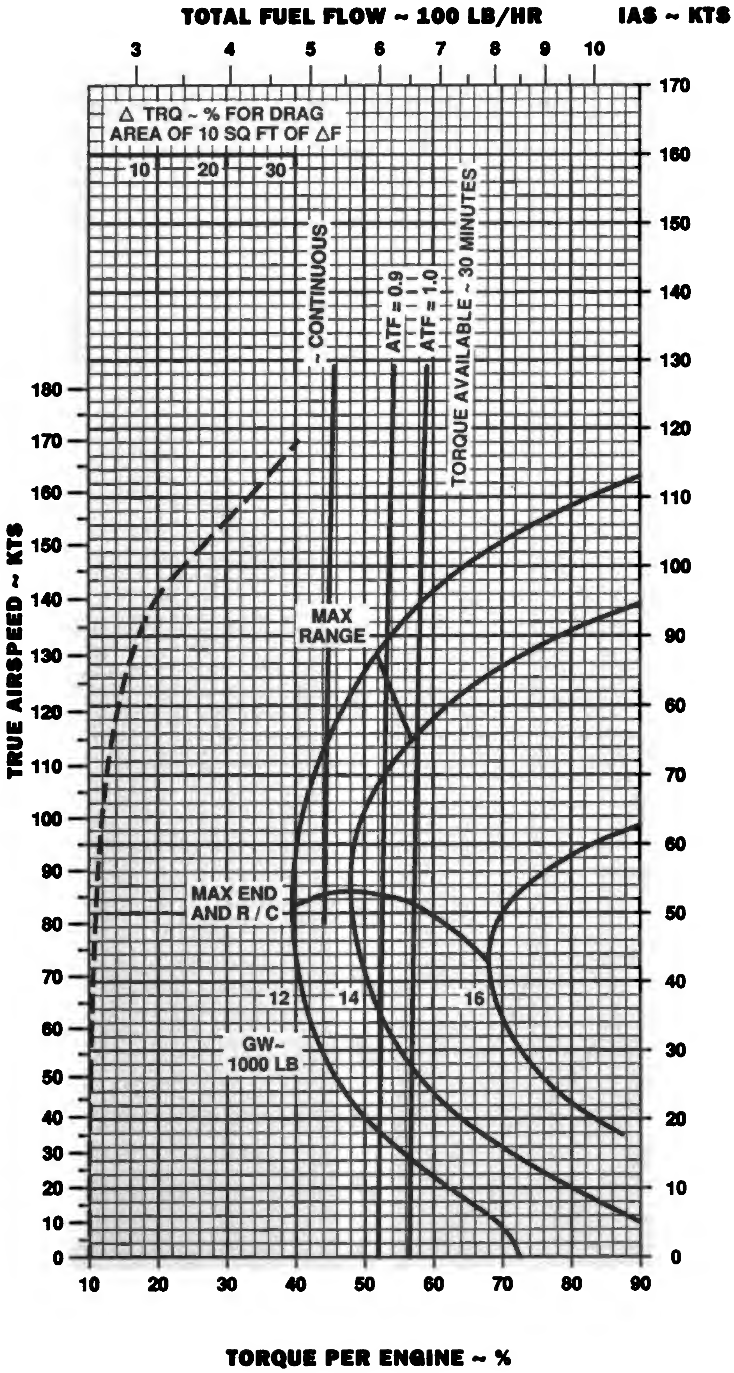
Figure 7-30. Cruise - Pressure Altitude 18,000 Feet (Sheet 4 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)

30°C



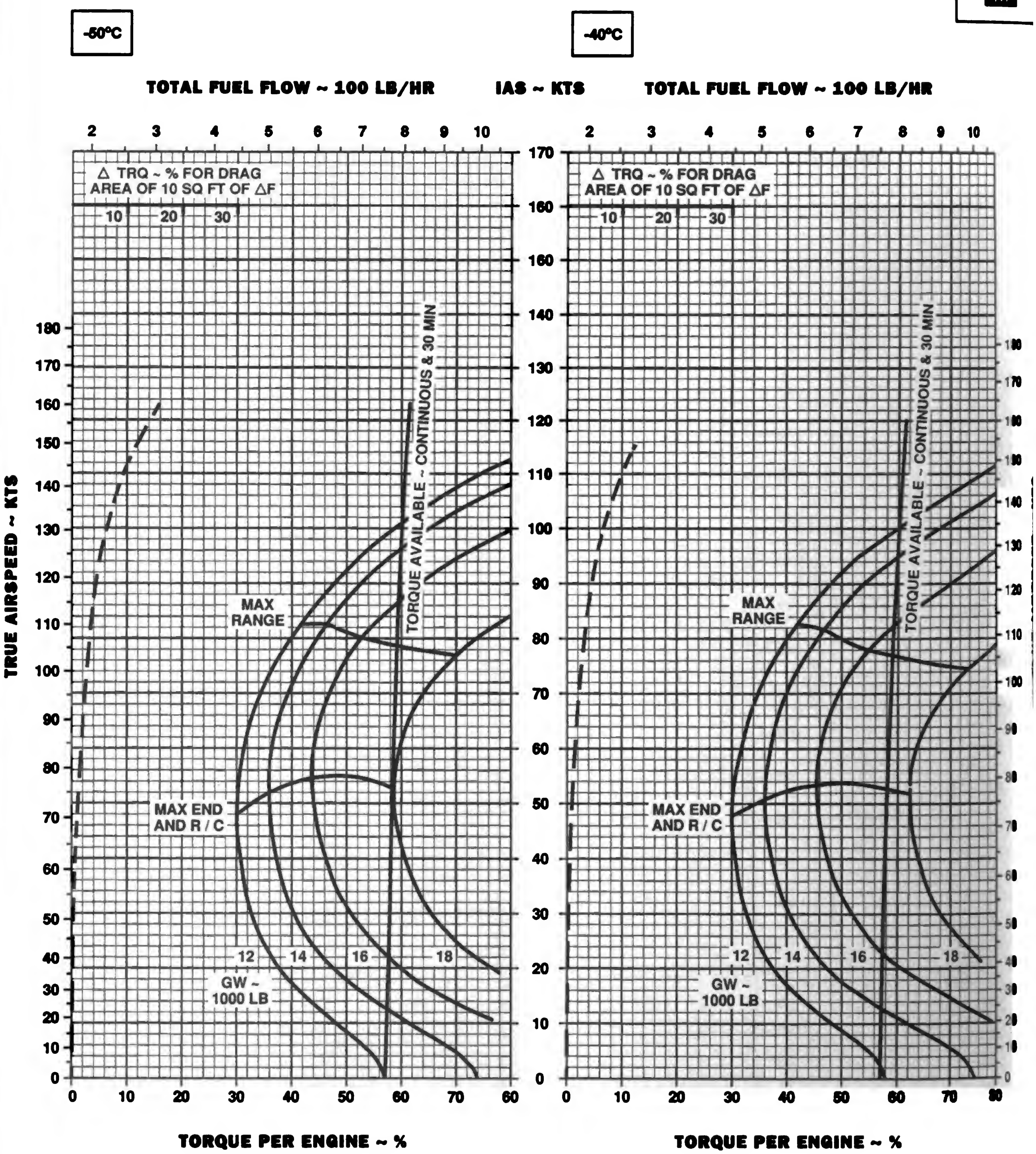
DATA BASE: FLIGHT TEST

AA0442
SA

Figure 7-30. Cruise - Pressure Altitude 18,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 18000 FT



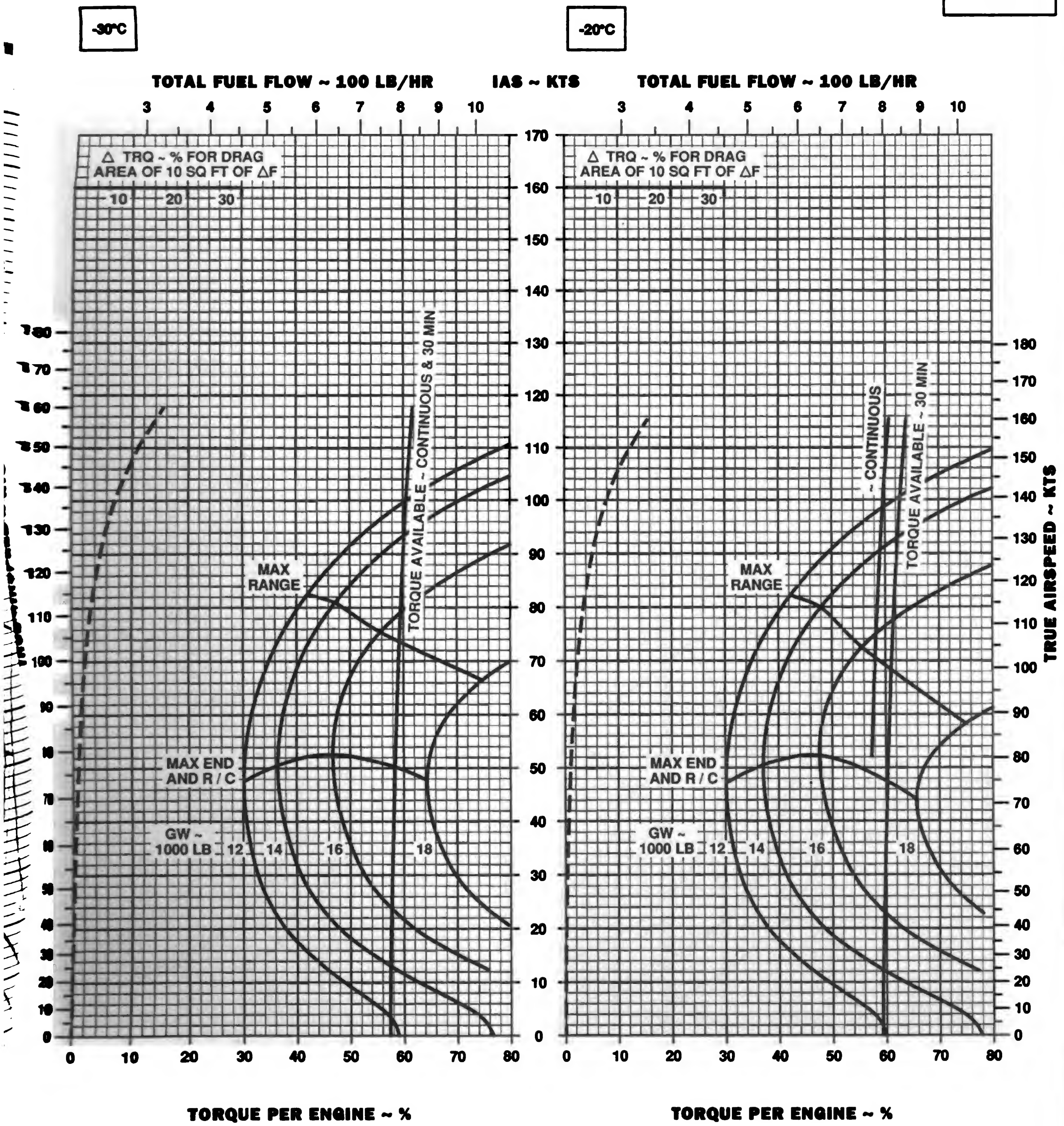
DATA BASE: FLIGHT TEST

Figure 7-31. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 1 of 4)

CRUISE

PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)



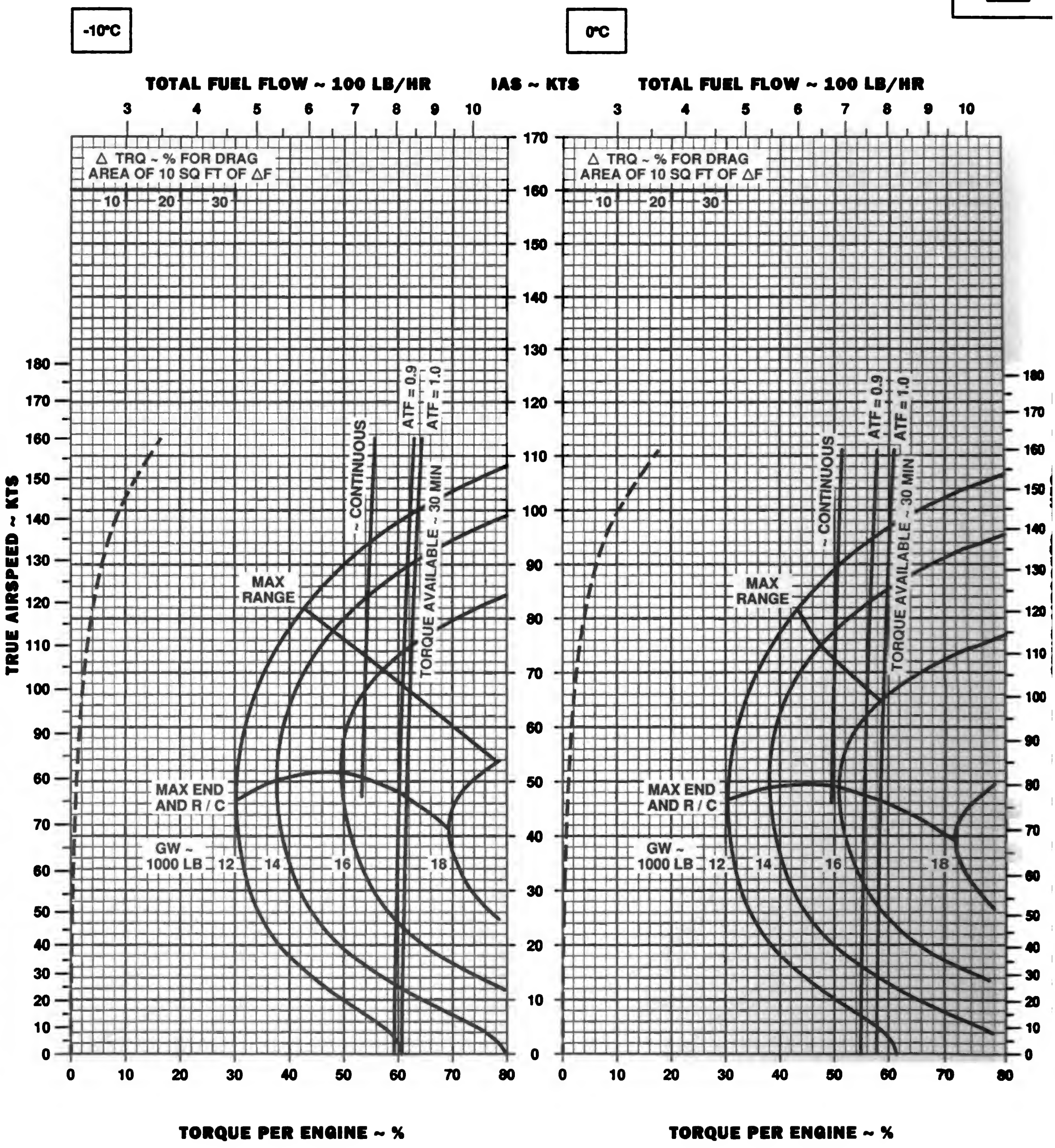
DATA BASE: FLIGHT TEST

AA0584 SA

Figure 7-31. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 2 of 4)

CRUISE

PRESS ALT: 18000 FT



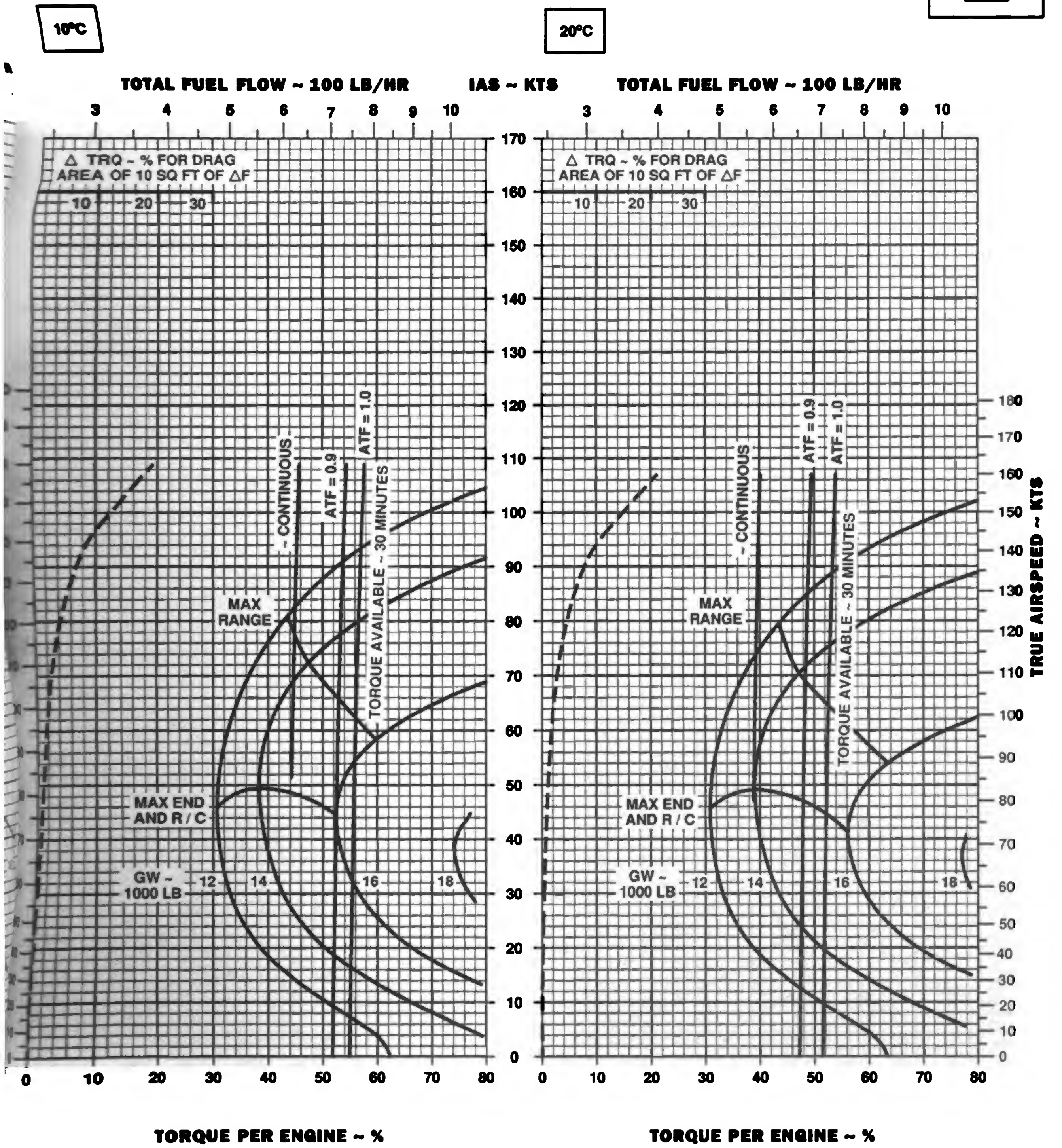
DATA BASE: FLIGHT TEST

Figure 7-31. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 3 of 4)

CRUISE

PRESS ALT: 18000 FT

CRUISE
18000 FT
T700 (2)



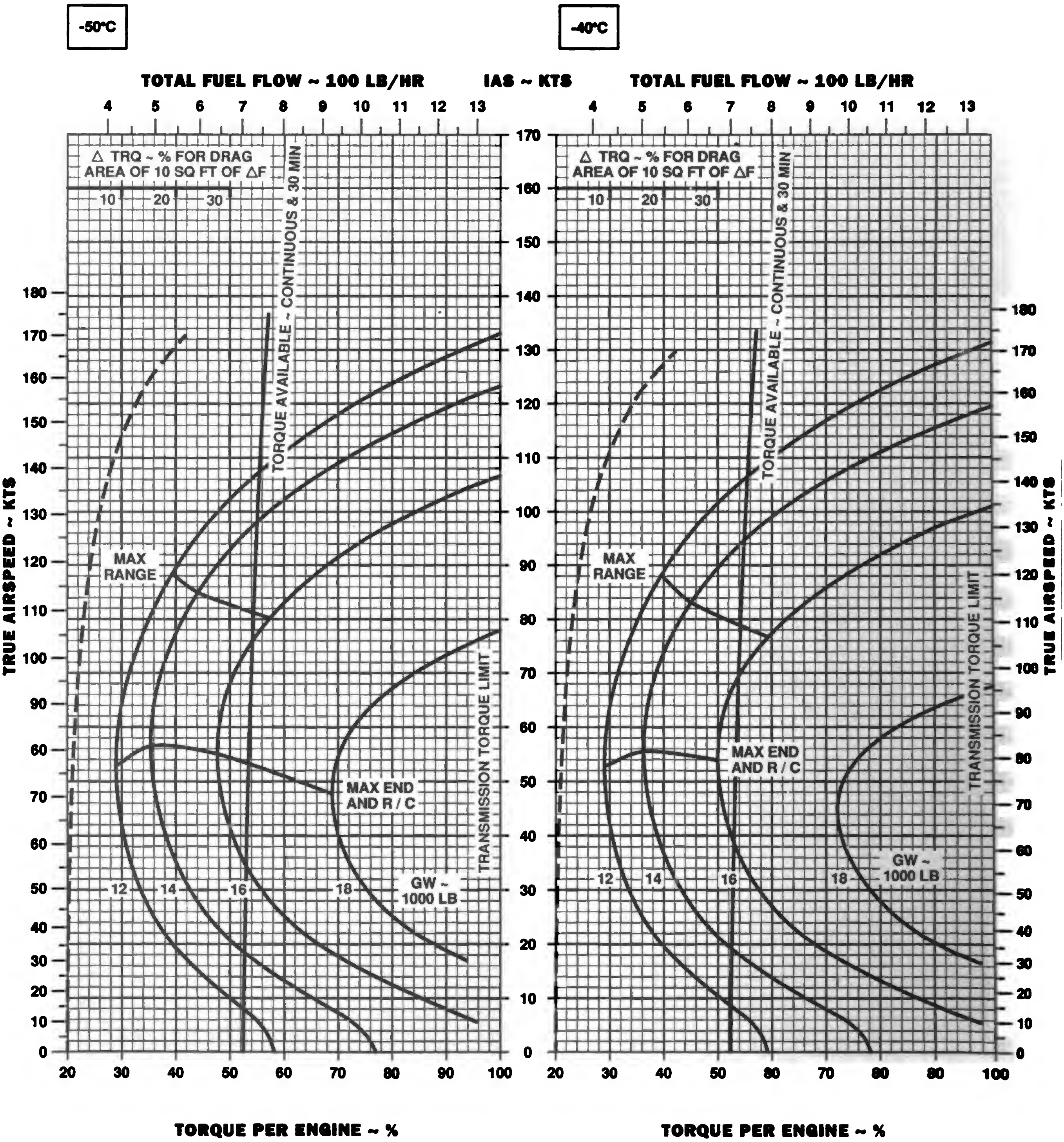
DATA BASE: FLIGHT TEST

AA0586 SA

Figure 7-31. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 4 of 4)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 20000 FT

CRUISE
20000 FT
T700 (2)



DATA BASE: FLIGHT TEST

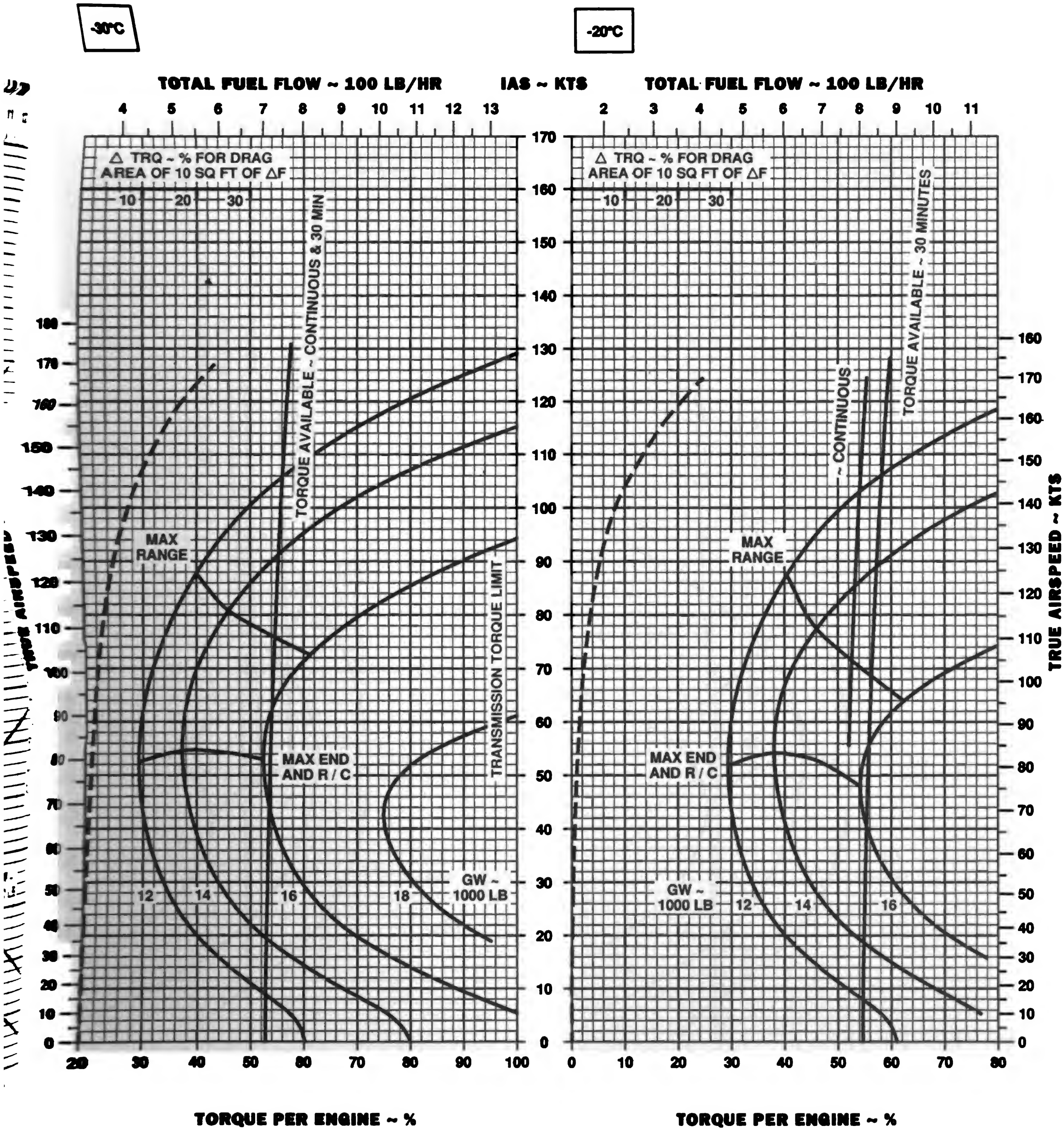
AA0445

Figure 7-32. Cruise - Pressure Altitude 20,000 Feet (Sheet 1 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 20000 FT

CRUISE
20000 FT
T700 (2)



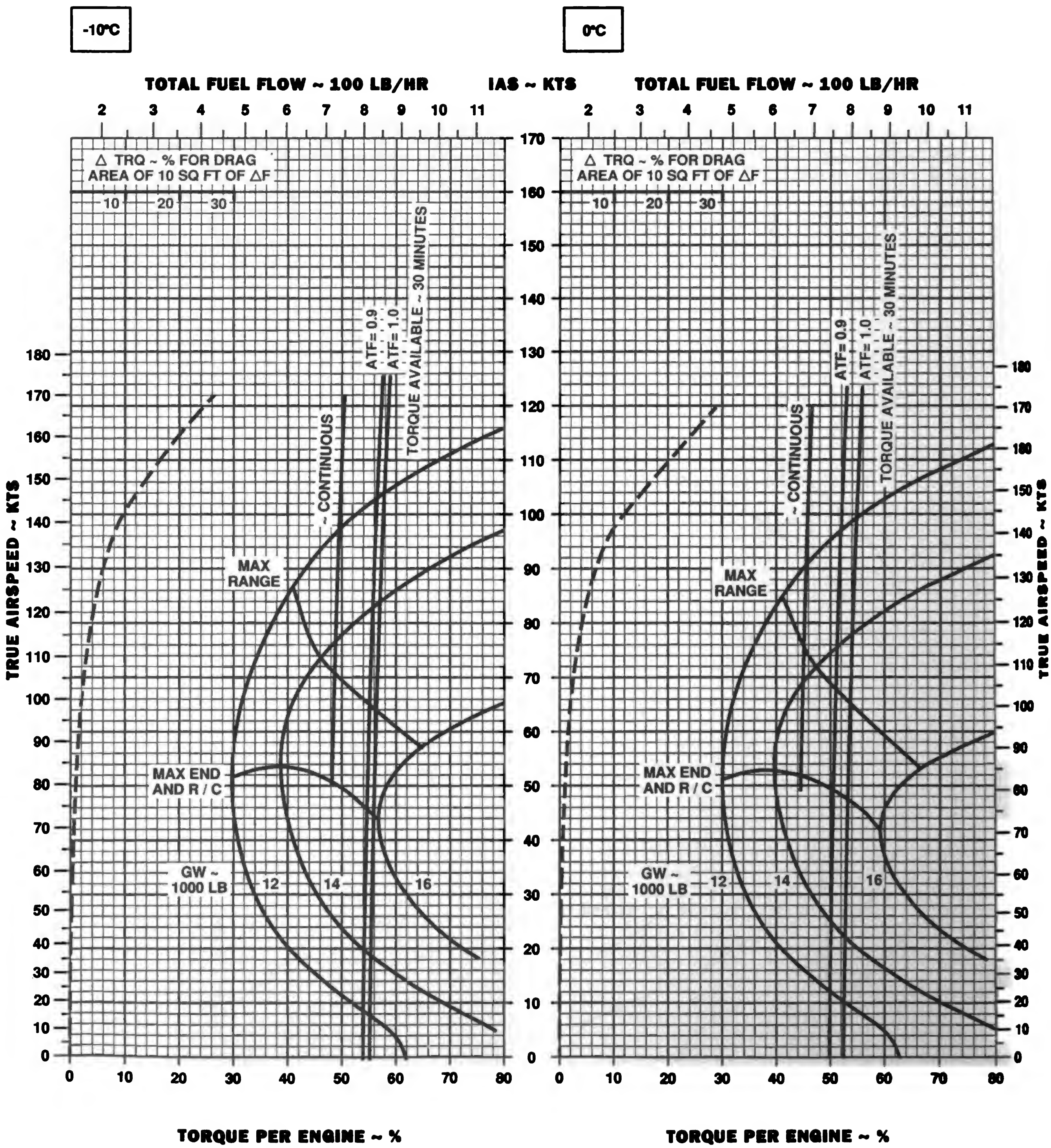
DATA BASE: FLIGHT TEST

AA0444
SA

Figure 7-32. Cruise - Pressure Altitude 20,000 Feet (Sheet 2 of 4)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 20000 FT

CRUISE
20000 FT
T700 (2)



DATA BASE: FLIGHT TEST

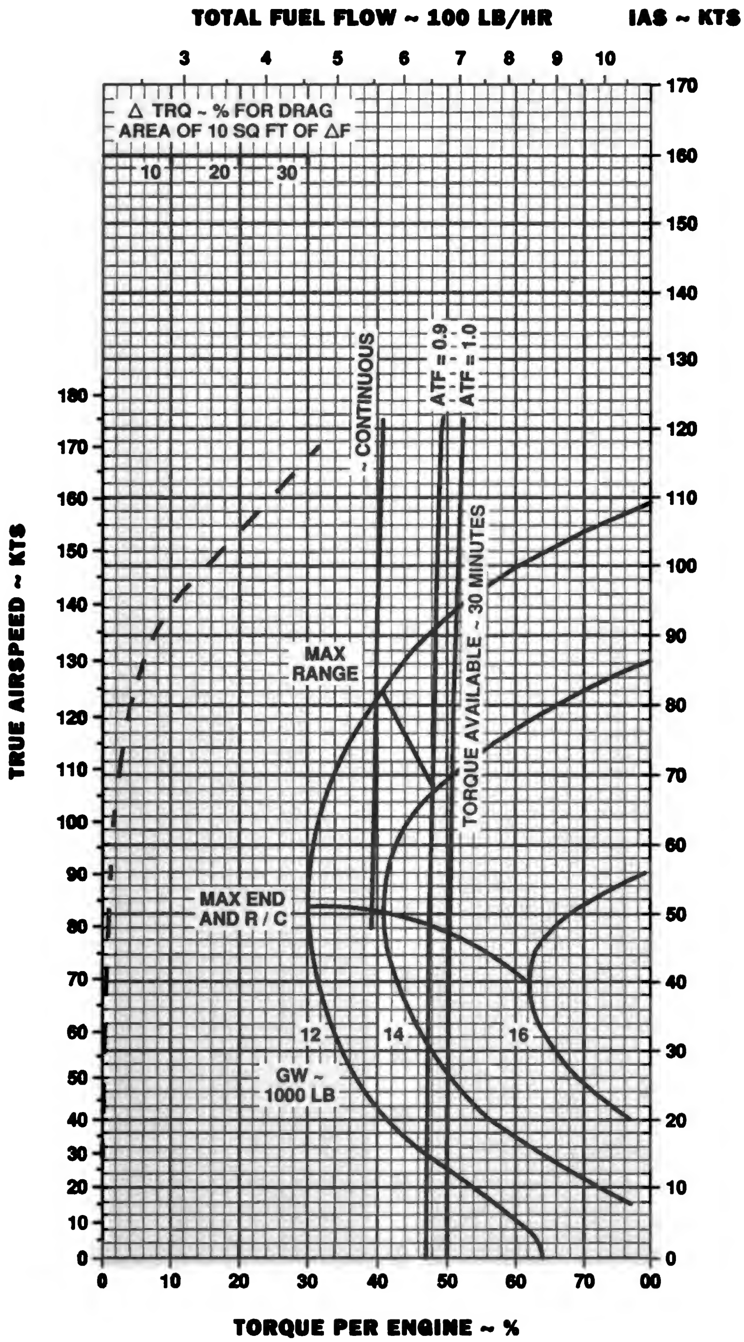
AA0443

Figure 7-32. Cruise - Pressure Altitude 20,000 Feet (Sheet 3 of 4)

CRUISE
CLEAN CONFIGURATION
PRESS ALT: 20000 FT

CRUISE
20000 FT
T700 (2)

10°C



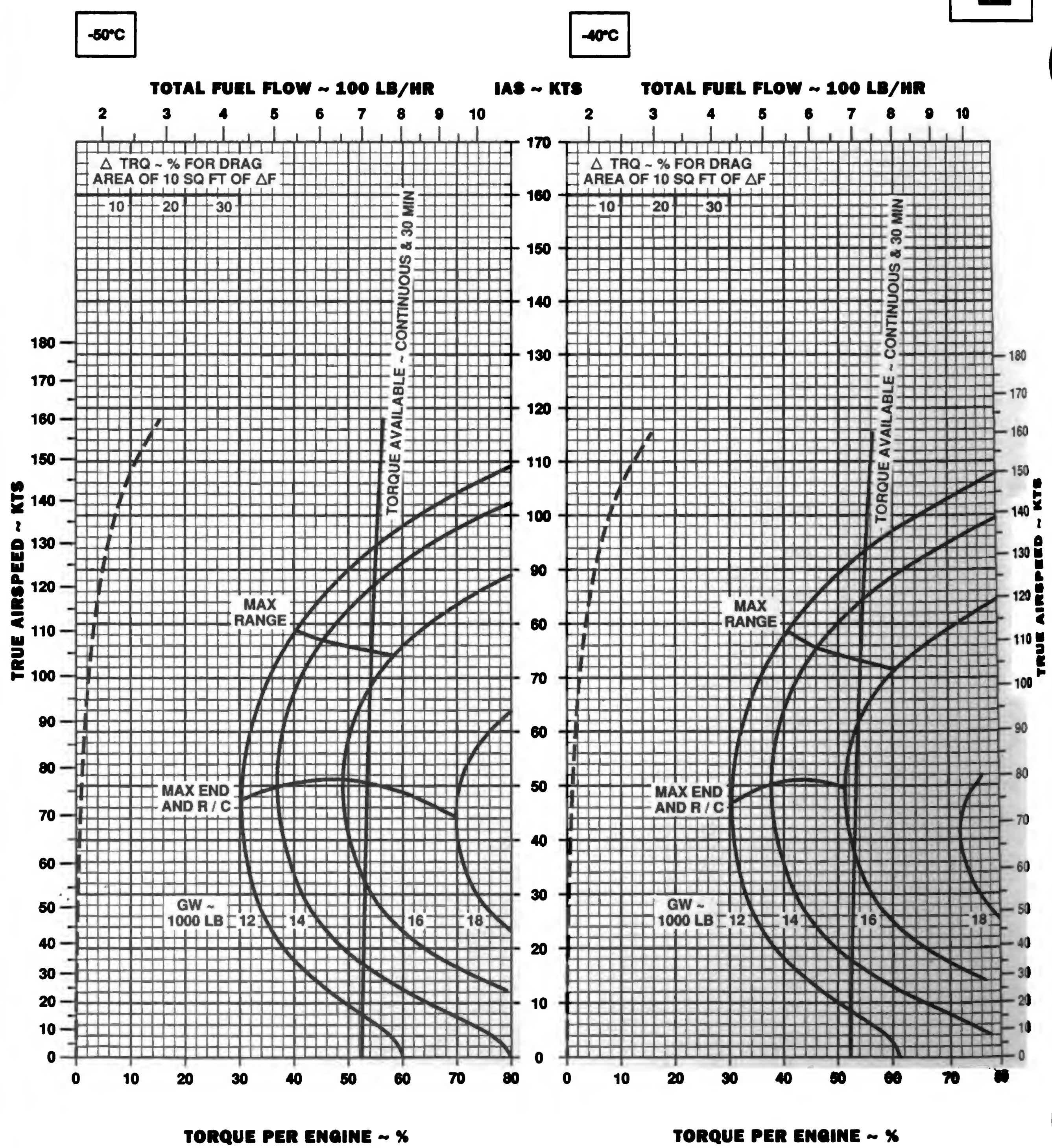
AA0446
SA

Figure 7-32. Cruise - Pressure Altitude 20,000 Feet (Sheet 4 of 4)

CRUISE

PRESS ALT: 20000 FT

CRUISE 20000 FT T700 (2)



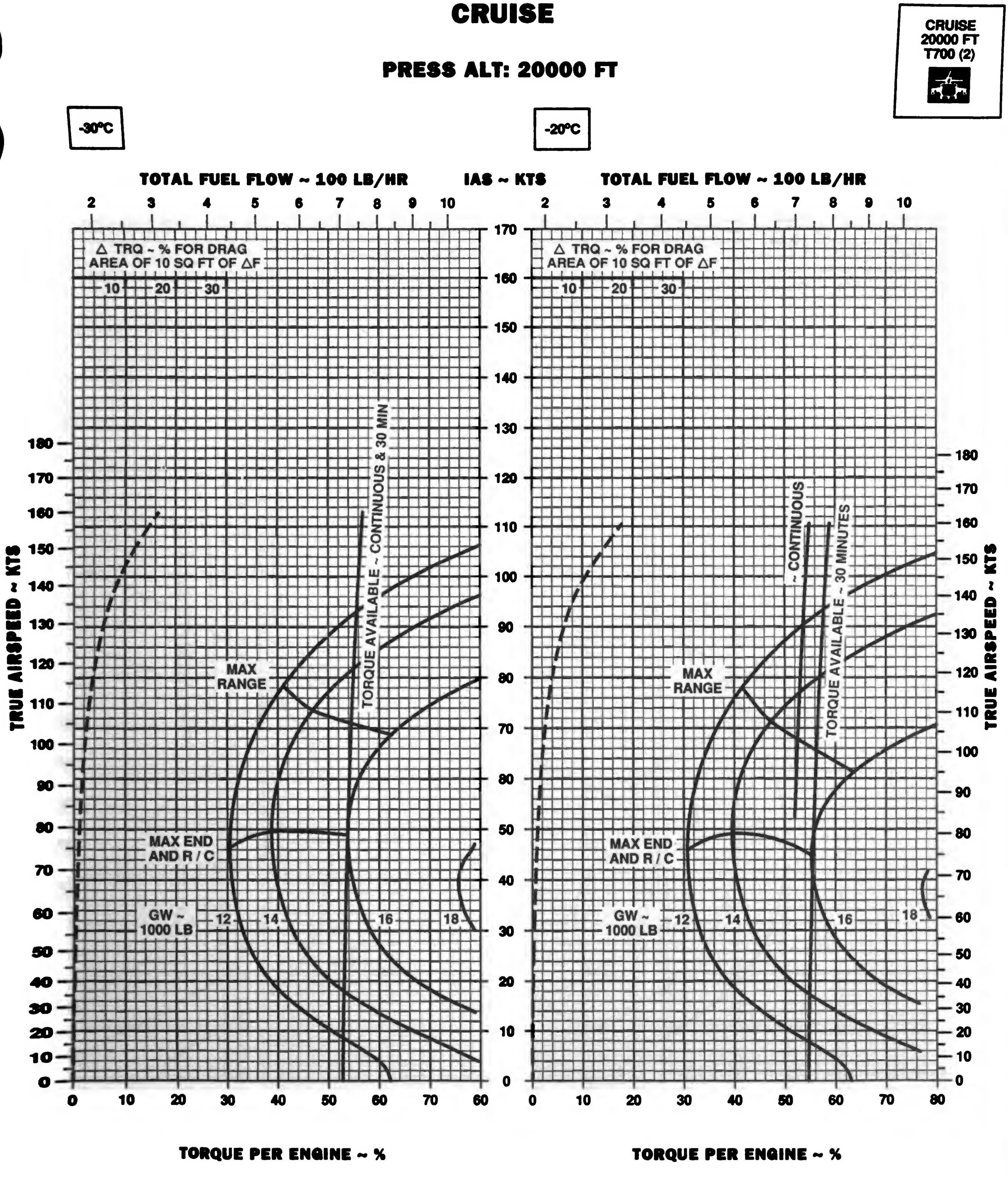
DATA BASE: FLIGHT TEST

AA0587

Figure 7-33. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 1 of 4)

CRUISE

PRESS ALT: 20000 FT



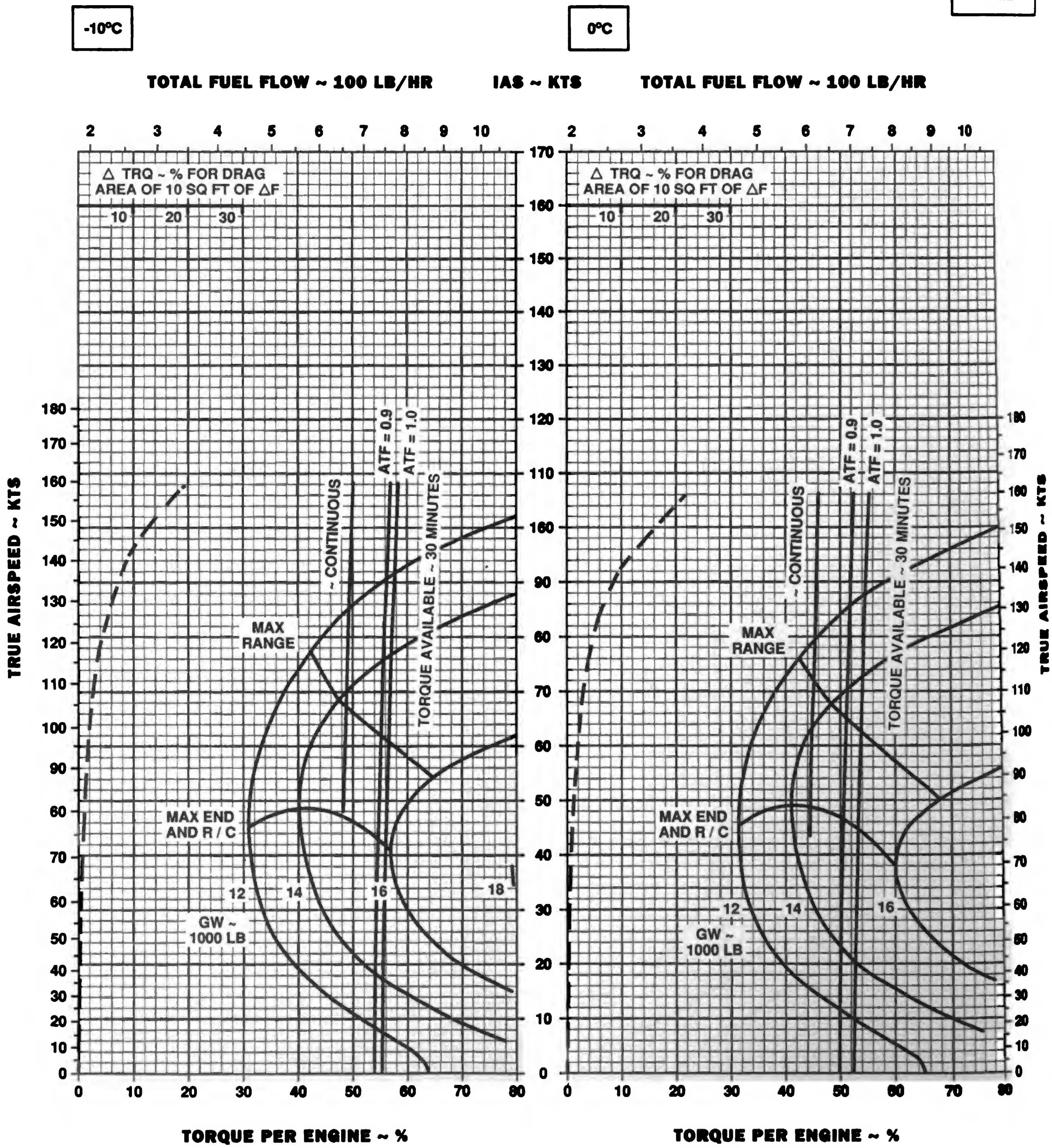
DATA BASE: FLIGHT TEST

Figure 7-33. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 2 of 4)

CRUISE

PRESS ALT: 20000 FT

CRUISE
20000 FT
T700 (2)



DATA BASE: FLIGHT TEST

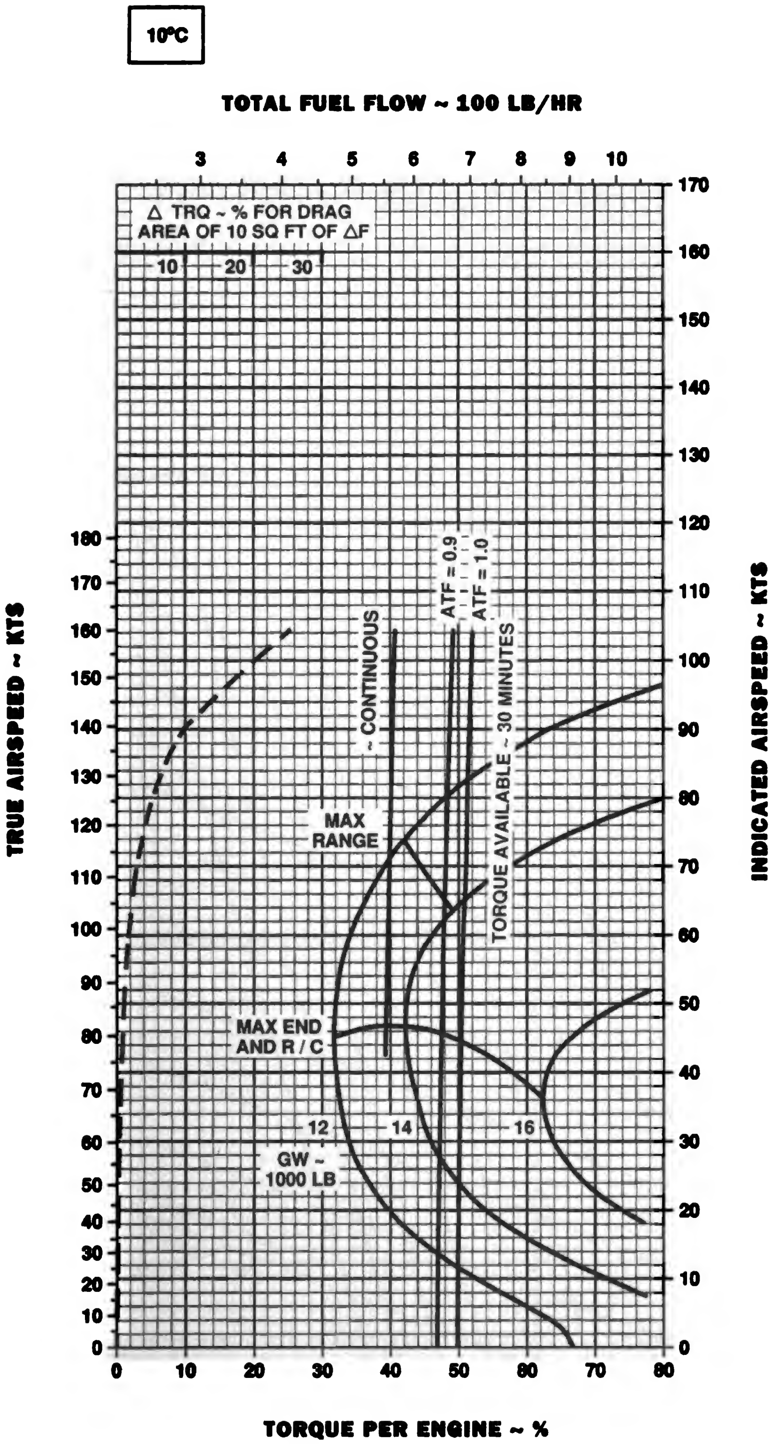
AA0569
SA

Figure 7-33. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 3 of 4)

CRUISE

PRESS ALT: 20000 FT

CRUISE
20000 FT
T700 (2)



DATA BASE: FLIGHT TEST

AA0590
SA

Figure 7-33. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 4 of 4)

Section VI OPTIMUM CRUISE

7-25. Optimum Range Charts.

This section presents a method to optimize cruise performance for long range missions when the altitudes flown are not restricted by other requirements. The optimum altitude for maximum range chart (Figure 7-34) provides the pressure altitude at which to cruise to obtain the maximum possible range for any gross weight and FAT conditions. The altitude determined for optimum range may also be used for optimum endurance. Enter the chart at a current cruise or takeoff temperature condition and move along the temperature guide lines to the anticipated gross weight for cruise and obtain the optimum pressure altitude. Turn to the cruise chart closest to the altitude and temperature predicted by the optimum range chart for specific cruise information. The use of this chart is shown by the example.

OPTIMUM RANGE

CLEAN CONFIGURATION 100% RPM R
HIRSS (BAFFELS INSTALLED)

EXAMPLE

WANTED:

CRUISE ALTITUDE FOR OPTIMUM RANGE AND CORRESPONDING CRUISE CHART FOR FLIGHT CONDITIONS

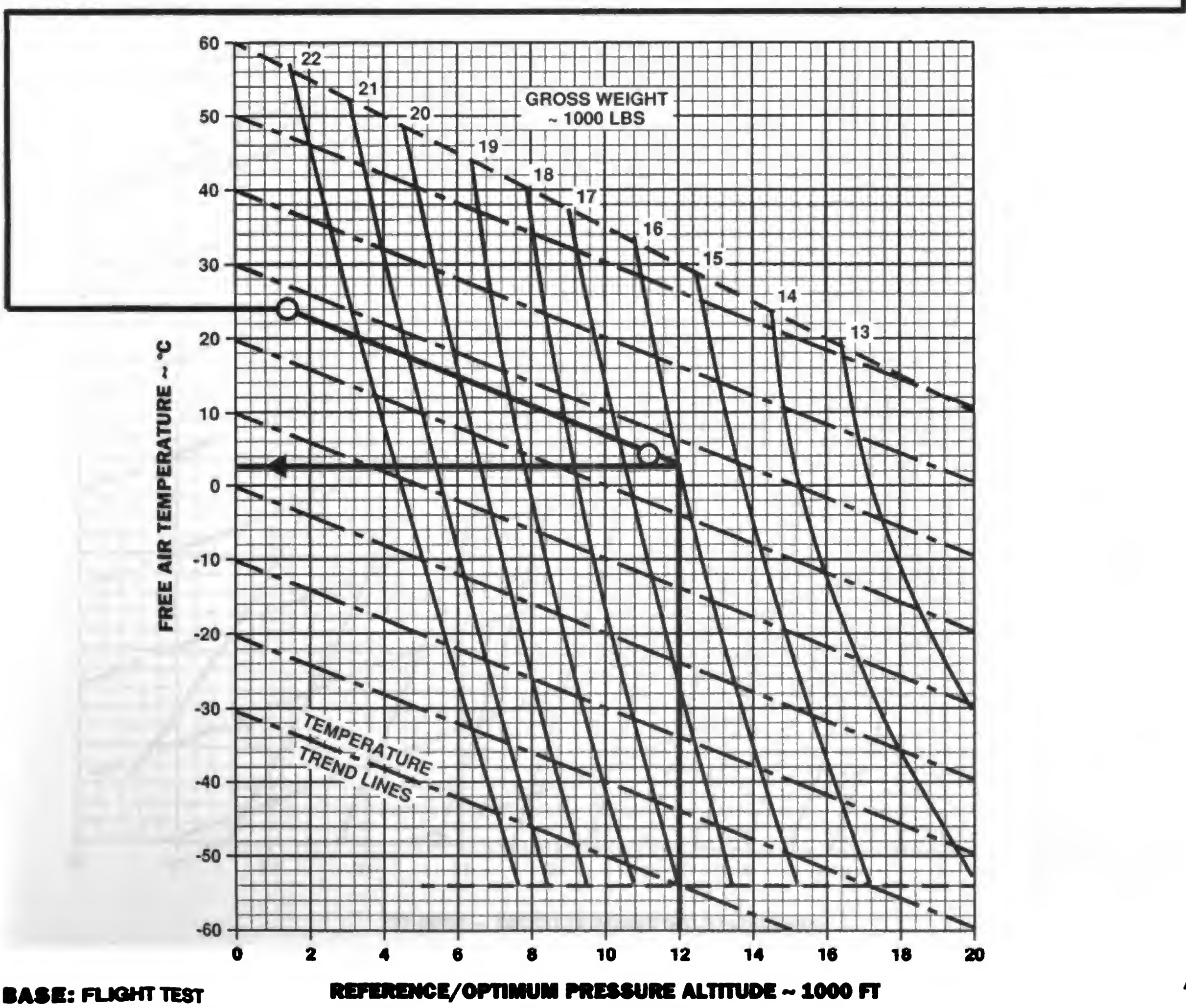
KNOWN:

REFERENCE CONDITIONS OF:
PRESSURE ALTITUDE = 1,500 FT
FAT = 24 °C
GROSS WEIGHT = 16,500 LB

METHOD:

ENTER CHART AT FAT (24 °C), MOVE RIGHT TO REFERENCE / OPTIMUM PRESSURE ALTITUDE (1,500 FT). MOVE PARALLEL WITH THE TEMPERATURE TREND LINES TO AIRCRAFT GROSS WEIGHT (16,500 LB). MOVE LEFT OR RIGHT PARALLELING THE TEMPERATURE TREND LINE TO NEAREST EVEN THOUSAND REFERENCE / OPTIMUM PRESSURE ALTITUDE LINE (12,000). MOVE LEFT TO FREE AIR TEMPERATURE LINE (2.5 °C), MOVE UP OR DOWN TO NEAREST TEN VALUE ON THE FREE AIR TEMPERATURE SCALE (0 °C).

SELECT CRUISE CHART WITH ALTITUDE AND TEMPERATURE DATA AT THE NEAREST REFERENCE / OPTIMUM PRESSURE ALTITUDE (12,000 FT) AND THE NEAREST TEN DEGREE FREE AIR TEMPERATURE (0 °C).



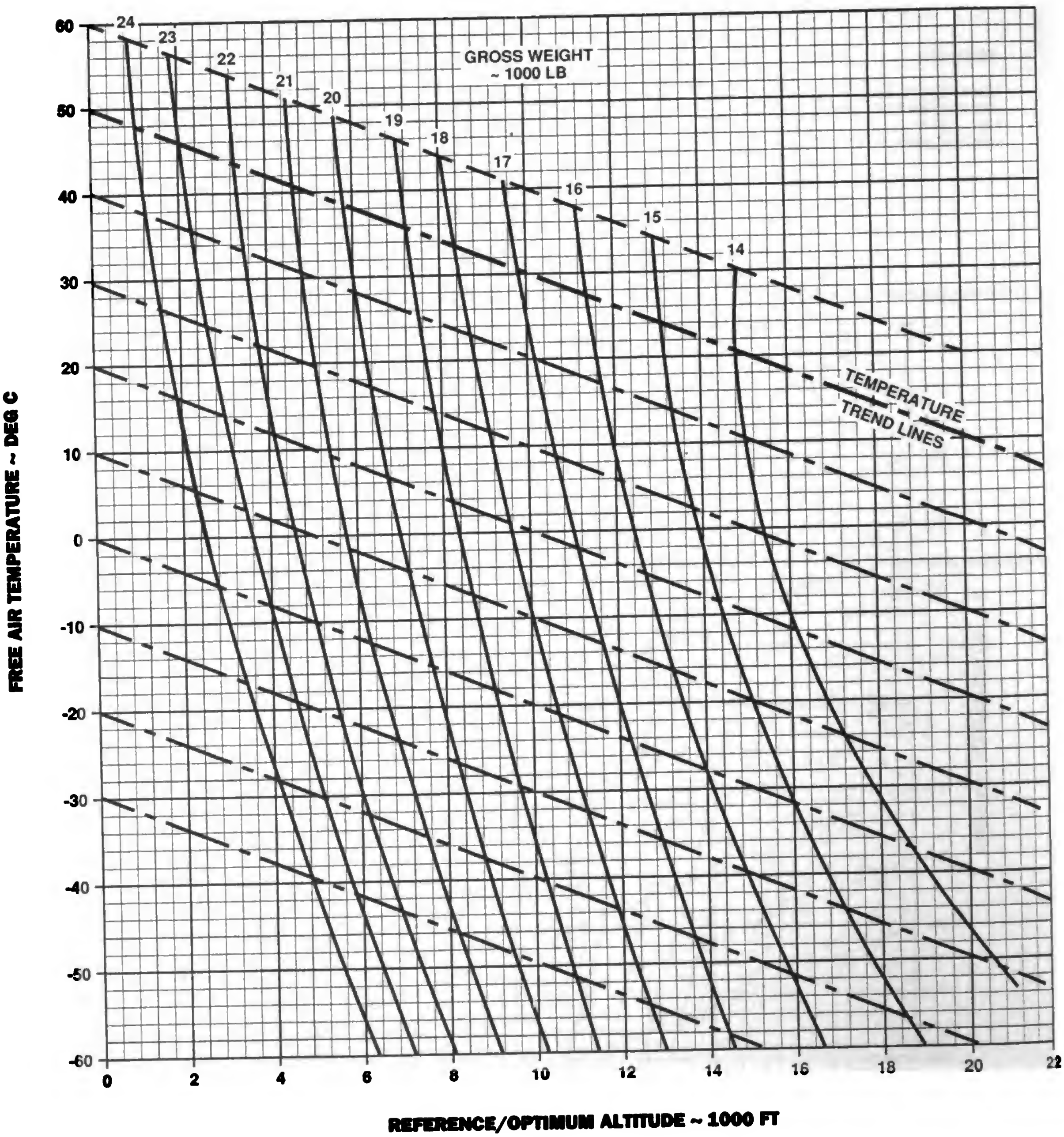
DATA BASE: FLIGHT TEST

AA0683_1

Figure 7-34. Optimum Altitude For Maximum Range (Sheet 1 of 2)

OPTIMUM RANGE

HIRSS (BAFFELS INSTALLED)
100% RPM R



DATA BASE: FLIGHT TEST

Figure 7-34. Optimum Altitude For Maximum Range (Sheet 2 of 2)

Section VII DRAG

7-26. External Load Drag Chart.

The general shapes of typical external loads are shown on Figure 7-35 as a function of the load frontal area. The frontal area is combined with the typical drag coefficient of the general shapes to obtain a drag multiplying factor for use with the 10 sq. ft. drag scale on each cruise chart. The ΔTRQ ~ % value obtained from the cruise chart is multiplied by the drag multiplying factor and added to indicated torque to obtain total torque required at any airspeed.

7-27. Aircraft Configuration Drag Changes For Use With Cruise Charts.

When external equipment or configuration differs from the baseline clean configuration as defined in Section I, a drag correction should be made similarly to the external drag load method. Typical configuration changes that have drag areas established from flight test or analysis along with their drag multiplying factor are shown on Figure 7-36.

EXTERNAL DRAG LOAD

LOAD
DRAG

EXAMPLE

WANTED:

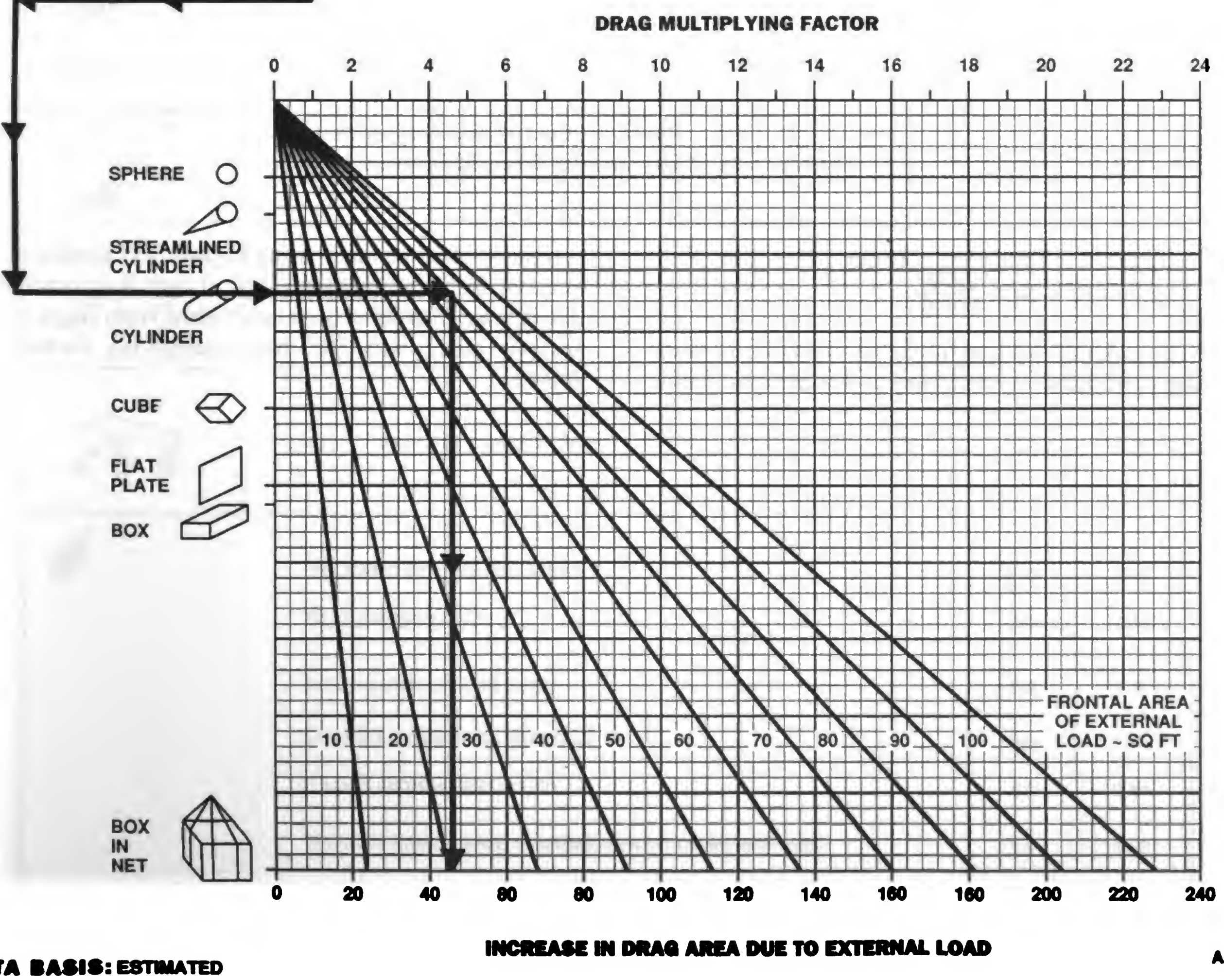
DRAG MULTIPLYING FACTOR
DUE TO EXTERNAL LOAD

KNOWN:

SHAPE OF EXTERNAL
LOAD = CYLINDER
FRONTAL AREA OF
EXTERNAL LOAD = 80 SQ FT

METHOD:

ENTER CHART AT SYMBOL
FOR CYLINDER
MOVE RIGHT TO 80 SQ FT.
MOVE DOWN AND READ
DRAG MULTIPLYING FACTOR
= 4.5



DATA BASIS: ESTIMATED

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Figure 7-35. External Load Drag

DRAG CHANGES FOR USE WITH CLEAN CRUISE CHARTS		
Item	Change in Flat Plate Drag Area - ΔF Sq. Ft.	Drag Multiplying Factor
a. Both cargo doors open	+6.0	0.60
b. Cargo doors removed	+4.0	0.40
c. Cargo mirror installed	+0.3	0.03
d. IR Countermeasure Transmitter (ALQ-144) installed	+0.8	0.08
e. Chaff Dispenser Installed	+0.3	0.03
f. Cruise IR Suppressor installed:	+4.6	0.46
g. Flare Dispenser EH	+0.3	0.03
h. EH-60A Mission Antennas Only EH	+3.8	0.38

Figure 7-36. Configuration Drag Change

7-28. Aircraft Configuration Changes For Use With High Drag Cruise Charts.

When external equipment differs from the baseline high drag configuration as defined in this Section, a drag correction shall be made using Figure 7-37 similar to the external drag load method. Typical high drag configuration changes that have been established from flight test or analysis along with the drag multiplying factors are shown.

DRAG CONFIGURATIONS

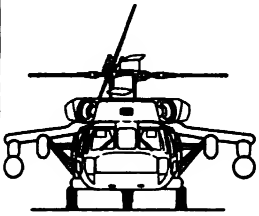
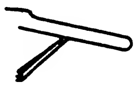
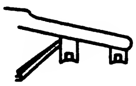
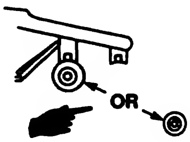
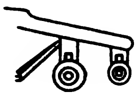
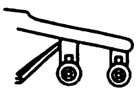
	HIGH DRAG CRUISE CHART BASELINE SPECIAL MISSION EQUIPMENT CONFIGURATIONS	CHANGE IN FLAT PLATE DRAG ΔF SQ FT	DRAG MULTI-PLYING FACTOR
	ESSS - CLEAN, PYLONS REMOVED	-4.0	-0.40
	ESSS - FOUR PYLONS / NO STORES	-1.7	-0.17
	ESSS-TWO 450 GALLON TANKS INBOARD -TWO 230 GALLON TANKS INBOARD	0.5 0.0	0.05 0.00
	ESSS-TWO 230 GALLON TANKS OUTBOARD -TWO 450 GALLON -TANKS INBOARD	2.5	0.25
	ESSS - FOUR 230 GALLON TANKS	2.0	0.20
	VOLCANO SYSTEM INSTALLED	32.5	3.25
	SKI CONFIGURATION	3.0	0.30
	BOTH CARGO DOORS OPEN	6.0	0.60
	BOTH CARGO DOORS REMOVED	4.0	0.40
	CARGO MIRROR INSTALLED	0.3	0.03
	IR COUNTERMEASURE TRANSMITTER (ALQ-144) REMOVED	-0.8	-0.08
	CHAFF DISPENSER REMOVED	-0.3	-0.03

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Figure 7-37. Typical High Drag Configurations

Section VIII CLIMB - DESCENT

7-29. Climb Performance Chart.

The CLIMB chart (Figure 7-38) presents the time, fuel required, and distance traveled to climb from sea level to various cruise altitudes using dual engine maximum power available (30-minute limit) for an aircraft with an ATF of 0.9. Aircraft with an ATF value above 0.9 will have somewhat better climb capability. The climb data are based on maintaining 80 KIAS which approximates the airspeed for maximum R/C in average flight conditions. If a more exact airspeed is required, the actual IAS for maximum R/C may be obtained from the cruise charts and corrected to IAS in climb as shown in section X. Warmup and takeoff fuel used are not included on this chart. The use of this chart is shown by the example.

7-30. Climb/Descent Chart.

The CLIMB/DESCENT chart (Figures 7-39 and 7-40) presents the rate of climb or descent resulting from an increase or decrease of engine torque from the value required for level flight above 40 KIAS. The data are presented at 100% RPM R for various gross weights. The charts may also be used in reverse to obtain the torque increase or reduction required to achieve a desired steady rate of climb or descent. The maximum R/C may be determined by subtracting the cruise chart torque required from the maximum torque available at the desired flight conditions. Then enter the difference on the torque increase scale of the climb chart, move up to the gross weight, and read the resulting maximum R/C.

CLIMB

CLIMB

30-MIN LIMIT 100% RPM R

HIRSS (BAFFELS INSTALLED) ATF = 0.9 DUAL ENGINE

EXAMPLE

WANTED:

TIME TO CLIMB FUEL USED, AND
DISTANCE REQUIRED TO CLIMB
FROM 2,000 TO 12,000 FEET

KNOWN:

GROSS WEIGHT = 17,000 POUNDS
TEMPERATURE AT 2,000 = + 14°C

METHOD:

USING STANDARD LAPSE RATE,
TEMPERATURE AT 12,000 FEET IS
-6°C. AVERAGE TEMPERATURE IS

$$\frac{+14 + (-6)}{2} = +4^{\circ}C$$

A. ENTER CHART AT 17,000 POUNDS GROSS WEIGHT, MOVE RIGHT TO 12,000 FEET THEN DOWN TO + 4°C ON TIME, DISTANCE, AND FUEL GRAPHS. MOVE LEFT TO READ 7.0 MINUTES, 134 POUNDS OF FUEL, AND 10.5 NM REQUIRED TO CLIMB FROM SEA LEVEL TO 12,000 FEET.

B. ENTER CHART AT 17,000 POUNDS GROSS WEIGHT, MOVE RIGHT TO 2,000 FEET THEN DOWN TO + 4°C ON TIME, DISTANCE, AND FUEL GRAPHS. MOVE LEFT TO READ 1.0 MINUTES, 20 POUNDS OF FUEL, AND 1.2 NM.

C. SUBTRACT DATA OBTAINED IN STEP B FROM DATA OBTAINED IN STEP A. THE DIFFERENCE IS 6 MINUTES, 114 POUNDS OF FUEL USED AND 9.3 NM TRAVELED IS THE CLIMB DATA FOR CLIMB STARTED AT 2,000 FEET AND ENDING AT 12,000 FEET.

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Figure 7-38. Climb - 2 Engine (Sheet 1 of 3)

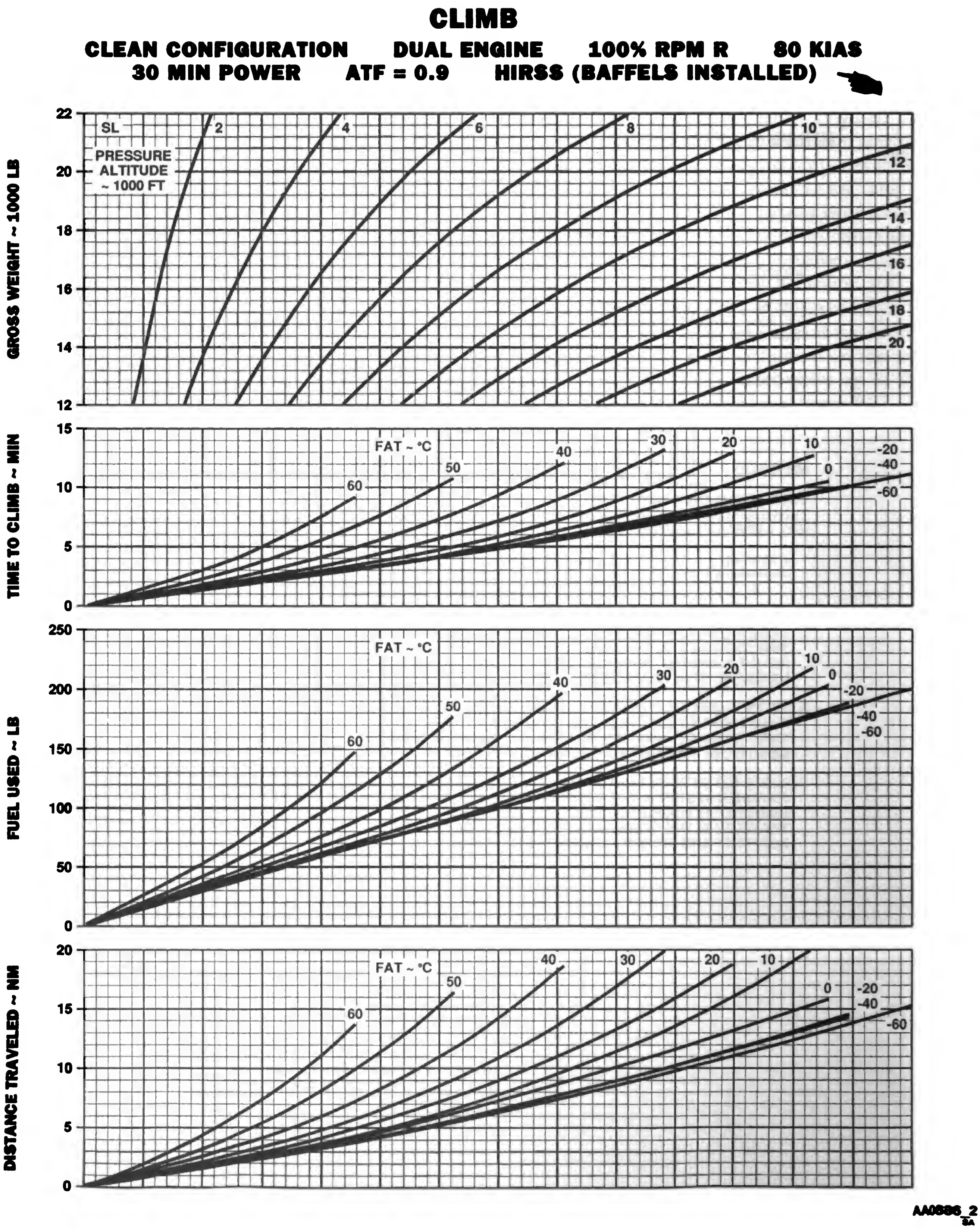


Figure 7-38. Climb - 2 Engine (Sheet 2 of 3)

CLIMB

CLEAN CONFIGURATION DUAL ENGINE 100% RPM R 70 KIAS
30 MIN POWER ATF = 0.9 HIRSS (BAFFLES INSTALLED)

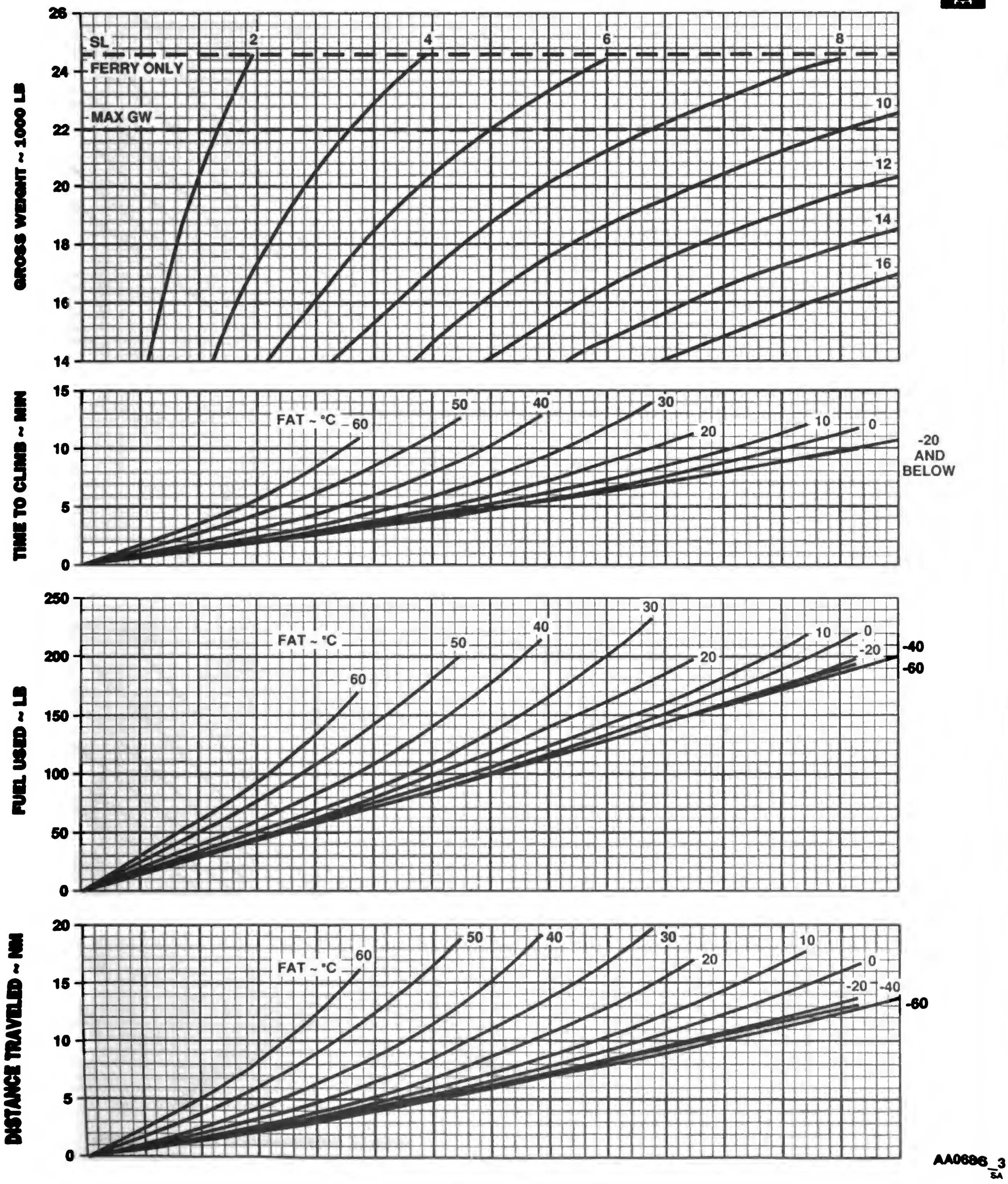
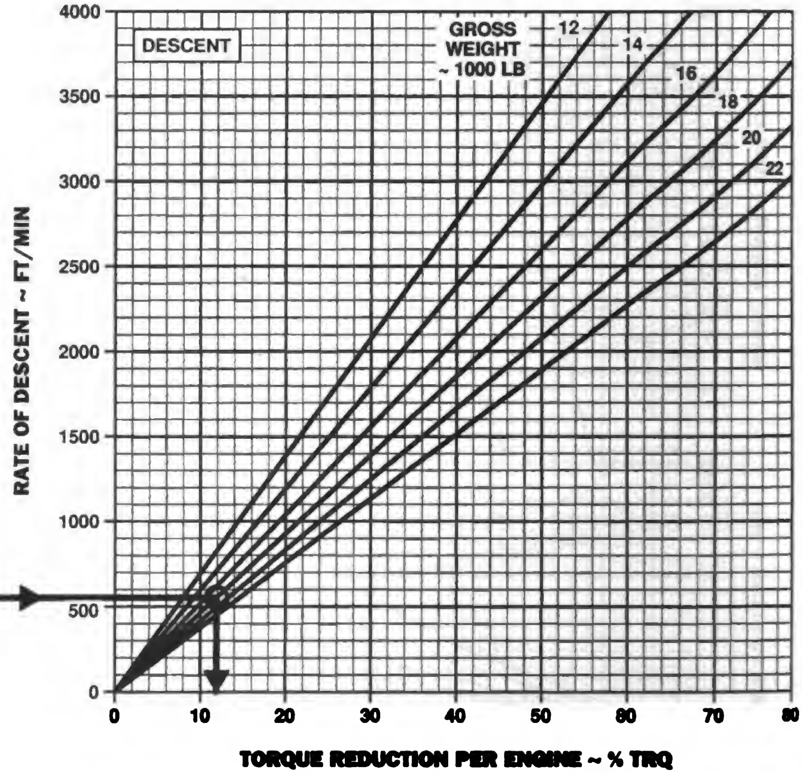


Figure 7-38. Climb - 2 Engine (Sheet 3 of 3)

CLIMB/DESCENT

CLEAN CONFIGURATION 100% RPM R
FOR IAS ABOVE 40 KIAS



EXAMPLE

WANTED:

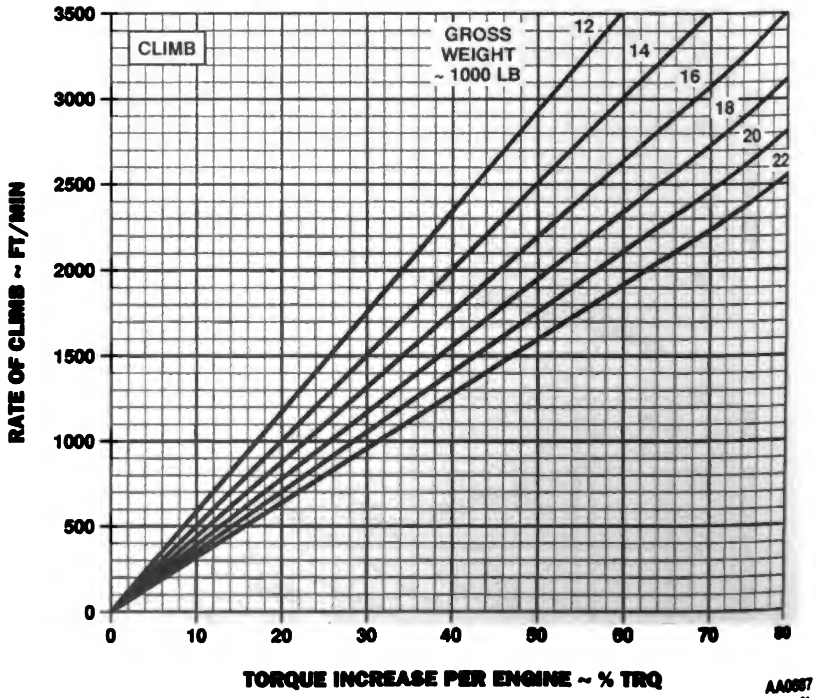
INDICATED TORQUE CHANGE FOR DESIRED RATE-OF-CLIMB OR DESCENT.

KNOWN:

GROSS WEIGHT = 18,000 POUNDS
DESIRED RATE = 550 FEET PER MINUTE

METHOD:

ENTER CHART AT 550 FEET PER MINUTE MOVE RIGHT TO INTERSECT GROSS WEIGHT LINE. MOVE DOWN TO READ 12% TRQ CHANGE.

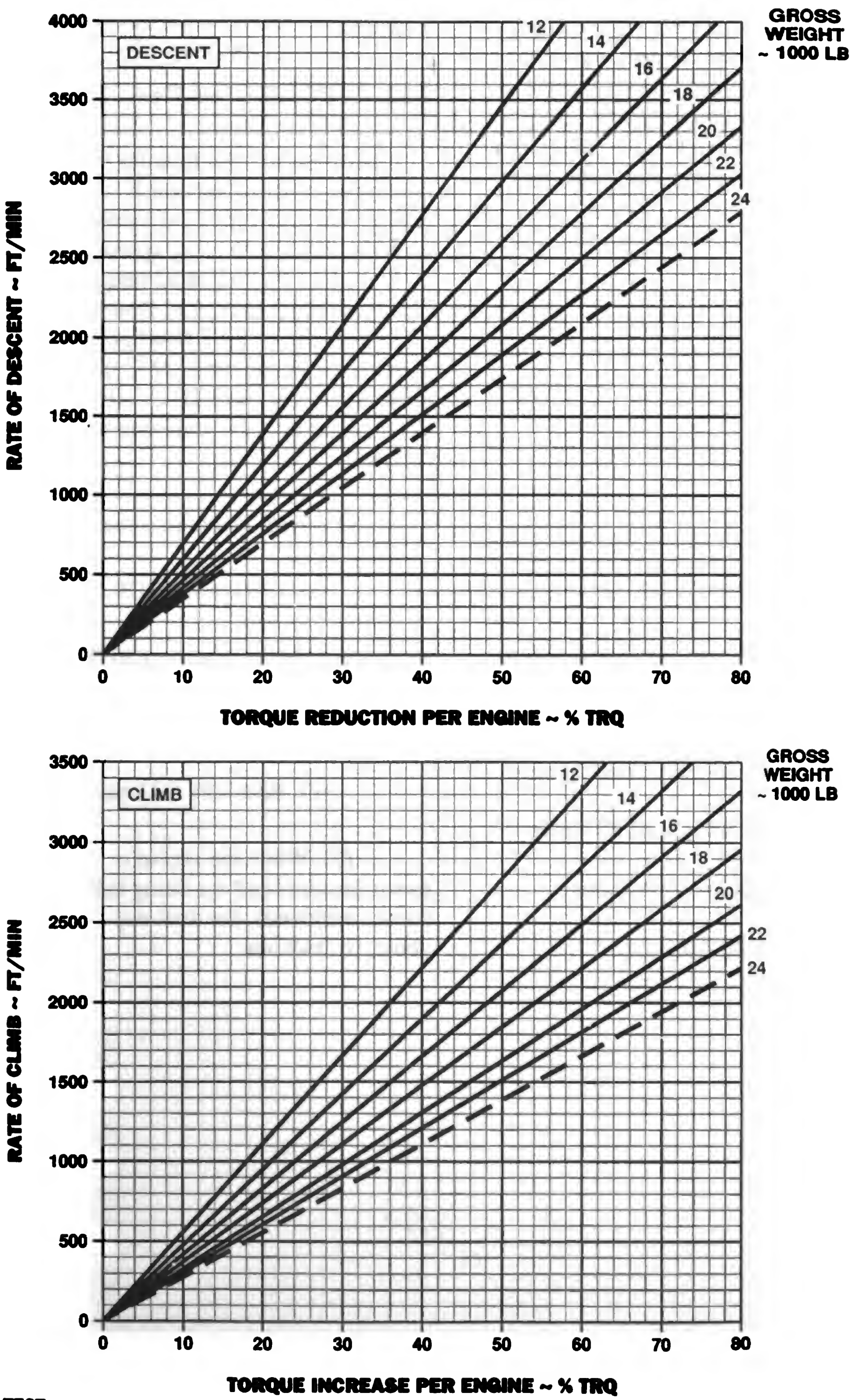


DATA BASE: FLIGHT TEST

Figure 7-39. Climb/Descent

CLIMB/DESCENT

100% RPM R
AIRSPEEDS ABOVE 40 KIAS



DATA BASE: FLIGHT TEST

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Figure 7-40. Climb/Descent - High Drag

Section IX FUEL FLOW

7-31. Idle Fuel Flow.

Dual-engine idle fuel flow is presented as a function of altitude at 0°C FAT in Figure (7-41). The data are based on operation at 62% to 69% N_g for idle and 85% to 89% for flat pitch (collective full down) at 100% RPM R. Fuel flow for the auxiliary power unit (APU) is also presented for a nominal load of 80% maximum power as a function of altitude and 0°C FAT for general planning.

7-32. Single-Engine Fuel Flow.

Engine fuel flow is presented in Figure (7-42) for various torque and pressure altitudes at a baseline FAT of 0°C with engine bleed air extraction OFF. When operating at other than 0°C FAT, engine fuel flow is increased 1% for each 20°C above the baseline temperature and, decreased 1% for each 20°C below the baseline temperature.

To determine single-engine fuel flow during cruise, enter the fuel flow chart at double the torque required for dual-engine cruise as determined from the cruise charts and obtain fuel flow from the single-engine scale. The single-engine torque may not exceed the transmission limit shown on the chart. With bleed air ON, single-engine fuel flow increases as follows:

(1) With bleed-air extracted, fuel flow increases:

(a) ENG ANTI-ICE ON - About 30 lbs/hour

(b) HEATER ON - About 10 lbs/hour

(c) Both ON - About 40 lbs/hour

(2) When the IR suppressor system is installed and operating in the benign mode (exhaust baffles removed), the single-engine fuel flow will decrease about 8 lbs/hour.

7-33. Dual-Engine Fuel Flow.

Dual-engine fuel flow for level flight is presented on the cruise charts in Section V. For other conditions dual-engine fuel flow may be obtained from Figure 7-42 when each engine is indicating approximately the same torque by averaging the indicated torques and reading fuel flow from the dual-engine fuel flow scale. When operating at other than the 0° FAT baseline, dual-engine fuel flow is increased 1% for each 20°C above baseline and is decreased 1% for each 20°C below baseline temperature. With bleed air ON, dual-engine fuel flow increases as follows:

(1) With bleed-air extracted, fuel flow increases:

(a) ENG ANTI-ICE ON - About 60 lbs/hour

Example: (760 lbs/hour = 820 lbs/hour).

(b) HEATER ON - About 20 lbs/hour

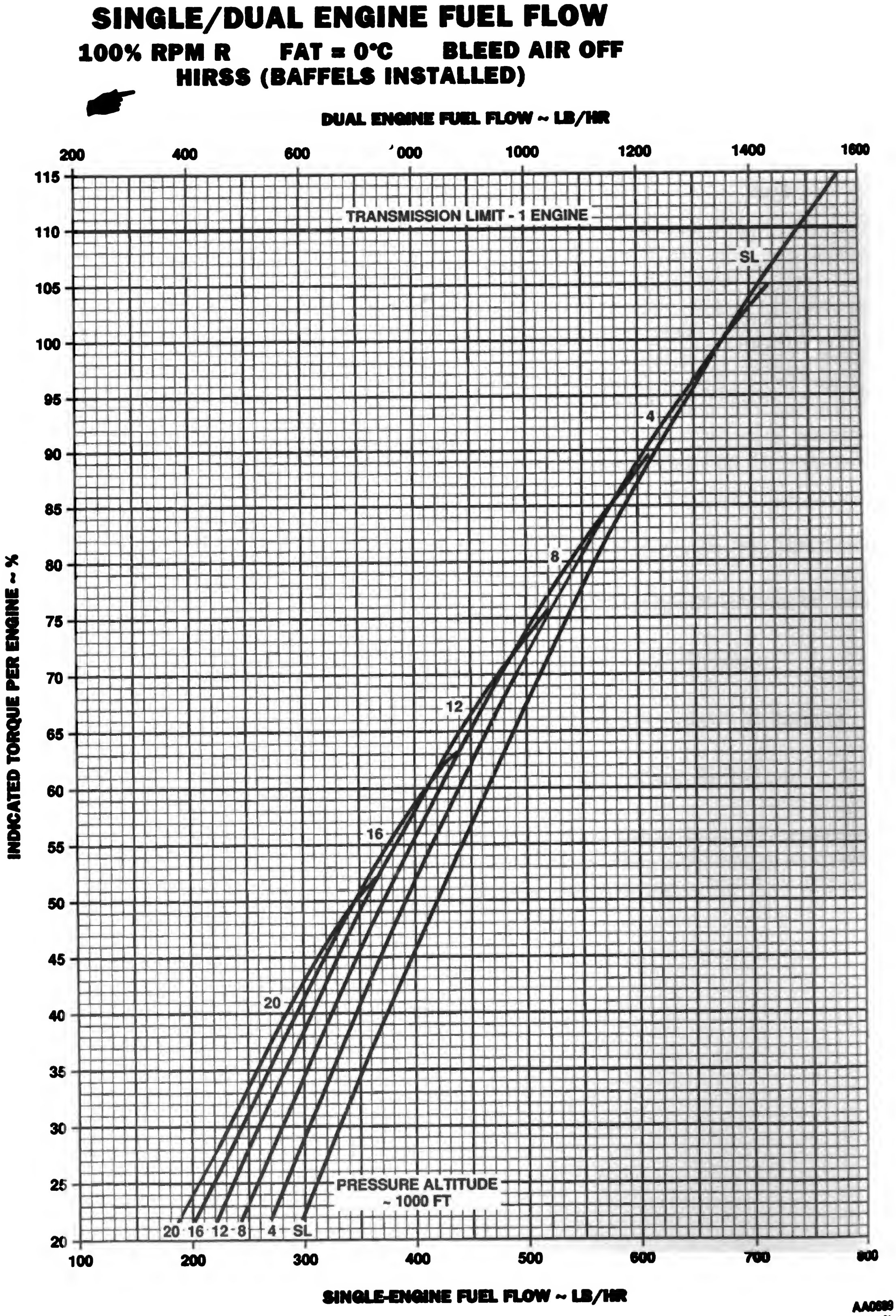
(c) Both ON - About 80 lbs/hour

(2) When the cruise or hover IR suppressor system is installed and operating in the benign mode (exhaust baffles removed), the dual-engine fuel flow will decrease about 16 lbs/hour.

Dual Engine Idle and Auxiliary
Power Unit Fuel Flow

	N_g = 62-69%	N_g = 85-89%	
Pressure Altitude Feet	Ground Idle (No Load) Lb/Hr	Flat Pitch (100% RPM R) Lb/Hr	APU (Nominal) Lb/Hr
0	350	580	120
4,000	326	500	105
8,000	268	440	90
12,000	234	380	75
16,000	206	320	65
20,000	182	270	55

Figure 7-41. Idle Fuel Flow



NOTE

INCREASE FUEL FLOW 1% FOR EACH 20 °C ABOVE 0 °C FAT AND DECREASE FUEL FLOW 1% FOR EACH 20 °C BELOW 0 °C FAT.

Figure 7-42. Single/Dual-Engine Fuel Flow

Section X AIRSPEED SYSTEM CHARACTERISTICS

7-34. Airspeed System Description.

There are two different pitot-static systems on the UH-60A depending on the installation of the ESSS provisions kit on each particular aircraft. The type of airspeed system may be determined from the mounting of the pitot-static probes on the cabin roof. The pitot-static probes were originally flush mounted and for the ESSS provision system the pitot-static probes are mounted on a wedge which rotates the pitot tube 20° further outboard and 3° nose down. The wedge is covered by an aerodynamic fairing to prevent ice accretion. The airspeed system provided with the ESSS provisions kit is the primary system and its calibration was used to derive the IAS presented on the charts in this manual.

7-35. Airspeed Charts.

7-36. Airspeed Correction Charts.

All indicated airspeeds shown on the cruise charts are based on level flight of an aircraft with ESSS provisions. Figures 7-43 through 7-45 provide the airspeed correction to be added to the cruise chart IAS values to determine the related airspeed indicator reading for other than level flight mode. There are small variations in airspeed system errors in level flight between those aircraft with ESSS provisions and those without ESSS provisions. Correction for these small variations is not normally warranted. There are relatively large variations in airspeed system error associated with climbs and descents. These errors are significant and Figures 7-43 through 7-45 are provided primarily to show the general magnitude and direction of the errors associated with the various flight modes. If desired these figures may be used in the manner shown by the examples to calculate specific airspeed corrections.

7-37. Airspeed System Dynamic Characteristics.

The dynamic characteristics of the pilot and copilot airspeed indicating systems are normally satisfactory. However, the following anomalies in the airspeed and IVSI indicating system may be observed during the following maneuvers or conditions:

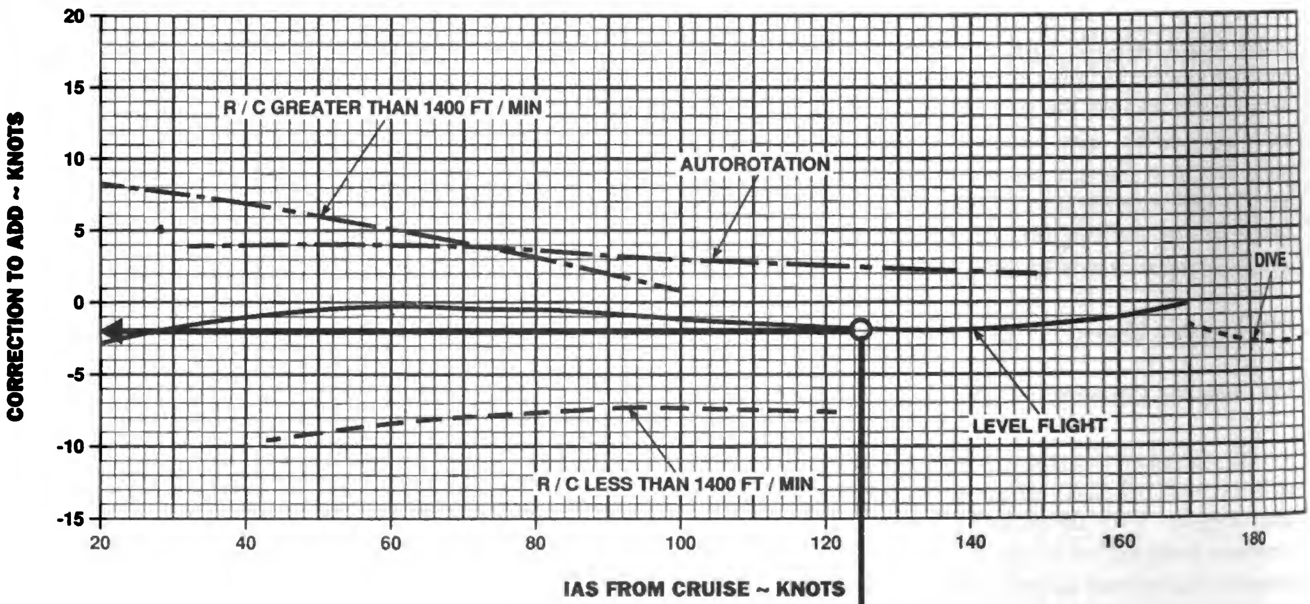
a. During takeoffs, in the speed range of 40 to 80 KIAS, 5 to 10 KIAS airspeed fluctuation may be observed on the pilot's and copilot's airspeed indicators.

b. Power changes in high power, low airspeed climbs may cause as much as 30 knot airspeed changes in indicated airspeed. Increase in power causes increase in indicated airspeed, and a decrease in power causes decrease in indicated airspeed.

c. The pilot and copilot airspeed indicators may be unreliable during high power climbs at low airspeeds (less than 50 KIAS) with the copilot system reading as much as 30 knots lower than the pilot system.

d. On aircraft with ESSS provision kit, in-flight opening and closing of doors and windows may cause momentary fluctuations of approximately 300 feet per minute on the vertical speed indicators.

AIRSPEED SYSTEM CORRECTION
CLEAN
AIRCRAFT WITHOUT
ESSS PROVISIONS



EXAMPLE

WANTED:

INDICATED AIRSPEED TO OBTAIN MAX RANGE FOR AN AIRCRAFT WITHOUT ESSS PROVISIONS KIT.

KNOWN:

125 KIAS FOR MAX RANGE CRUISE CHART AT A GIVEN PRESSURE ALTITUDE, FAT, AND GROSS WEIGHT.

METHOD:

ENTER AT KNOWN IAS FROM CRUISE CHART FOR MAX RANGE, MOVE UP TO LEVEL FLIGHT LINE, MOVE LEFT, READ CORRECTION TO ADD TO IAS = -2 KIAS. CALCULATE IAS FOR MAX RANGE: = 125 KIAS - 2 KIAS = 123 KIAS.

DATA BASE: FLIGHT TEST

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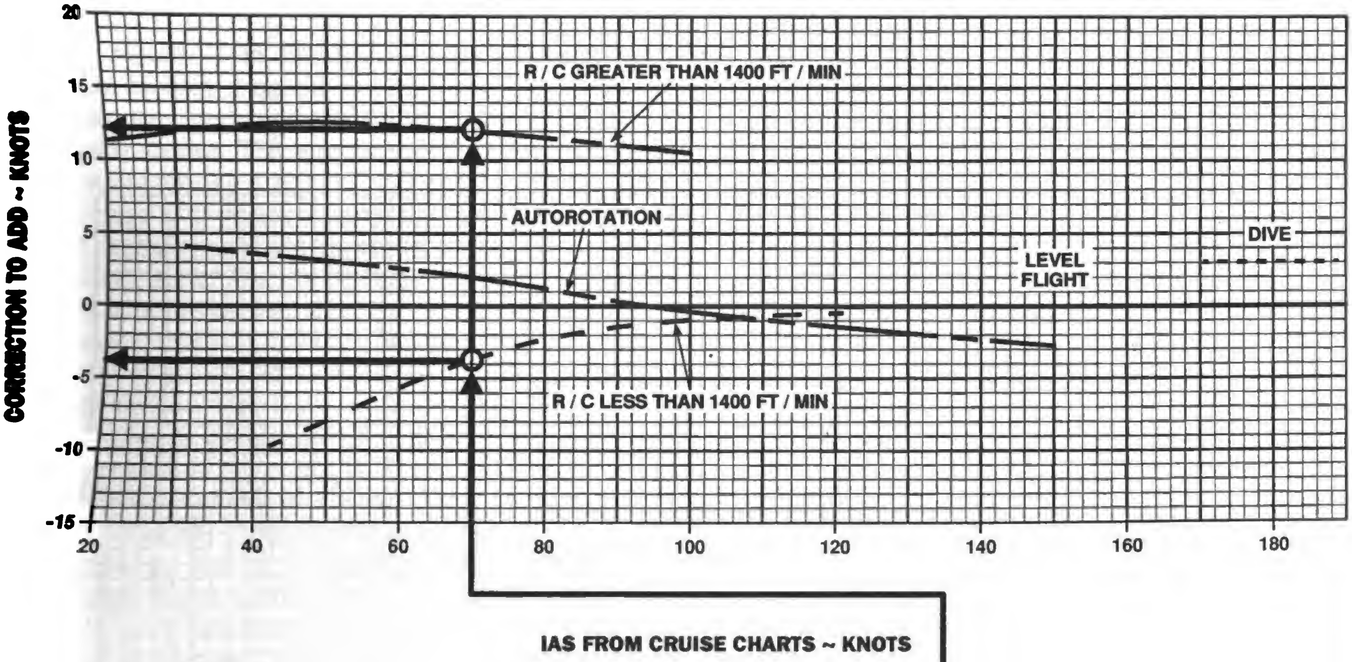
Figure 7-43. Airspeed Correction Aircraft Without ESSS Fixed Provisions

AIRSPEED SYSTEM CORRECTION
CLEAN



EXAMPLE

WANTED:

INDICATED AIRSPEED TO CLIMB AT MAXIMUM RATE OF CLIMB FOR AN AIRCRAFT WITH ESSS PROVISIONS KIT

KNOWN:

70 KIAS MAX END / AND R / C FROM APPROPRIATE CRUISE CHART FOR A GIVEN PRESSURE ALTITUDE, FAT, AND GROSS WEIGHT

METHOD:

ENTER AT KNOWN IAS FROM CRUISE CHART, MOVE UP TO R / C GREATER THAN 1400 FPM, MOVE LEFT READ CORRECTION TO ADD TO IAS = + 12.5 KTS, RE-ENTER AT KNOWN IAS FROM CRUISE CHART, MOVE UP TO R / C LESS THAN 1400 FPM LINE, MOVE LEFT, READ CORRECTION TO ADD TO IAS = - 4 KTS
CALCULATE IAS FOR MAX R / C WHEN:

FOR R / C GREATER THAN 1400 FPM, AIRSPEED = 70 KIAS + 12.5 KIAS = 82.5 KIAS

FOR R / C LESS THAN 1400 FPM, AIRSPEED = 70 KIAS - 4 KIAS = 66 KIAS

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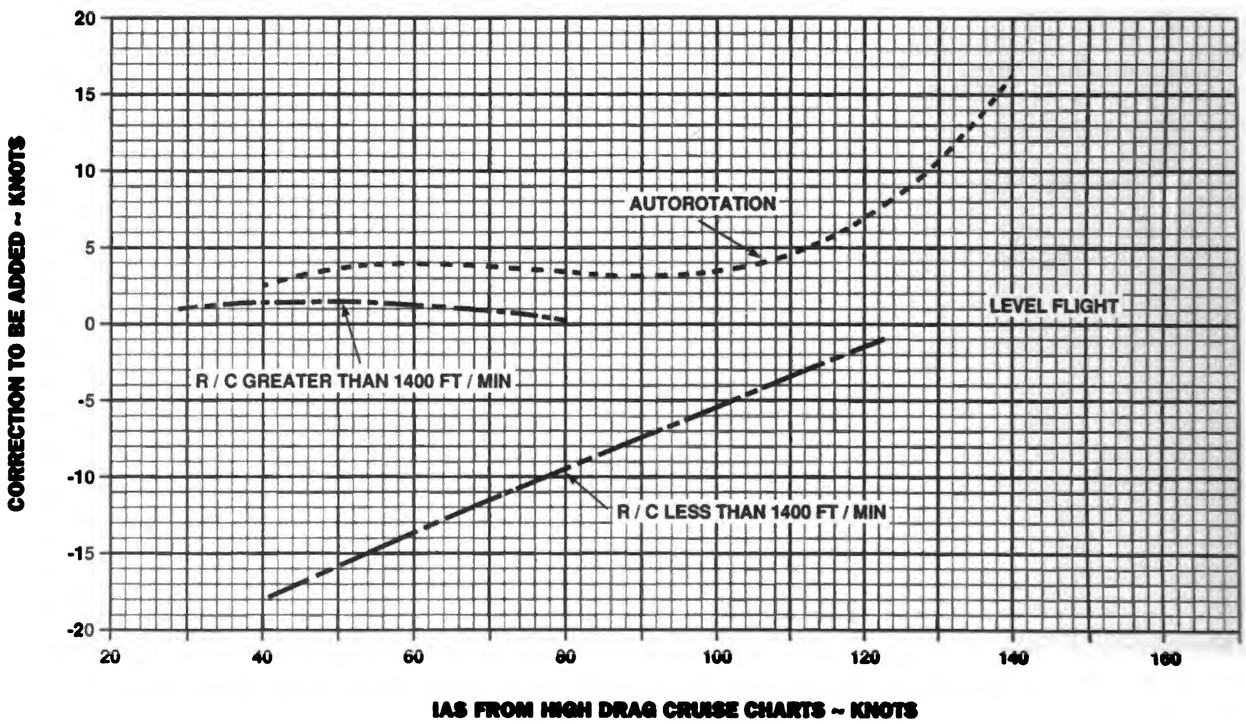
DATA BASE: FLIGHT TEST

Figure 7-44. Airspeed Correction Aircraft With ESSS Fixed Provisions

AIRSPEED SYSTEM CORRECTION



DATA BASE: FLIGHT TEST

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Figure 7-45. Airspeed Correction Chart - High Drag

Section XI SPECIAL MISSION PERFORMANCE

7-38. Special Mission Flight Profiles.

Figures 7-46 through 7-48 show special mission flight profiles required to obtain near maximum range when equipped with the ESSS in three different tank configurations. The upper segment of each chart provides the recommended altitude profile along with the IAS and average TRQ versus distance traveled. An average value of elapsed time is also presented on the lower axis of the altitude scale. The lower segment of each chart provides the relationship between fuel remaining and distance traveled resulting from the flight profile shown. This portion may be utilized to check actual inflight range data to provide assurance that adequate range is being achieved. The chart is divided into 3 regions of Adequate Range, Inadequate range-return to base, and Inadequate range-requiring emergency action. When an in-flight range point is in the Adequate range region, the required mission range can be obtained by staying on the recommended flight profile. However, the range may not be achieved if stronger headwinds are encountered as the flight progresses, and normal pilot judgement must be used. These charts also assume that the flight track is within proper navigational limits. Standard temperature variation with PA is shown on the upper segment of the charts. A general correction for temperature variation is to decrease IAS by 2.5 KTS and total distance traveled by 0.5% for each 10°C above standard. Detailed flight planning must always be made for the actual aircraft configuration, fuel load, and flight conditions when maximum range is required.

(a) SELF-DEPLOYMENT MISSION.

The self-deployment mission is shown in Figure 7-46 and the ESSS is configured with two 230 gallon tanks outboard and two 450 gallon tanks inboard. In this configuration, the aircraft holds in excess of 11,000 lb of JP4 fuel and has a take-off gross weight of 24,500 pounds in order to achieve the desired mission range of 1,150 Nm. This gross weight is allowed for ferry missions only, requiring low load factors and less than 30 deg angle banked turns. This mission was calculated for a standard day with a constant 10 knot headwind added to be conservative. Since there may not be any emergency landing areas available, the misson should not be attempted if headwinds in excess of 10 knots are forecast. Take-off must be made with a minimum of fuel used (60 pounds) for engine start and warm-up, and a Climb to 2,000 feet should be made with max power and airspeed between 80 and 105 KIAS. The first sement should be maintained at 2,000 feet and 105 KIAS for 2 hours. The average engine TRQ should be about 79% for this segment, but will initially be a little more and gradually decrease. Altitude is increased in 2,000 feet increments to maintain the optimum altitude for max range to account for fuel burn. The first 2 segments are for 2 hours each, followed by 1 hr segments until reaching 10,000 feet. At this altitude, the airspeed for best range should also be reduced to 95 KIAS for the remainder of the flight. Engine bleed air was assumed to be off for this mission except for that required for fuel tank pressurization. Electrical cabin heat may be used. Removal of the HIRSS baffels (benign mode) will reduce fuel flow by about 12 lb/hr. If oxygen is available, continuation of the staircase climb sequence to 15,500 feet PA will result in about 23 additional Nm of range capability.

(b) ASSAULT MISSION PROFILE - 4 tanks

The assault mission profile is shown in Figure 7-47 with the ESSS configured with four 230 gallon tanks. In this configuration, the aircraft holds in excess of 8,300 pounds of JP4 fuel and assumes a take-off gross weight of 22,000 pounds which provides a maximum mission range of 1140 Nm with 400 lbs reserve. This mission was calculated for a standard day with a zero headwind. Take-off must be made with a minimum of fuel used (80 pounds) for engine start and warm-up, and a Climb to 4,000 feet should be made with max power and airspeed between 80 and 108 KIAS. The first sement should be maintained at 4,000 feet and 108 KIAS for 1 hour. The average engine TRQ should be about 79% for this segment, but will initially be a little more and gradually decrease. Altitude is increased in 2,000 feet increments to maintain the optimum altitude for maximum range to account for fuel burn. The segments are for 1 hour each, until reaching 10,000 feet. At this altitude, the airspeed for best range should be reduced to 95 KIAS for the remainder of the flight.

(c) ASSAULT MISSION PROFILE - 2 tanks

The assault mission profile is shown in Figure 7-48 with the ESSS configured with two 230 gallon tanks. In this configuration, the aircraft holds in excess of 5,300 pounds of JP4 fuel and assumes a take-off gross weight of 22,000 pounds which provides a maximum mission range of 630 Nm. with 400 lb reserve. This mission was calculated for a standard day with a zero headwind. Take-off must be made with a minimum of fuel used (80 lbs) for engine start and warm-up, and a Climb to 4,000 feet should be made with max power and airspeed between 80 and 108 KIAS. The first sement should be maintained at 4,000 feet and 108 KIAS for 1 hour. The average engine TRQ should be about 77% for this segment, but will initially be a little more and gradually decrease as shown on each segment. Altitude is increased in 2,000 feet increments to maintain the optimum altitude for maximum range to account for fuel burn. At this altitude, the airspeed for best range should also be reduced to 95 KIAS for the remainder of the flight.

EXAMPLE:

WANTED:

Assurance of adequate aircraft range for mission defined.

KNOWN:

Flight position: 300 nm from base
Flight Track Within Limits
Fuel Remaining = 7,900 pounds
Elapsed flight time = 2 HRS, 50 MINS (2.83 HRS)
Target: Nominal Flight Conditions:
Airspeed = 105 KIAS
Press Alt = 4,000 feet
Approx Torque = 75%

METHOD:

(1) Enter chart at total distance flown and at fuel remaining, move to intersection and plot point. If point falls on or above fuel remaining line (adequate range), remaining fuel is adequate to complete the mission. If point falls below the fuel remaining line in the inadequate range, abort mission region, immediately return to departure point while continuimg to utilize altitude profile using total elapsed flight time (see item 2). If point falls below the fuel remaining line in the adequate range region, consult emergency procedures for corrective action.

(2) To determine target nominal flight conditions, enter upper chart at elapsed flight time and move up to determine target airspeed, approximate torque, and pressure altitude.

Figure 7-46. Self Deployment Mission Profile (Sheet 1 of 2)

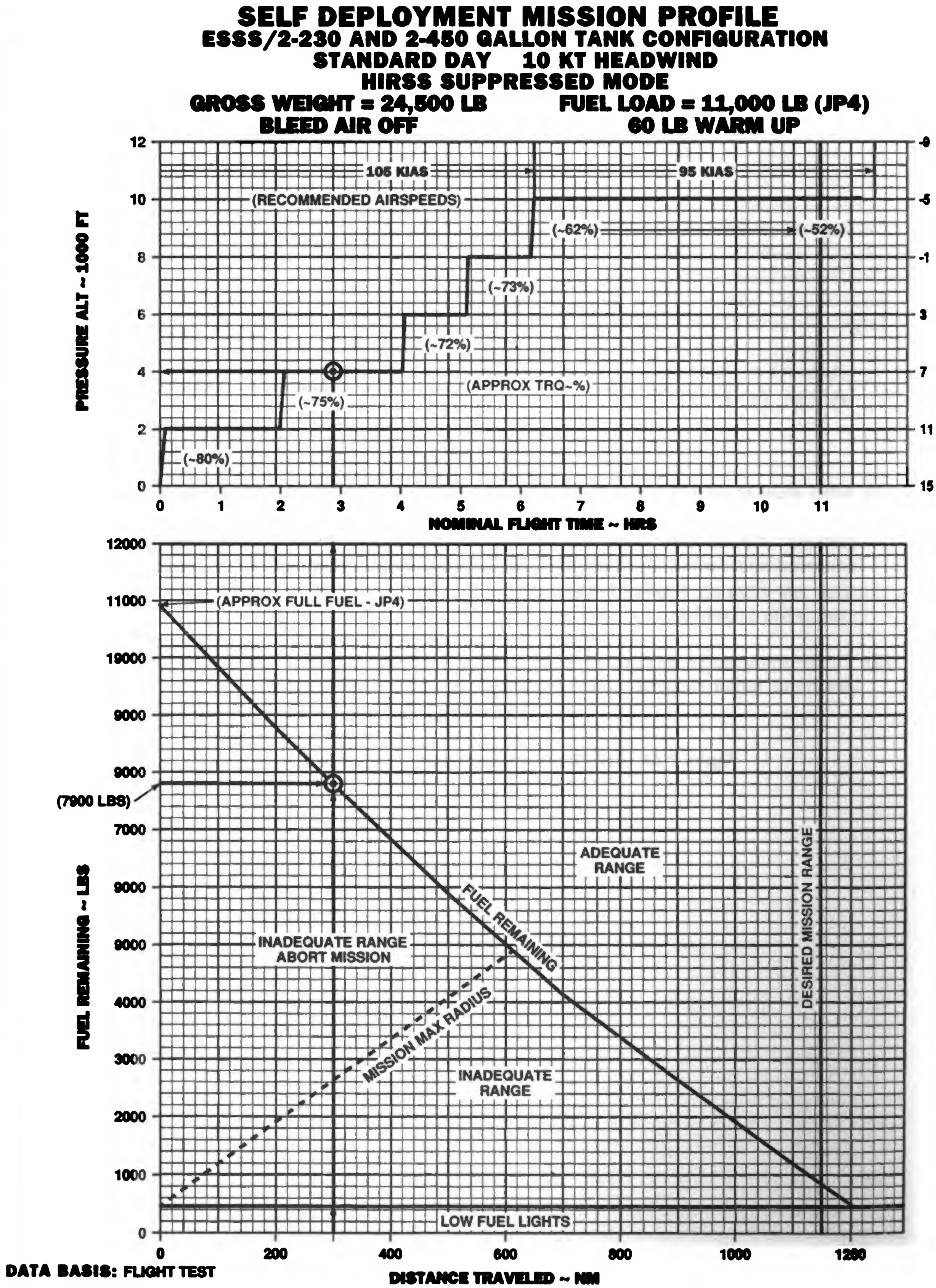
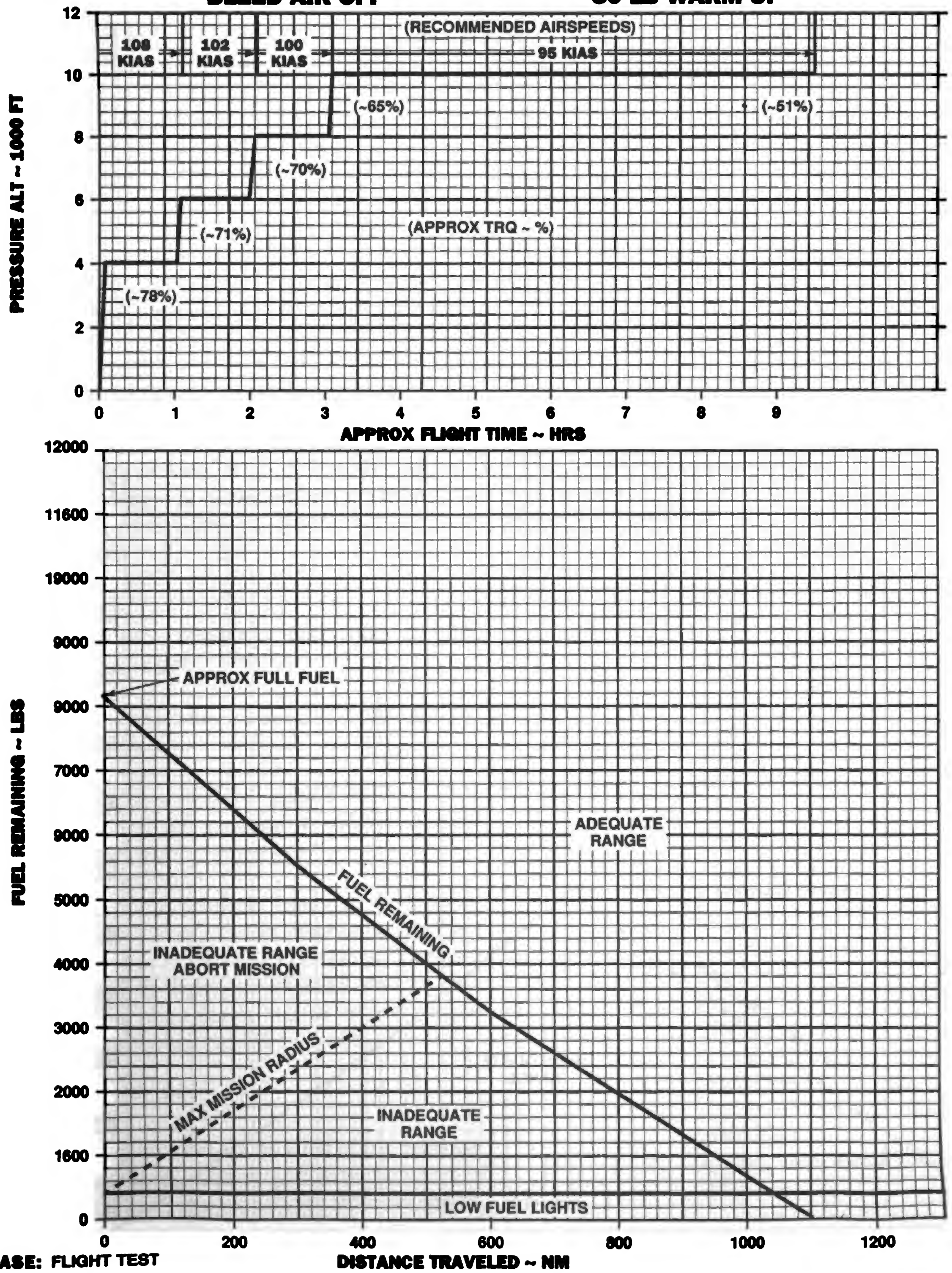


Figure 7-46. Self Deployment Mission Profile (Sheet 2 of 2)

ASSAULT MISSION PROFILE FOR MAX RANGE
ESSS/4-230 GALLON TANK CONFIGURATION
STANDARD DAY ZERO HEADWIND
HIRSS SUPPRESSED MODE

GROSS WEIGHT = 22,000 LB **FUEL LOAD = 8,300 LB (JP4)**
BLEED AIR OFF **80 LB WARM UP**



DATA BASE: FLIGHT TEST

Figure 7-47. Assault Mission Profile (4 - 230 Gallon Tanks)

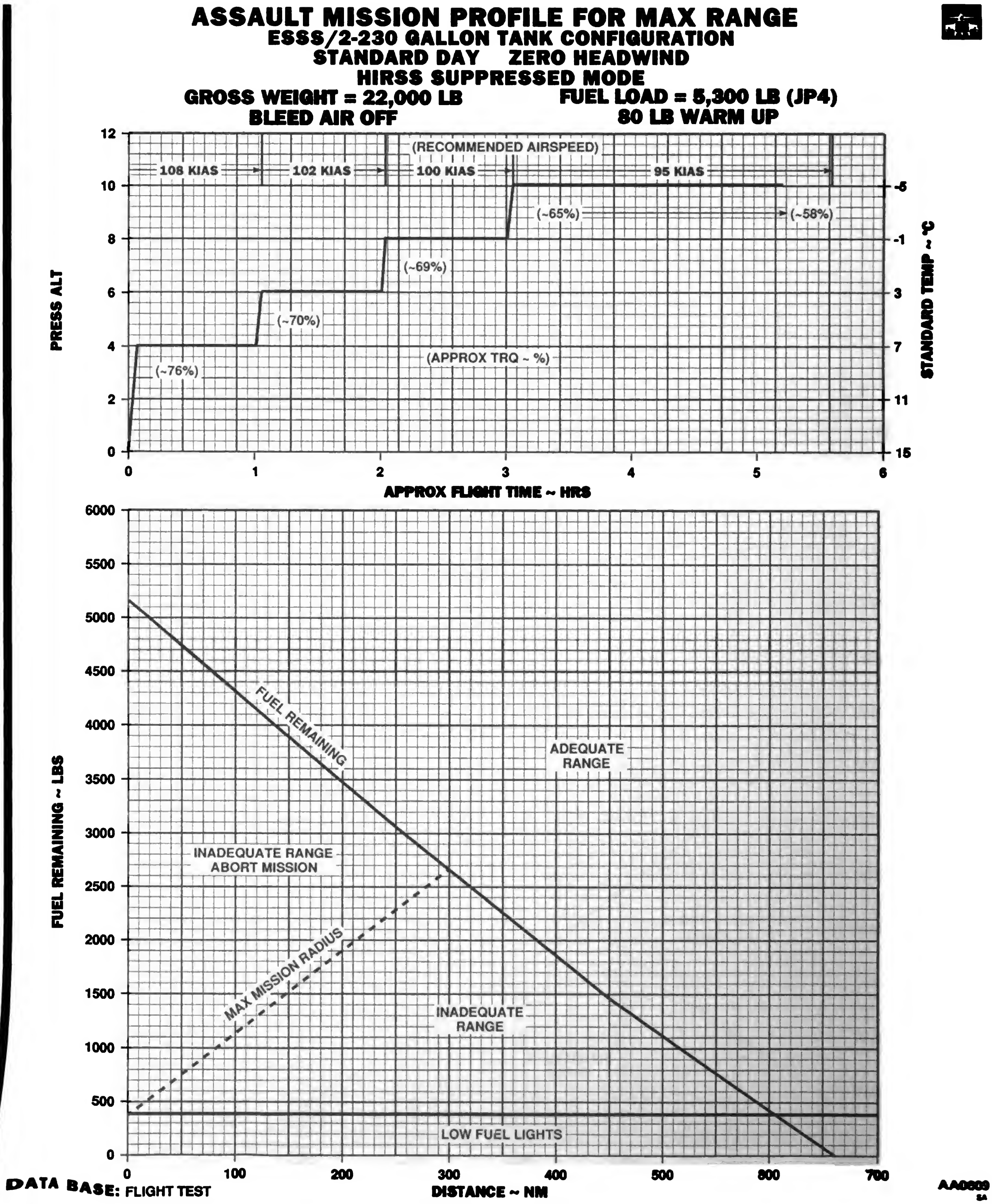


Figure 7-48. Assault Mission Profile (2 - 230 Gallon Tanks)

CHAPTER 7.1

PERFORMANCE DATA -701C

Section I INTRODUCTION

NOTE

Chapter 7.1 contains performance data for aircraft equipped with T700-GE-701C engines. Performance data for other models are contained in Chapter 7. Users are authorized to remove whichever chapter not applicable to their model aircraft, and are not required to carry both chapters on board.

7.1-1. Purpose.

The purpose of this chapter is to provide the best available performance data for the UH-60L. Regular use of this information will enable you to receive maximum safe utilization of the helicopter. Although maximum performance is not always required, regular use of this chapter is recommended for these reasons:

a. Knowledge of your performance margin will allow you to make better decisions when unexpected conditions or alternate missions are encountered.

b. Situations requiring maximum performance will be more readily recognized.

c. Familiarity with the data will allow performance to be computed more easily and quickly.

d. Experience will be gained in accurately estimating the effects of variables for which data are not presented.

The information is primarily intended for mission planning and is most useful when planning operations in unfamiliar areas or at extreme conditions. The data may also be used in flight, to establish unit or area standard operating procedures, and to inform ground commanders of performance/risk tradeoffs.

7.1-2. Chapter 7.1 Index.

The following index contains a list of the sections, titles, figure numbers, subjects and page numbers of each performance data chart contained in this chapter.

INDEX

7.1-3. GENERAL.

The data presented covers the maximum range of conditions and performance that can reasonably be expected. In each area of performance, the effects of altitude, temperature, gross weight, and other parameters relating to that phase of flight are presented. In addition to the presented data, your judgment and experience will be necessary to accurately obtain performance under a given set of circumstances. The conditions for the data are listed under the title of each chart. The effects of different conditions are discussed in the text accompanying each phase of performance. Where practical, data are presented at conservative conditions. However, NO GENERAL CONSERVATISM HAS BEEN APPLIED. All performance data presented are within the applicable limits of the helicopter.

CAUTION

Exceeding operating limits can cause permanent damage to critical components. Overlimit operation can decrease performance, cause early failure, or failure on a subsequent flight.

7.1-4. Limits.

Applicable limits are shown on the charts. Performance generally deteriorates rapidly beyond limits. If limits are exceeded, minimize the amount and time. Enter the maximum value and time above limits on DA Form 2408-13, so proper maintenance action can be taken.

7.1-5. Use of Charts.

7.1-6. Dashed Line Data.

Weights above 22,000 lbs are limited to ferry missions for which an Airworthiness Release is required.

7.1-7. Data Basis.

The type of data used is indicated at the bottom of each performance chart under DATA BASIS. The data provided generally is based on one of three categories:

a. Flight test data. Data obtained by flight test of the helicopter by experienced flight test personnel at precise conditions using sensitive calibrated instruments.

b. Calculated data. Data based on tests, but not on flight test of the complete helicopter.

c. Estimated data. Data based on estimates using aerodynamic theory or other means but not verified by flight test.

7.1-8. Specific Conditions.

The data presented is accurate only for specific conditions listed under the title of each chart. Variables for which data is not presented, but which may affect that phase of performance, are discussed in the text. Where data is available or reasonable estimates can be made, the amount that each variable affects performance will be given.

7.1-9. Performance Discrepancies.

Regular use of this chapter will allow you to monitor instrument and other helicopter systems for malfunction, by comparing actual performance with planned performance. Knowledge will also be gained concerning the effects of variables for which data is not provided, thereby increasing the accuracy of performance predictions.

7.1-10. Performance Data Basis - Clean.

The data presented in the performance charts are primarily derived for a clean UH-60L aircraft and are based on U. S. Army test data. The clean configuration assumes all doors and windows are closed and includes the following external configuration:

a. Fixed provisions for the External Stores Support System (ESSS).

b. Main rotor de-ice system

c. Mounting brackets for IR jammer and chaff dispenser.

d. The Hover Infrared Suppressor System (HIRSS) with baffles installed.

e. Includes wire strike protection system.

NOTE

Aircraft which have an external configuration which differs from the clean configuration may be corrected for drag differences on cruise performance as discussed in Section VII DRAG.

7.1-10.1 Performance Date Basis - High Drag.

The data presented in the high drag performance charts are primarily derived for the UH-60L with the ESSS system installed and two 230 gallon tanks mounted on the outboard pylons, and are based on U.S. Army test data. The high drag configuration assumes all doors and windows are closed and includes the following external configuration:

a. External stores support system installed.

b. Two 230 gallon tanks mounted on the outboard pylons.

c. Inboard vertical pylons empty.

d. IR jammer and chaff dispenser installed.

e. Hover Infrared Suppressor System (HIRSS) with baffels are installed.

f. Main rotor de-ice and wire strike protection systems are installed.

NOTE

Aircraft with an external configuration that differs from the high drag configuraton baseline may be corrected for differences in cruise performance as discussed in Section VII DRAG.

7.1-10.2. Free Air Temperatures.

A temperature conversion chart (Figure 7.1-1) is included for the purpose of converting Fahrenheit temperature to Celsius.

Section II TORQUE AVAILABLE

7.1-11. Torque Factor Method.

The torque factor method provides an accurate indication of available power by incorporating ambient temperature effects on degraded engine performance. This section presents the procedure to determine the maximum dual- or single-engine torque available. Specification power is defined for a newly delivered low time engine. The aircraft HIT log forms for each engine provide the engine and aircraft torque factors which are obtained from the maximum power check and recorded to be used in calculating maximum torque available.

7.1-12. Torque Factor Terms.

The following terms are used when determining the maximum torque available for an individual aircraft:

a. Torque Ratio (TR). The ratio of torque available to specification torque at the desired ambient temperature.

b. Engine Torque Factor (ETF). The ratio of an individual engine torque available to specification torque at reference temperature of 35°C. The ETF is allowed to range from 0.9 to 1.0.

c. Aircraft Torque Factor (ATF). The ratio of an individual aircrafts power available to specification power at a reference temperature of 35°C. The ATF is the average of the ETF's of both engines and its value is allowed to range from 0.9 to 1.0.

7.1-13. Torque Factor Procedure:

The use of the ATF or ETF to obtain the TR from Figure 7.1-1.1 for ambient temperatures between −15°C and 35°C is shown by the example. The ATF and ETF values for an individual aircraft are found on the engine HIT Log. The TR always equals 1.0 for ambient temperatures of −15°C and below, and the TR equals the ATF or ETF for temperatures of 35°C and above.

7.1-14. TORQUE AVAILABLE.

This section presents the maximum dual engine torque available for the 10 minute, 30 minute, and maximum continuous limits at zero airspeed and 100% RPM R for the operational range of pressure altitude and FAT. The single and dual engine transmission limits for continuous operation are also shown and should not be exceeded.

TEMPERATURE CONVERSION

EXAMPLE

TED:

AIR TEMPERATURE IN DEGREES CELSIUS

WN:

AIR TEMPERATURE = +32°F

OD:

FREE AIR TEMPERATURE HERE
RIGHT TO DIAGONAL LINE
DOWN TO DEGREES CELSIUS SCALE
FREE AIR TEMPERATURE = 0°C

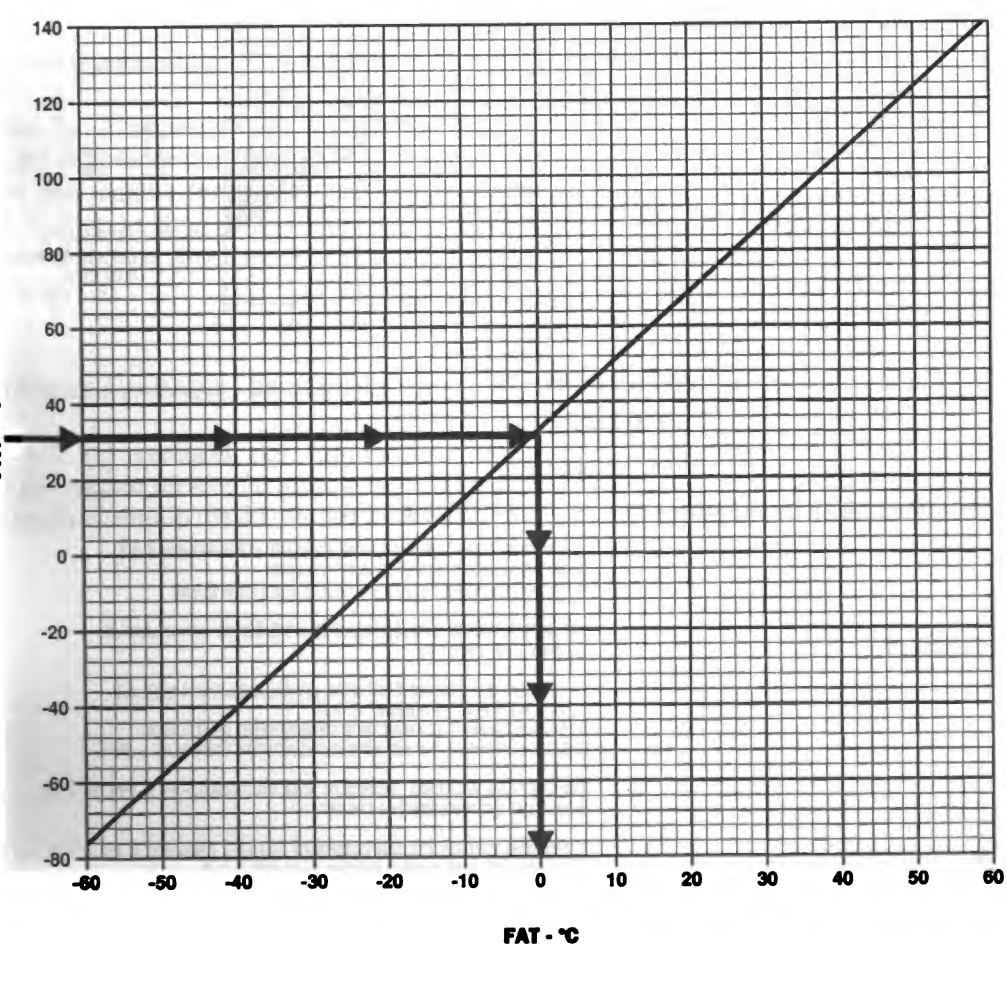
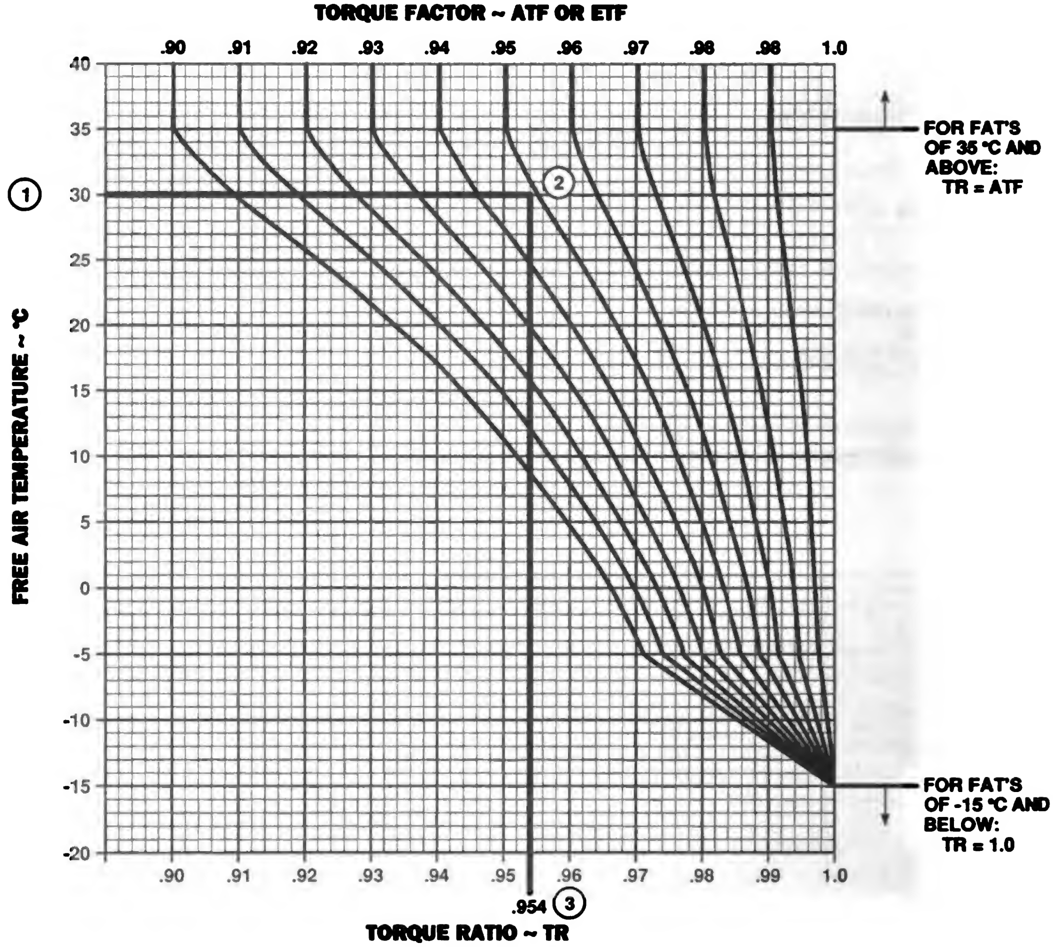


Figure 7.1-1. Temperature Conversion Chart

TORQUE FACTOR

T700-GE-701C ENGINE 100% RPM R



EXAMPLE

WANTED:

TORQUE RATIO AND MAXIMUM TORQUE AVAILABLE - 10 MINUTE LIMIT

KNOWN:

ATF = 0.95
PRESSURE ALTITUDE = 6000 FT.
FAT = 30 °C

NOTE

EITHER OF THE THREE TORQUE AVAILABLE CHARTS MAY BE USED. MAXIMUM ALLOWABLE DUAL ENGINE TORQUE LIMITS SHALL NOT BE EXCEEDED.

DATA BASE: CALCULATED

METHOD:

TO OBTAIN TORQUE RATIO:

1. ENTER TORQUE FACTOR CHART AT KNOWN FAT
2. MOVE RIGHT TO THE ATF VALUE
3. MOVE DOWN, READ TORQUE RATIO = 0.954

TO DETERMINE SPECIFICATION TORQUE AVAILABLE - 10 MINUTE LIMITS:

4. ENTER MAXIMUM TORQUE AVAILABLE CHART AT KNOWN FAT (FIGURE 7.1-3)
5. MOVE RIGHT TO KNOWN PRESSURE ALTITUDE
6. MOVE DOWN, READ SPECIFICATION TORQUE = 98%

TO OBTAIN ACTUAL TORQUE VALVE AVAILABLE FROM THE TORQUE CONVERSION CHART:

7. ENTER TORQUE CONVERSION CHART FIGURE 7.1-2 AT % TORQUE OBTAINED FROM FIGURE 7.1-3
8. MOVE UP TO TORQUE RATIO OBTAINED FROM FIGURE 7.1-1.1
9. MOVE LEFT, READ MAXIMUM TORQUE AVAILABLE - 10 MINUTE LIMIT = 93%
10. ENTER DUAL ENGINE TORQUE LIMIT CHART FIGURE 7.1-4 AT 30 °C. MOVE RIGHT TO INTERSECTION AT 6,000 FT. PA. MOVE DOWN TO READ 90.4% TORQUE.

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Figure 7.1-1.1. Aircraft Torque Factor (ATF)

CAUTION

Do not exceed the UH-60L DUAL ENGINE TORQUE LIMITS in Chapter 5. These torque limits are presented in Figure 7.1-4 and on the TORQUE PLACARD mounted on the instrument panel.

When the TR equals 1.0, the torque available may be read directly from the torque available per engine scales. When the TR is less than 1.0, the actual torque available is determined by multiplying the specification torque available by the TR (example for TR = 0.98: 90% TRQ × 0.98 = 88.2% TRQ). The torque conversion chart (Figure 7.1-2) is provided to convert specification data to actual torque available.

7.1-15. TORQUE AVAILABLE - 10 MINUTES.

Figure 7.1-3 presents the specification torque available per engine for the 10 minute limit. This is the maximum dual engine torque available and is set by the TGT limiter in dual engine operation. For one engine operation, the pilot must maintain the 10 minute TGT limit.

7.1-16. TORQUE AVAILABLE - 30 MINUTES.

Figure 7.1-3 presents the specification torque available per engine for the 30 minute limit. The pilot must manually maintain the 30 minute TGT limit.

7.1-17. MAXIMUM CONTINUOUS TORQUE AVAILABLE.

Figure 7.1-3 presents the maximum specification torque available per engine for continuous operation. The pilot must manually maintain the maximum continuous TGT limit.

7.1-18. Engine Bleed Air.

With engine bleed air on, the available torque per engine is reduced as follows:

a. Engine anti-ice on: −18% TRQ

(example: 90% TRQ −18% TRQ = 72% TRQ).

b. Cockpit heater on: −4% TRQ.

c. Both on: −22% TRQ.

7.1-19. Infrared Suppressor System.

When the IR suppressor is OPERATING IN THE BENIGN MODE (exhaust baffles removed) the torque available at a constant TGT is increased about 1% TRQ.

7.1-20. Dual Engine Torque Limits.

Sustained dual engine power levels shall be limited to the DUAL ENGINE TORQUE LIMITS presented in Chapter 5, and on the TORQUE PLACARD mounted on the instrument panel. Figure 7.1-4 graphically presents the dual engine torque limits for use with the torque available charts and is the maximum torque that may be used for dual engine flight. This chart is not applicable to single engine operation.

TORQUE CONVERSION

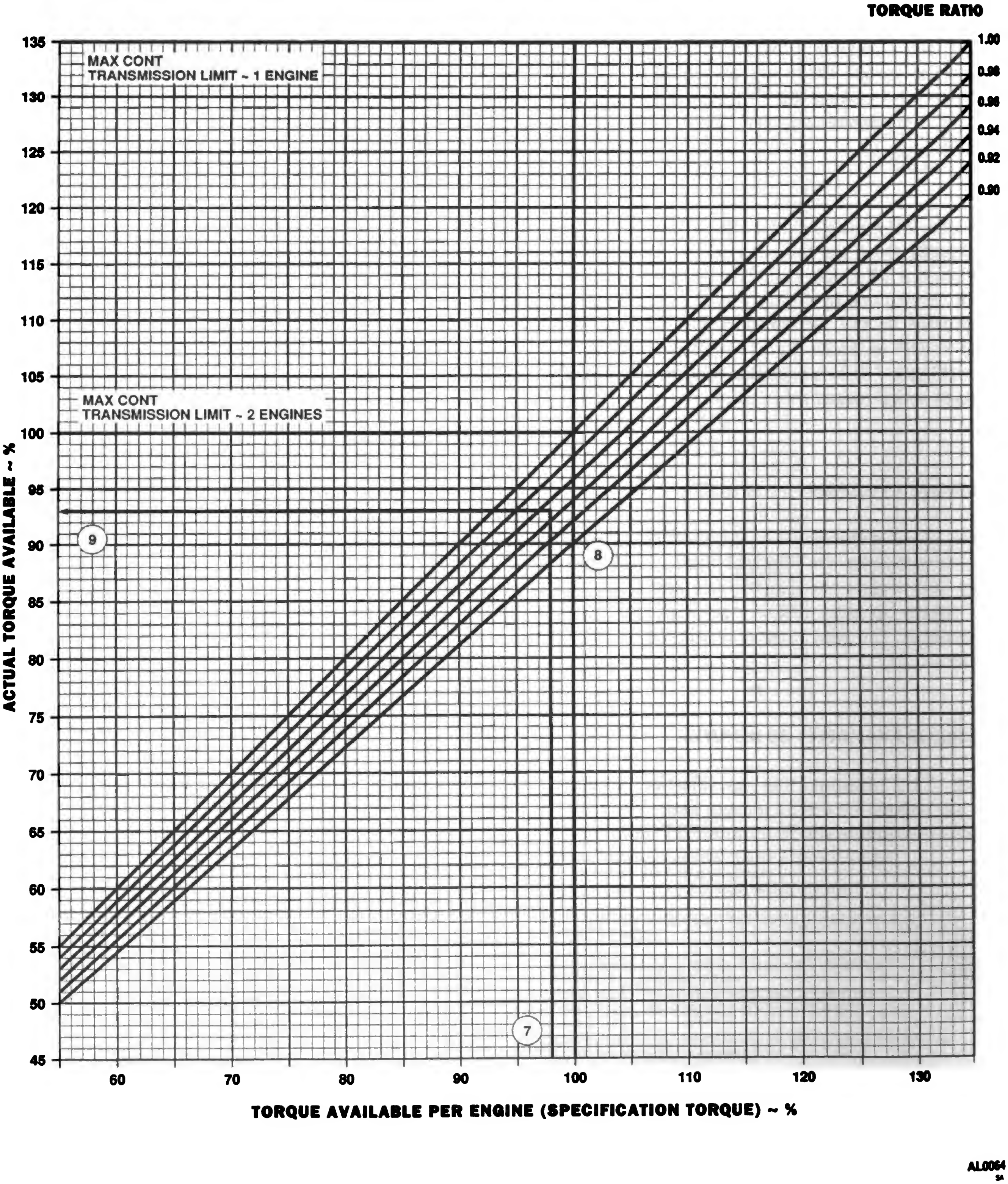


Figure 7.1-2. Torque Conversion Chart

MAXIMUM TORQUE AVAILABLE - 10 MINUTE LIMIT
T700-GE-701C HIRSS (BAFFELS INSTALLED)
100% RPM R BLEED AIR OFF
ZERO AIRSPEED

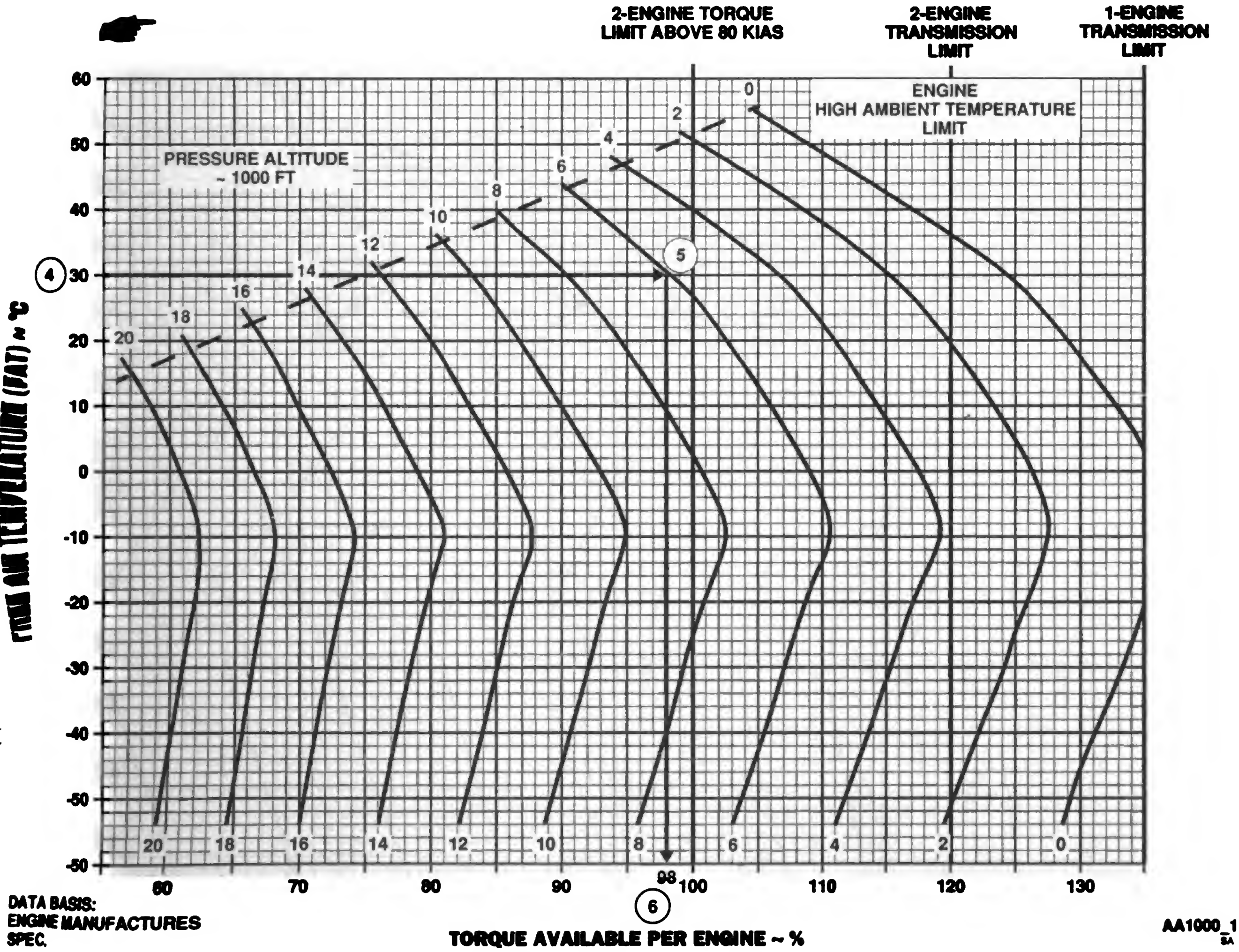


Figure 7.1-3. Maximum Torque Available (Sheet 1 of 3)

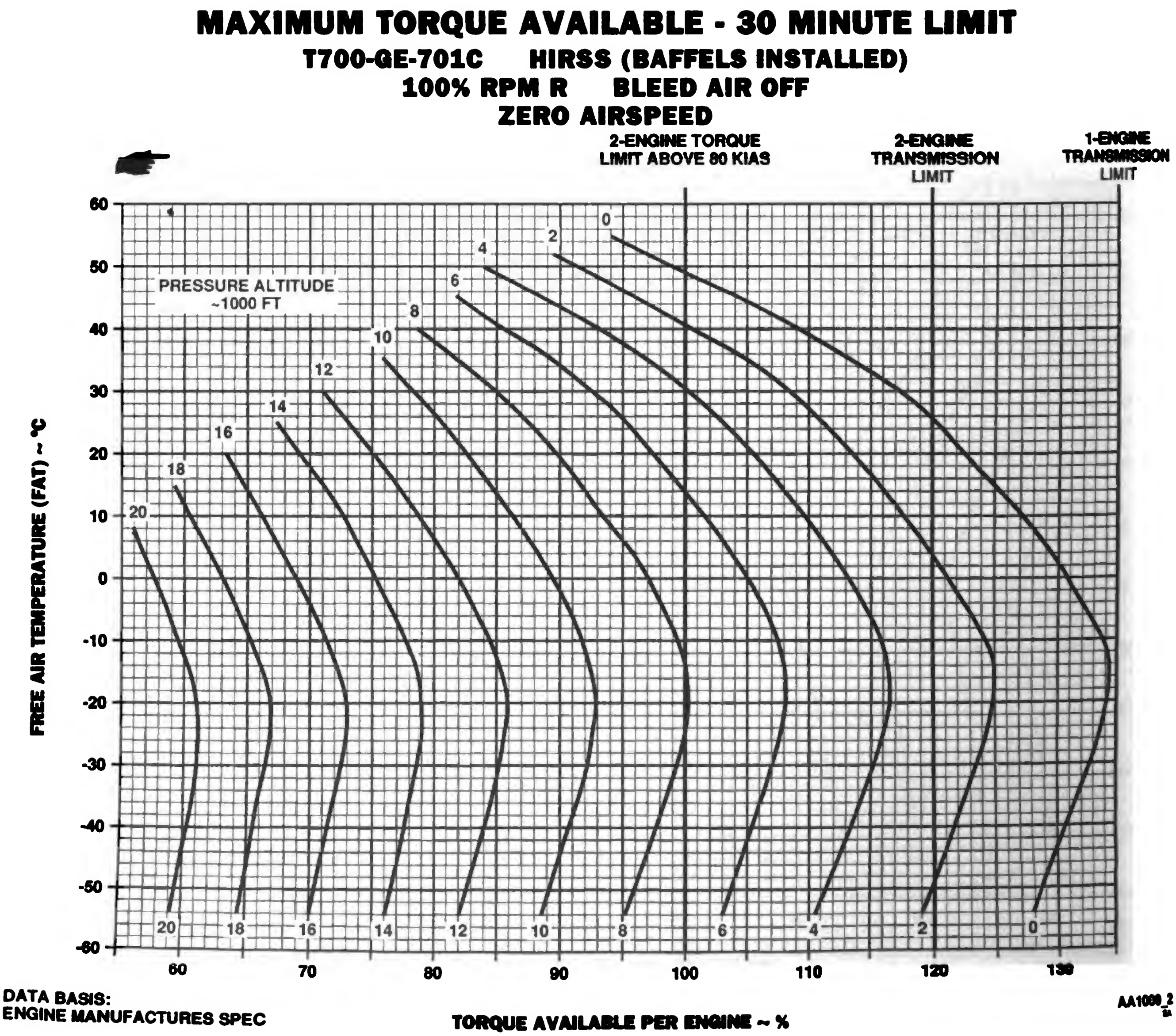


Figure 7.1-3. Maximum Torque Available (Sheet 2 of 3)

MAXIMUM TORQUE AVAILABLE - CONTINUOUS

T700-GE-701C HIRSS (BAFFELS INSTALLED) 100% RPM R

ZERO AIRSPEED

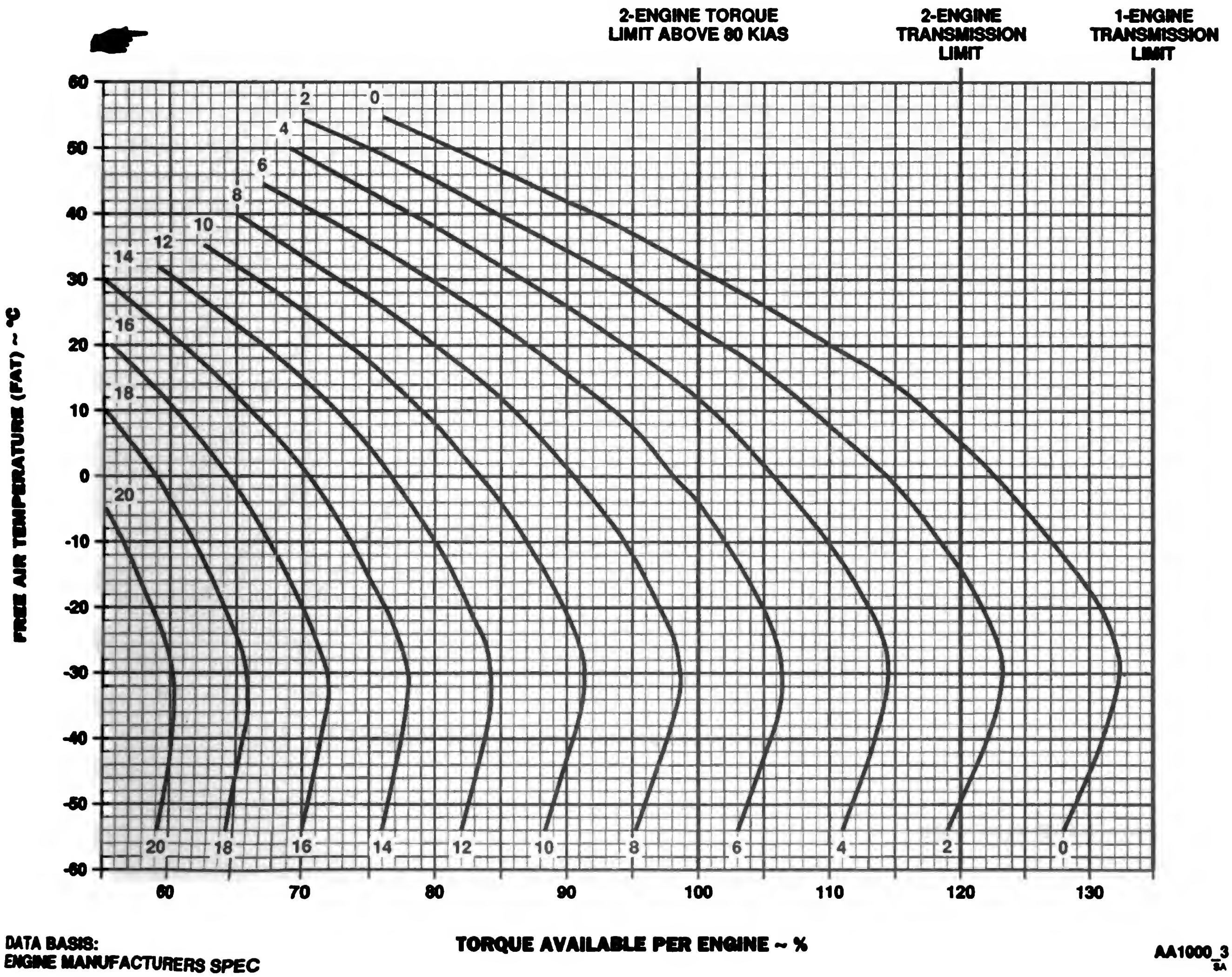
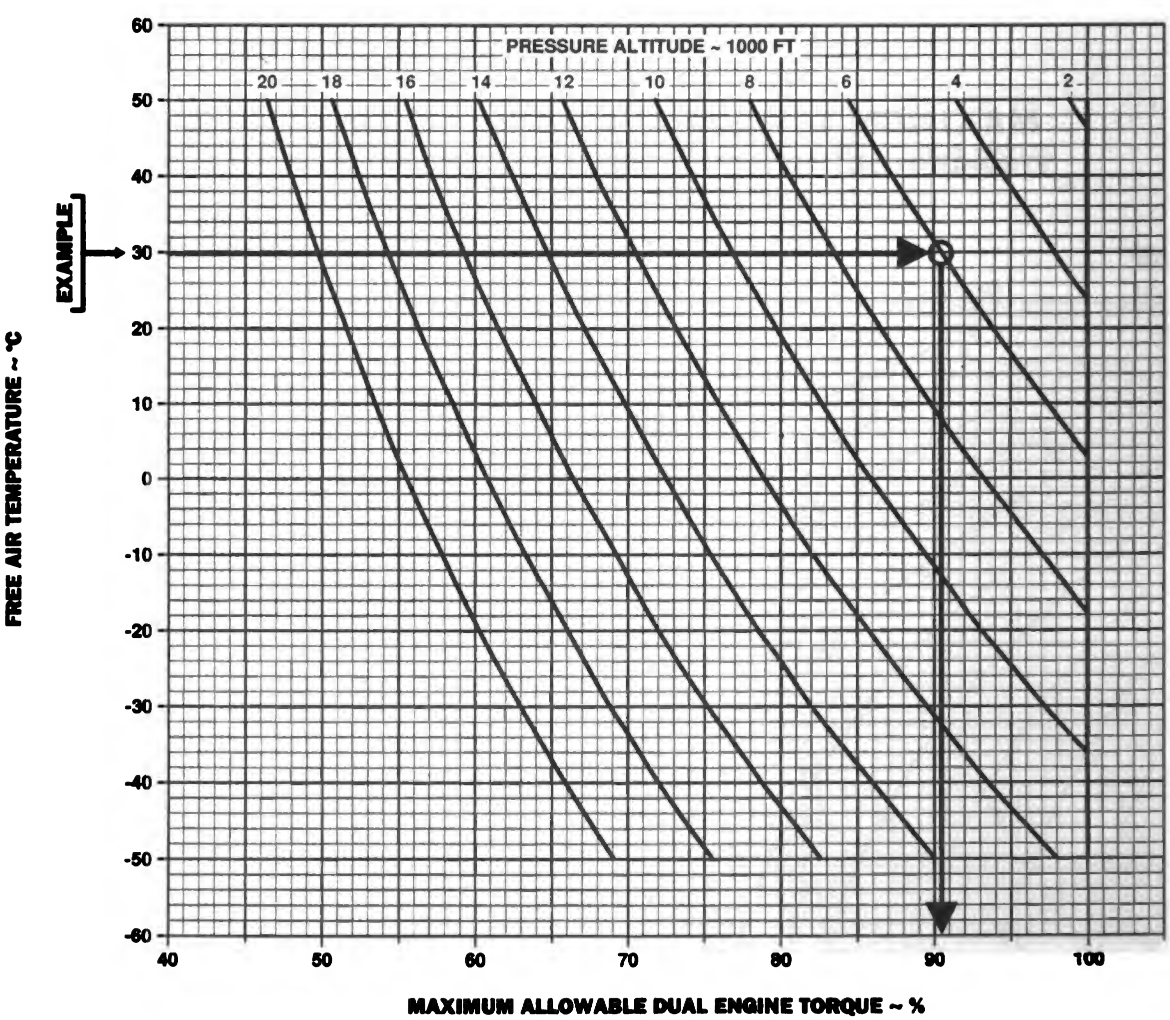


Figure 7.1-3. Maximum Torque Available (Sheet 3 of 3)

DUAL ENGINE TORQUE LIMITS

T-700-GE-701C 100% RPM R

FOR AIRCRAFT WITH TORQUE PLACARD ONLY



DATA BASE: FLIGHT TEST

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SA

Figure 7.1-4. Dual Engine Torque Limit

Section III HOVER

7.1-21. Hover Charts.

These charts (Figures 7.1-5 and 7.1-5.1) provide the torque required to hover at various altitudes, FAT, and gross weight conditions. Dual- and single-engine torque requirements at various wheel heights both in ground effect and out-of-ground effect may be determined from this chart. Maximum transmission limits for single- and dual-engine operation are also shown. After determining torque required to hover, refer to the desired maximum torque available chart to determine that enough torque is available under the given conditions. If the torque available is less than torque required to hover, the gross weight must be reduced. The maximum hover capability occurs when the torque required to hover and the maximum torque available are equal. To determine maximum hover capability, follow the same procedure for determining torque required to hover. Determine the maximum torque available. Enter the indicated torque scale on the hover chart at the determined maximum torque available and move up to intersect the horizontal trace previously determined. The intersection is the maximum wheel height for hovering at the maximum power limit.

7.1-22. Maximum Gross Weight to Hover Chart.

The maximum gross weight for hover charts (Figures 7.1-6 and 7.1-6.1) provide a means of finding the maximum gross weight at which the helicopter can be hovered IGE and OGE in zero wind for combinations of pressure altitude with FAT at ATF values of 0.9 and 1.0, respectively. FAT's of −15°C and below provide the same gross weight capability. Aircraft with ATF values between 1.0 and 0.9 require interpolation to obtain the maximum gross weight to hover as shown in the example. Figure 7.1-6.2 may be used to determine IGE for different wheel heights once OGE is known.

HOVER - CLEAN

ZERO WIND 100% RPM R LEVEL SURFACE COLD DAY

EXAMPLE

WANTED:

A. TORQUE REQUIRED TO HOVER OGE AND AT A 10 FOOT WHEEL HEIGHT

B. MAXIMUM GROSS WEIGHT TO HOVER OGE

KNOWN:

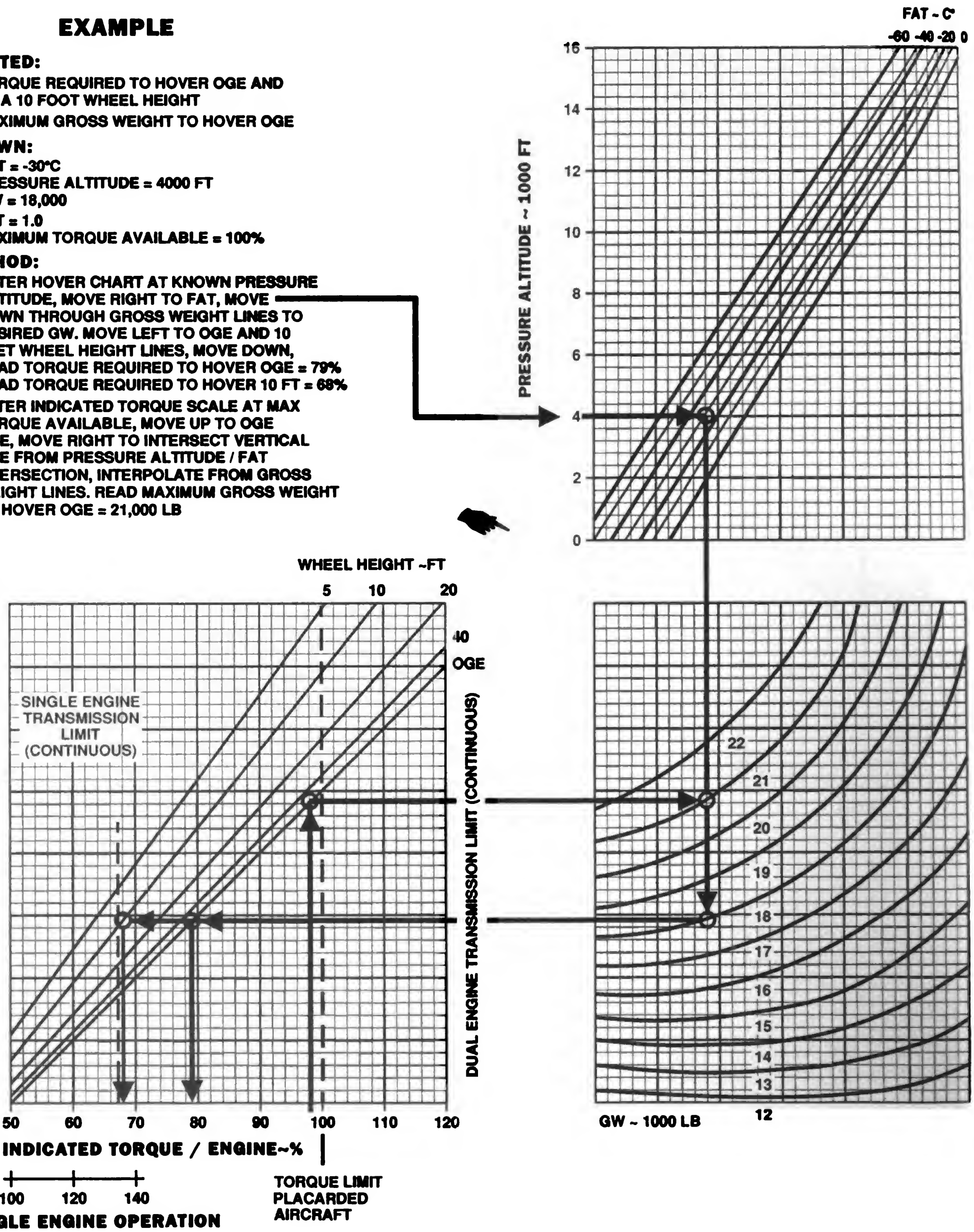
A. FAT = -30°C
PRESSURE ALTITUDE = 4000 FT
GW = 18,000

B. AFT = 1.0
MAXIMUM TORQUE AVAILABLE = 100%

METHOD:

A. ENTER HOVER CHART AT KNOWN PRESSURE ALTITUDE, MOVE RIGHT TO FAT, MOVE DOWN THROUGH GROSS WEIGHT LINES TO DESIRED GW. MOVE LEFT TO OGE AND 10 FEET WHEEL HEIGHT LINES, MOVE DOWN, READ TORQUE REQUIRED TO HOVER OGE = 79% READ TORQUE REQUIRED TO HOVER 10 FT = 68%

B. ENTER INDICATED TORQUE SCALE AT MAX TORQUE AVAILABLE, MOVE UP TO OGE LINE, MOVE RIGHT TO INTERSECT VERTICAL LINE FROM PRESSURE ALTITUDE / FAT INTERSECTION, INTERPOLATE FROM GROSS WEIGHT LINES. READ MAXIMUM GROSS WEIGHT TO HOVER OGE = 21,000 LB



DATA BASE: FLIGHT TEST

AL0946_3

Figure 7.1-5. Hover (Sheet 1 of 2)

HOVER - CLEAN

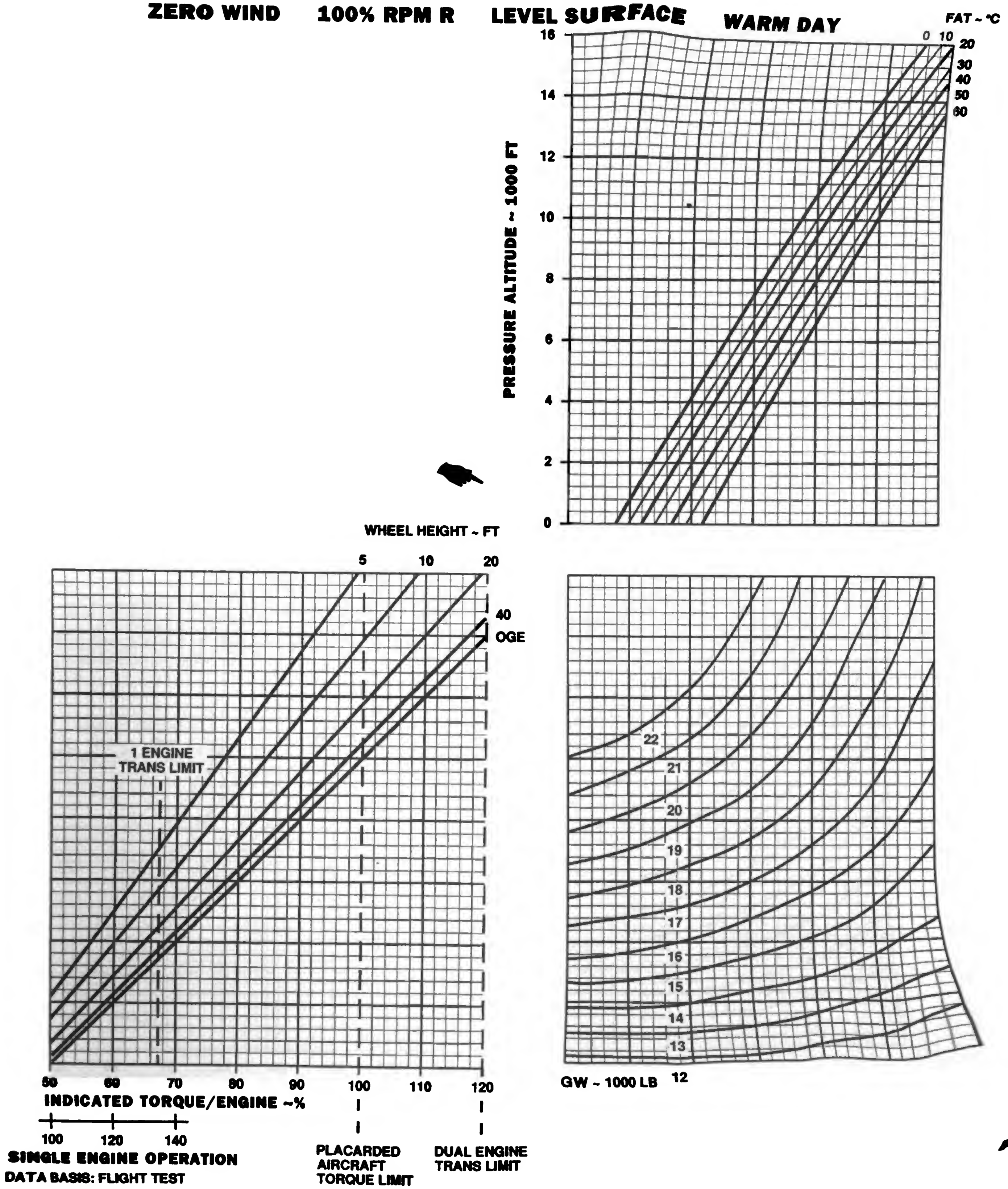
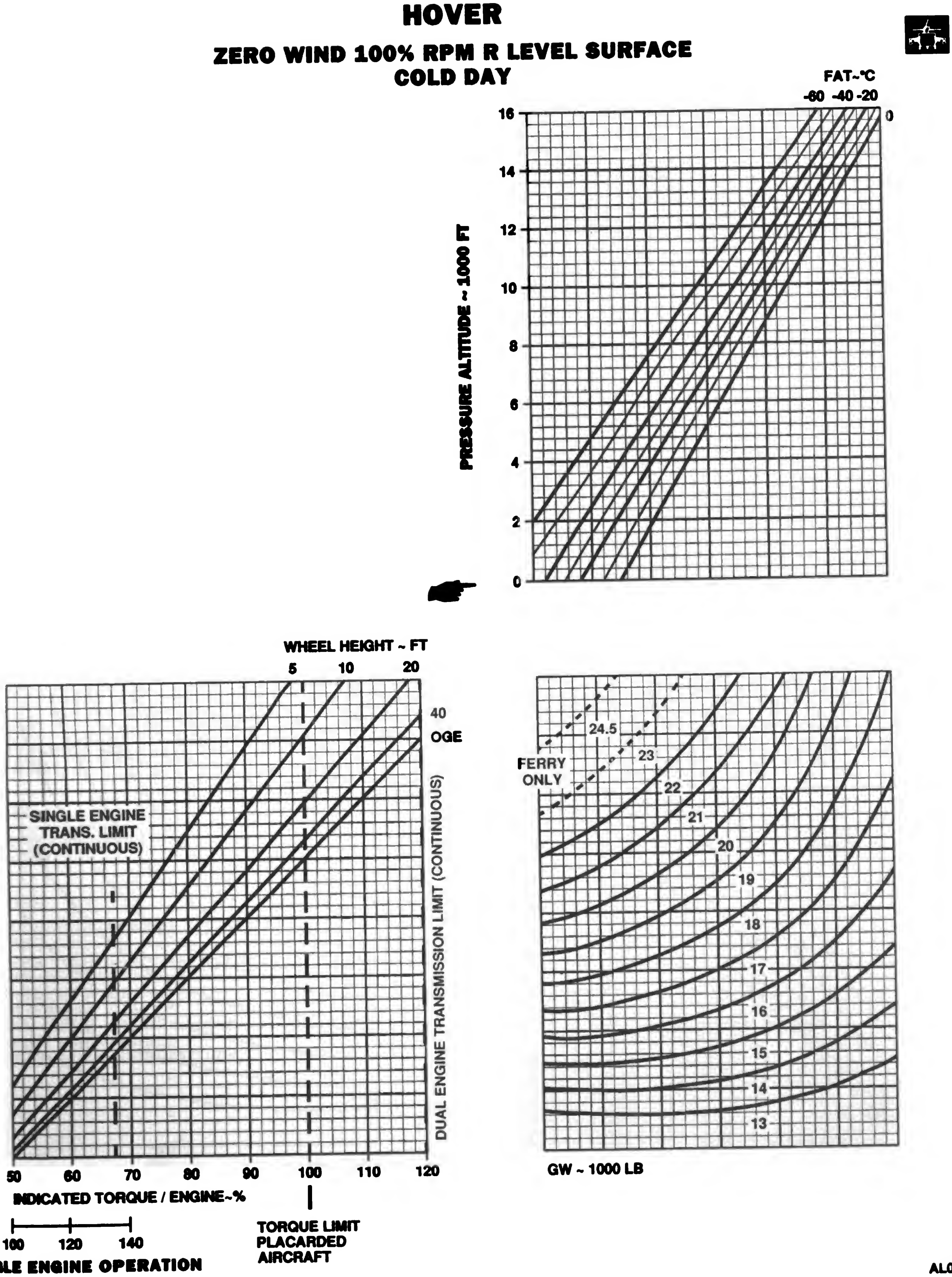


Figure 7.1-5. Hover (Sheet 2 of 2)

HOVER

ZERO WIND 100% RPM R LEVEL SURFACE
COLD DAY



DATA BASE: FLIGHT TEST

AL0003_3

Figure 7.1-5.1. Hover - High Drag (Sheet 1 of 2)

HOVER

NON-PLACARDED AIRCRAFT
ZERO WIND 100% RPM R LEVEL SURFACE
WARM DAY

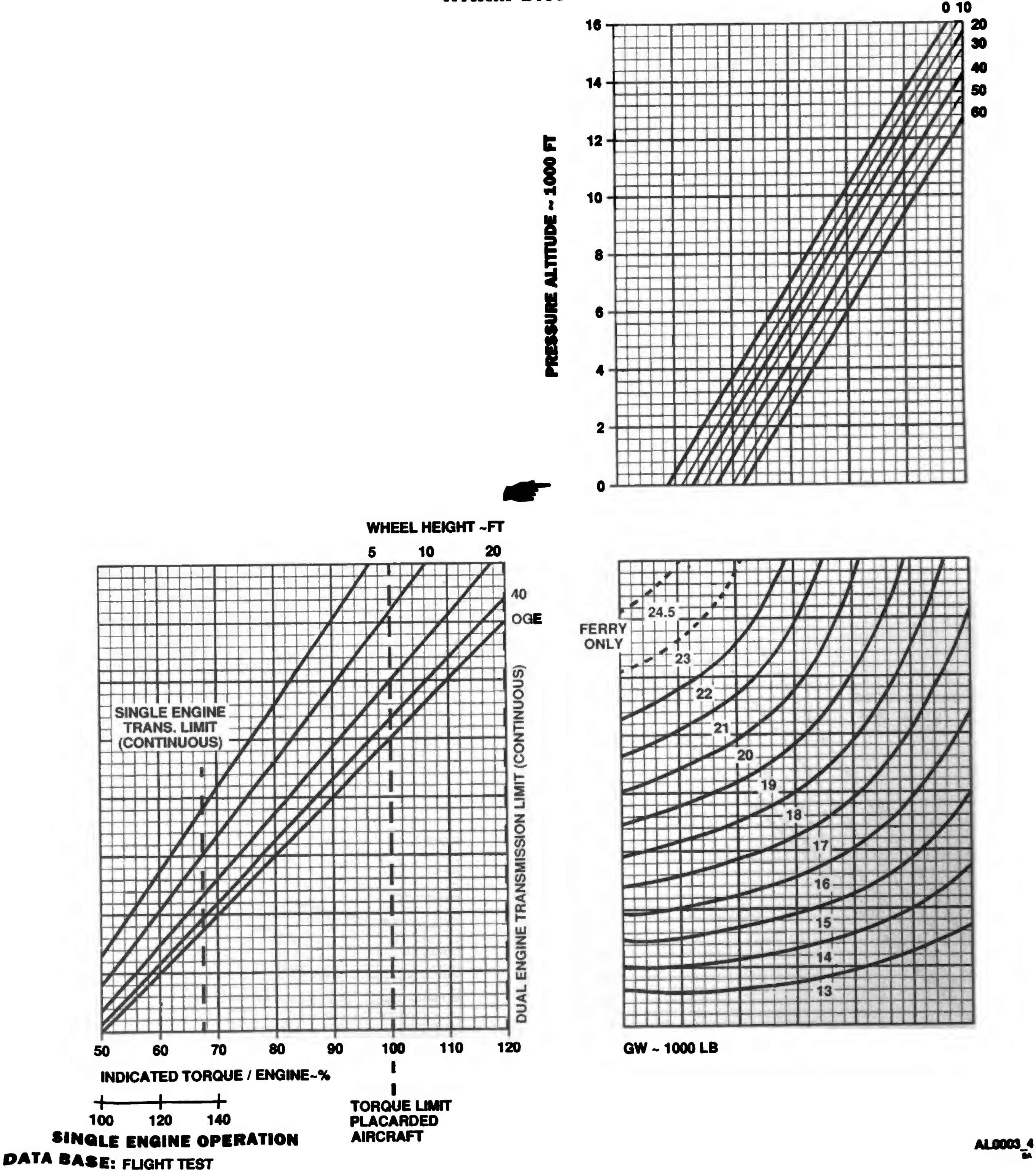
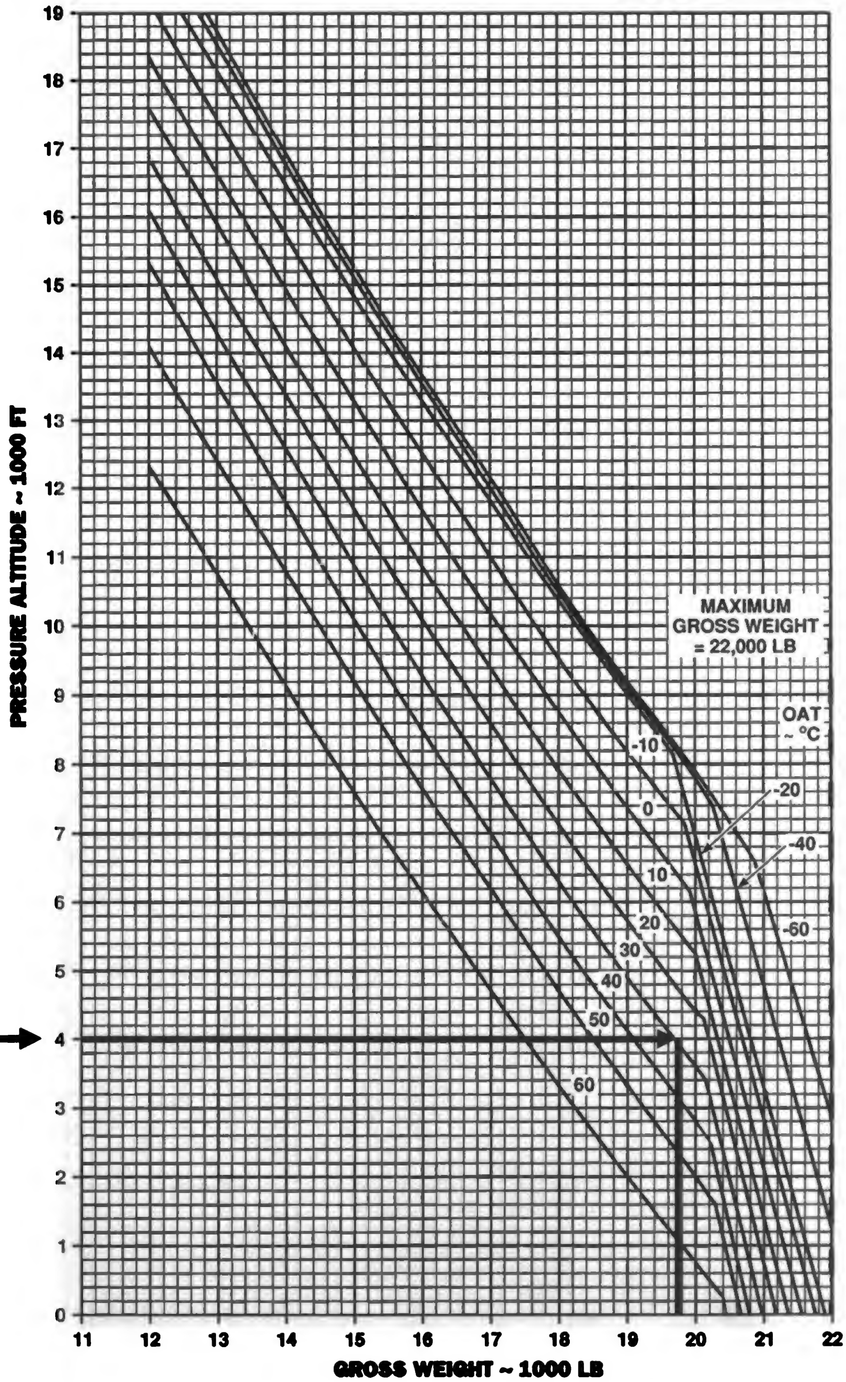


Figure 7.1-5.1. Hover - High Drag (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

CLEAN CONFIGURATION 100% RPM R ATF = 1.0
HIRSS (BAFFELS INSTALLED) MAXIMUM POWER (10 MINUTE LIMIT)
PLACARDED AIRCRAFT



EXAMPLE

WANTED:

MAXIMUM GROSS WEIGHT FOR HOVER OGE AND 20 FEET

KNOWN:

PRESSURE ALTITUDE = 4,000 FEET
FAT = +30°C

METHOD:

ENTER CHART AT PRESSURE ALTITUDE 4,000 FEET
MOVE RIGHT TO FAT +30°C - MOVE DOWN TO READ, MAXIMUM GROSS WEIGHT TO HOVER OUT OF GROUND EFFECT = 19,700 POUNDS
MAXIMUM GROSS WEIGHT TO HOVER AT 20 FOOT WHEEL HEIGHT = 20,750 POUNDS (SEE FIGURE 7.1-6.2)

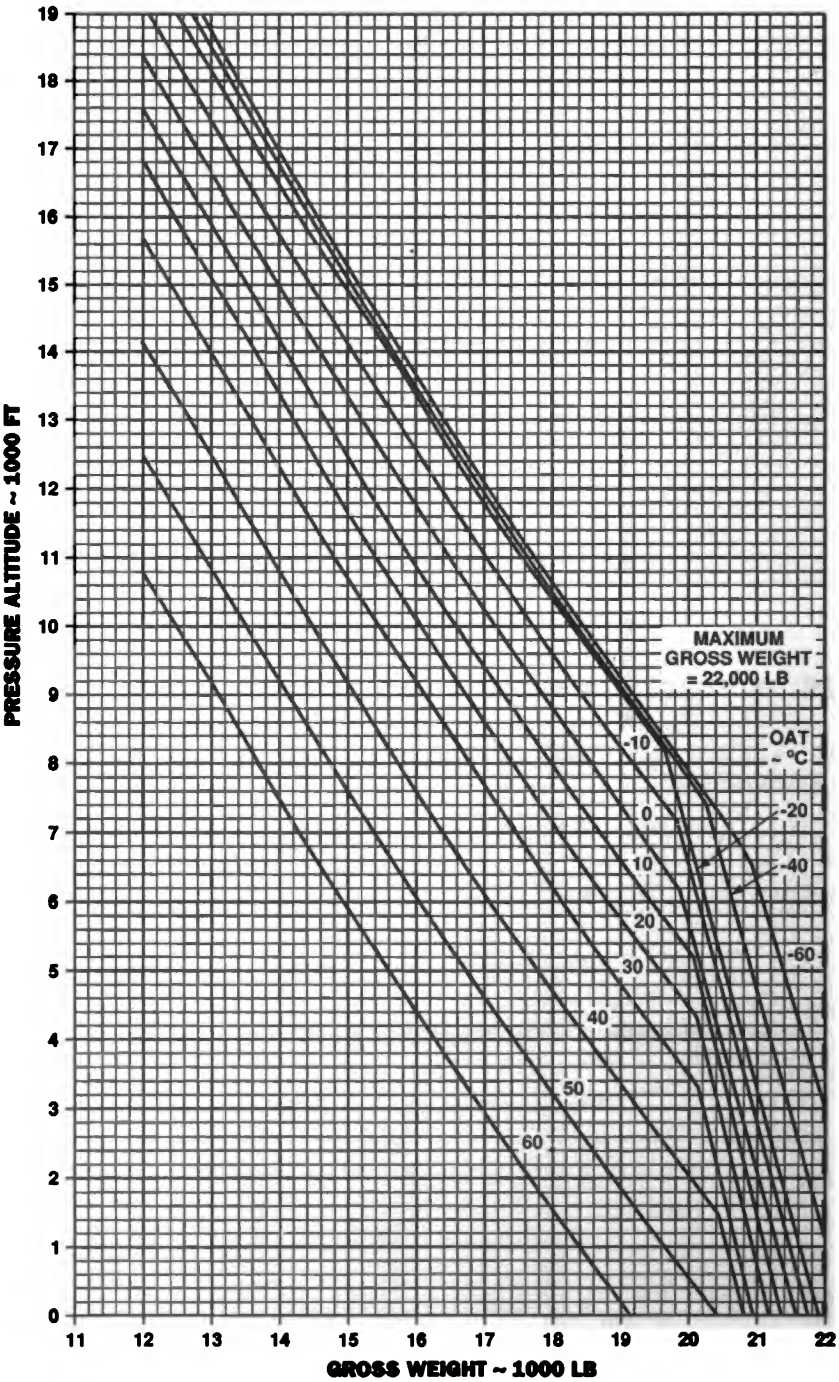
DATA BASIS: FLIGHT TEST

AL0047_1 SA

Figure 7.1-6. Maximum Gross Weight to Hover (Sheet 1 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

CLEAN CONFIGURATION 100% RPM R ATF = 0.9
HIRSS (BAFFELS INSTALLED) MAXIMUM POWER OR PLACARD TORQUE LIMIT



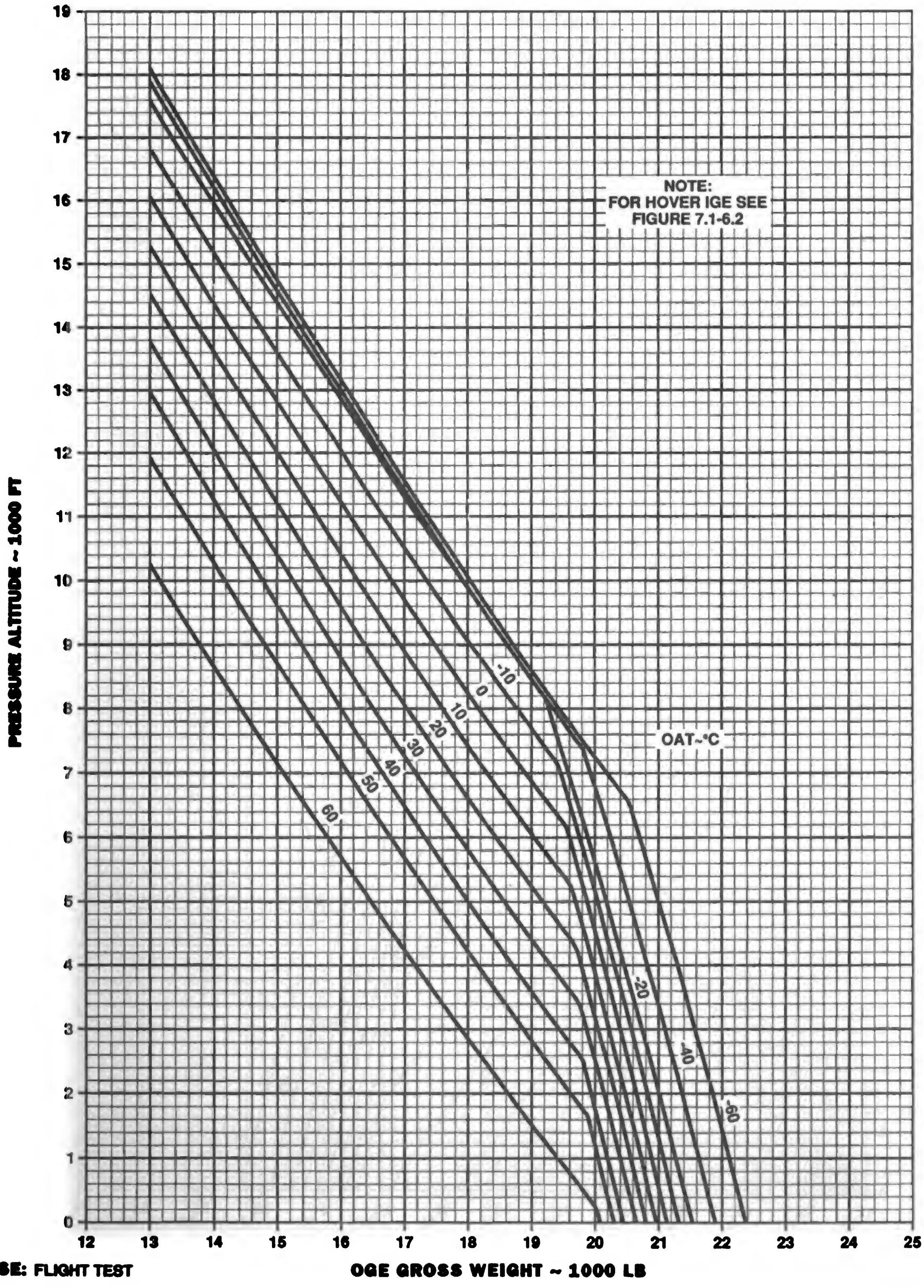
DATA BASIS: FLIGHT TEST

AL0047_2

Figure 7.1-6. Maximum Gross Weight to Hover (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

MAXIMUM POWER (10 MIN LIMIT) OR PLACARD TORQUE LIMIT
HIRSS (BAFFELS INSTALLED) 100% RPMR ATF=1.0



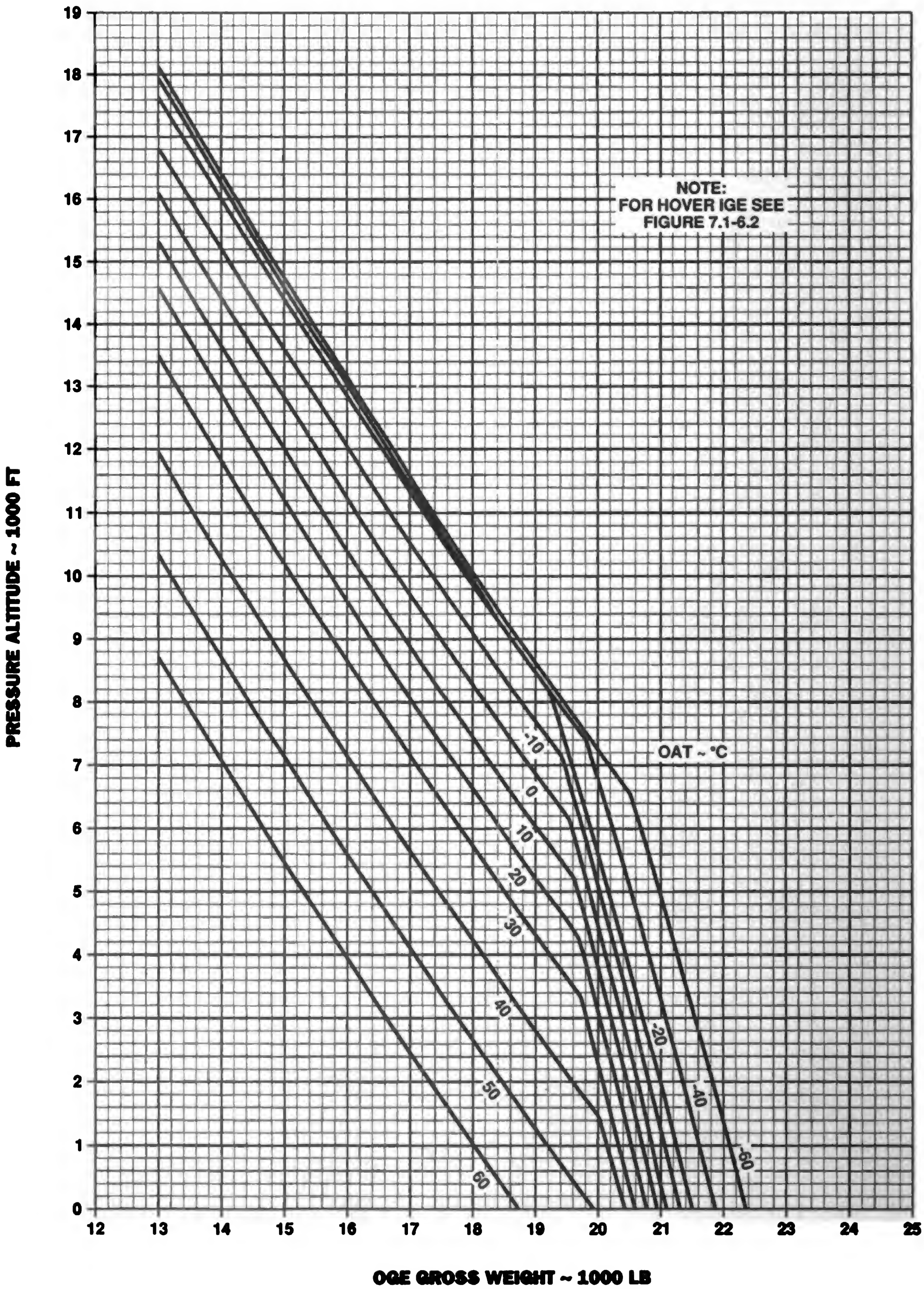
DATA BASE: FLIGHT TEST

AL0004_1A

Figure 7.1-6.1. Maximum Gross Weight to Hover OGE - High Drag (Sheet 1 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

MAXIMUM POWER (10 MIN LIMIT) OR PLACARD TORQUE LIMIT
HIRSS (BAFFELS INSTALLED) 100% RPM R ATF=0.9



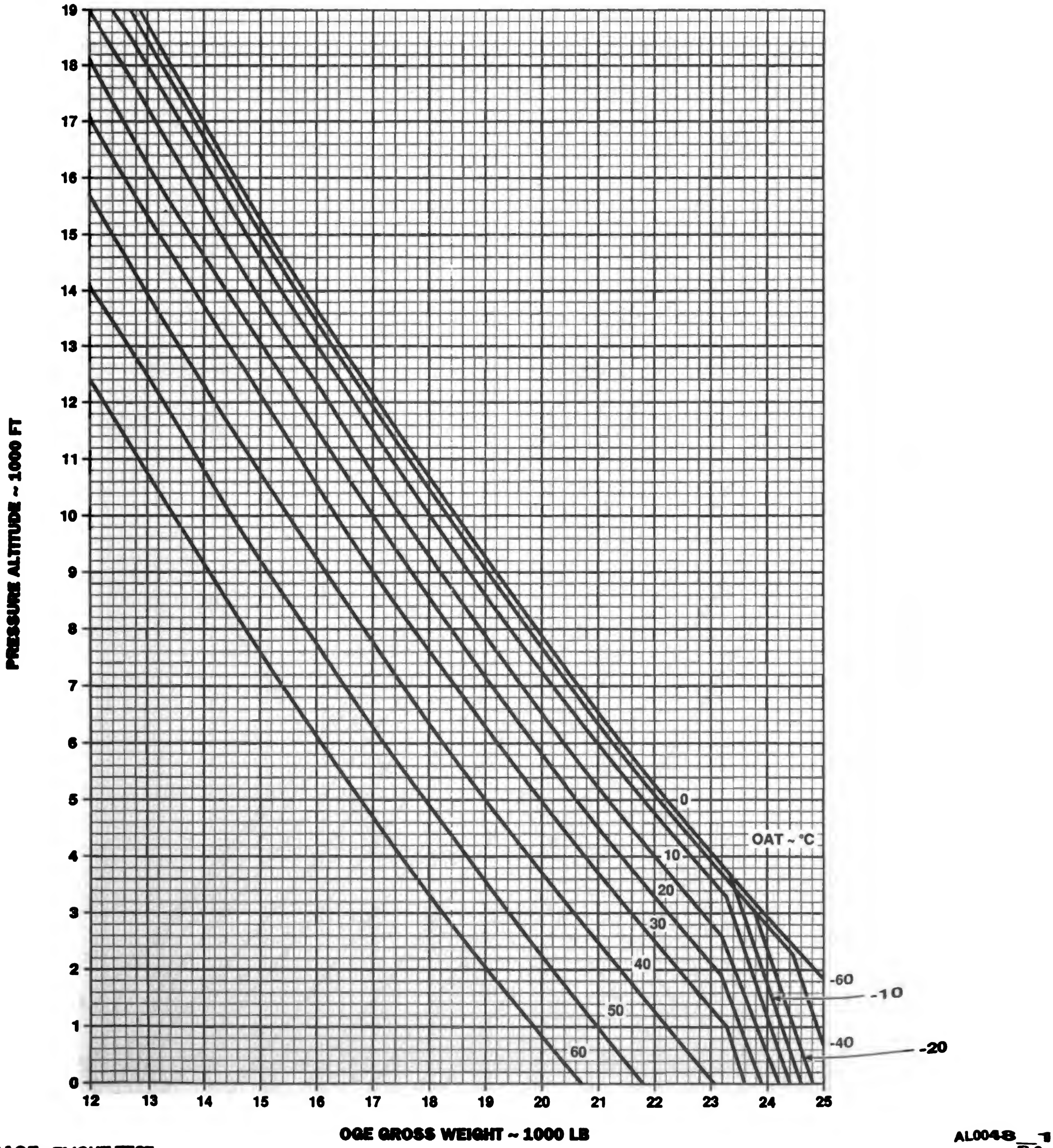
DATA BASE: FLIGHT TEST

AL0004_2A

Figure 7.1-6.1. Maximum Gross Weight to Hover OGE - High Drag (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

CLEAN CONFIGURATION 100% RPM R ATF=1.0
HIRSS (BAFFELS INSTALLED) MAXIMUM POWER
120% TRANSMISSION TORQUE LIMIT
NON-PLACARDED AIRCRAFT

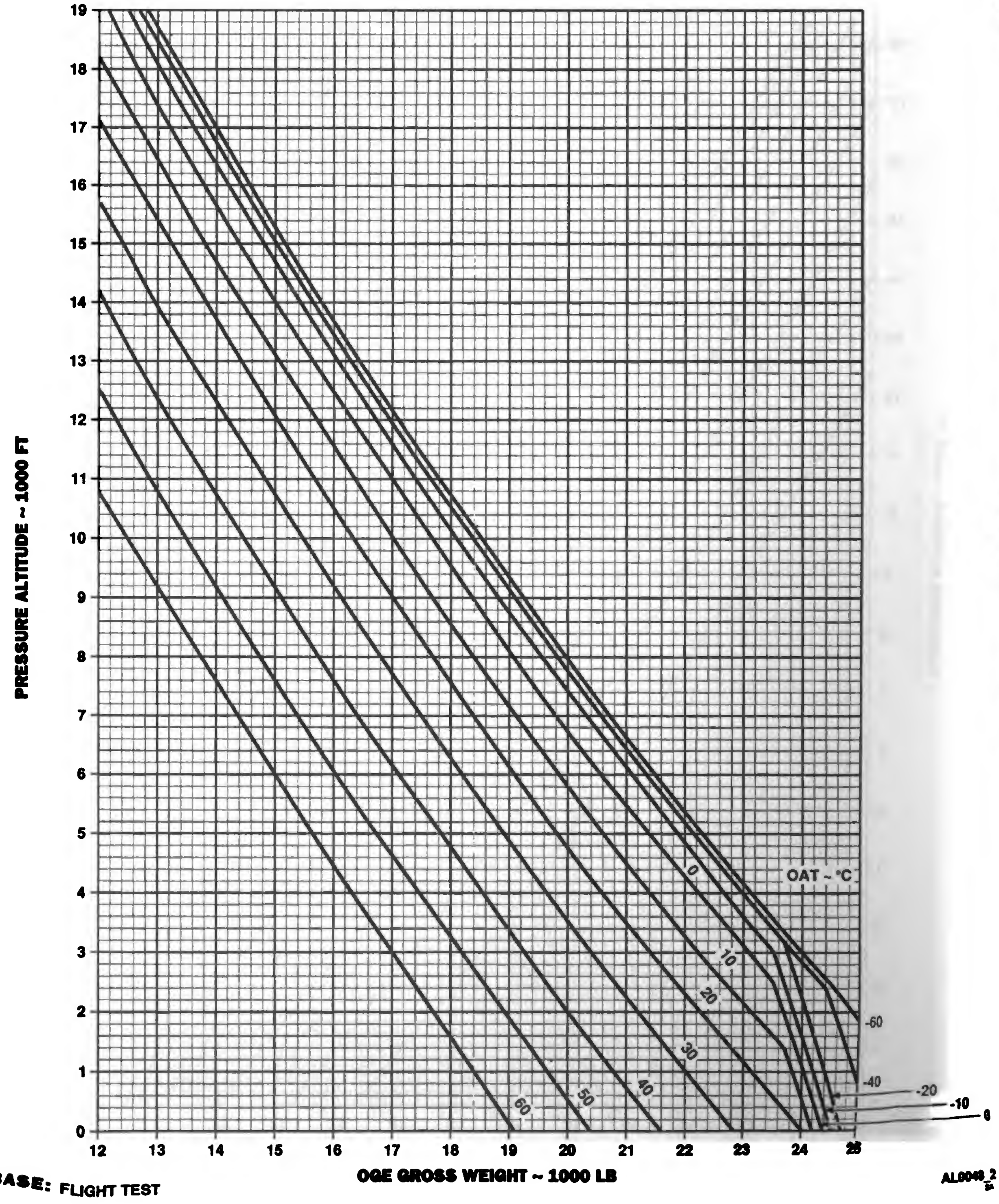


DATA BASE: FLIGHT TEST

Figure 7.1-6.1.1. Maximum Gross Weight to Hover OGE (Sheet 1 of 2)

MAXIMUM GROSS WEIGHT TO HOVER OGE

CLEAN CONFIGURATION 100% RPM R ATF=0.9
HIRSS (BAFFELS INSTALLED) MAXIMUM POWER (10 MINUTE LIMIT)
120% TRANSMISSION TORQUE LIMIT
NON-PLACARDED AIRCRAFT



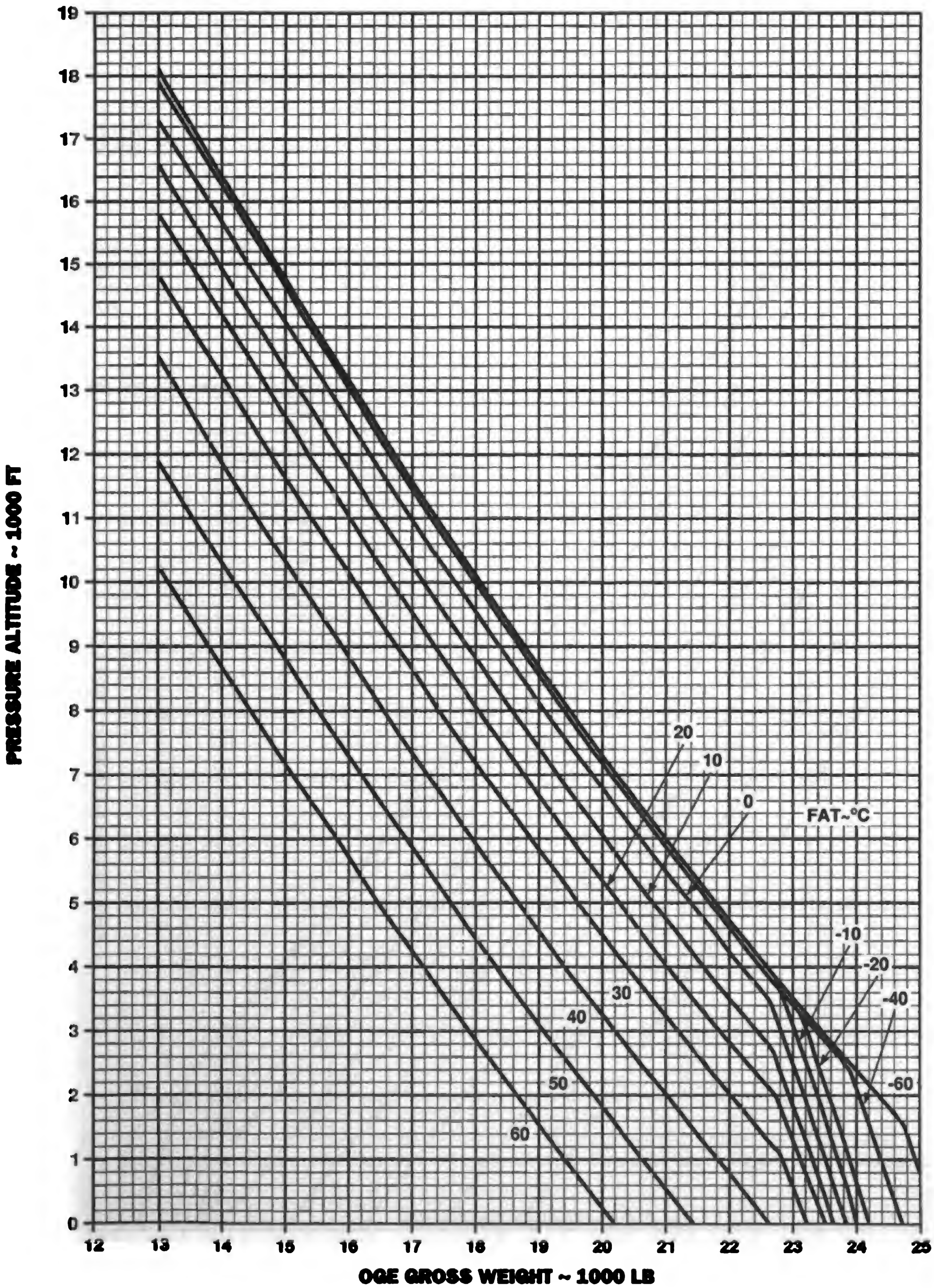
DATA BASE: FLIGHT TEST

AL0048_2

Figure 7.1-6.1.1. Maximum Gross Weight to Hover OGE (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER

2-230 GALLON TANKS 100% RPM R ATF=1.0
HIRSS (BAFFELS INSTALLED) MAXIMUM POWER (10 MINUTE LIMIT)
120% TRANSMISSION TORQUE LIMIT
NON-PLACARDED AIRCRAFT



AL0049_1 BA

Figure 7.1-6.1.2. Maximum Gross Weight to Hover OGE - High Drag (Sheet 1 of 2)

MAXIMUM GROSS WEIGHT TO HOVER

2-230 GALLON TANKS 100% RPM R ATF=0.9
HIRSS (BAFFELS INSTALLED) MAXIMUM POWER (10 MINUTE LIMIT)
120% TRANSMISSION TORQUE LIMIT
NON-PLACARDED AIRCRAFT

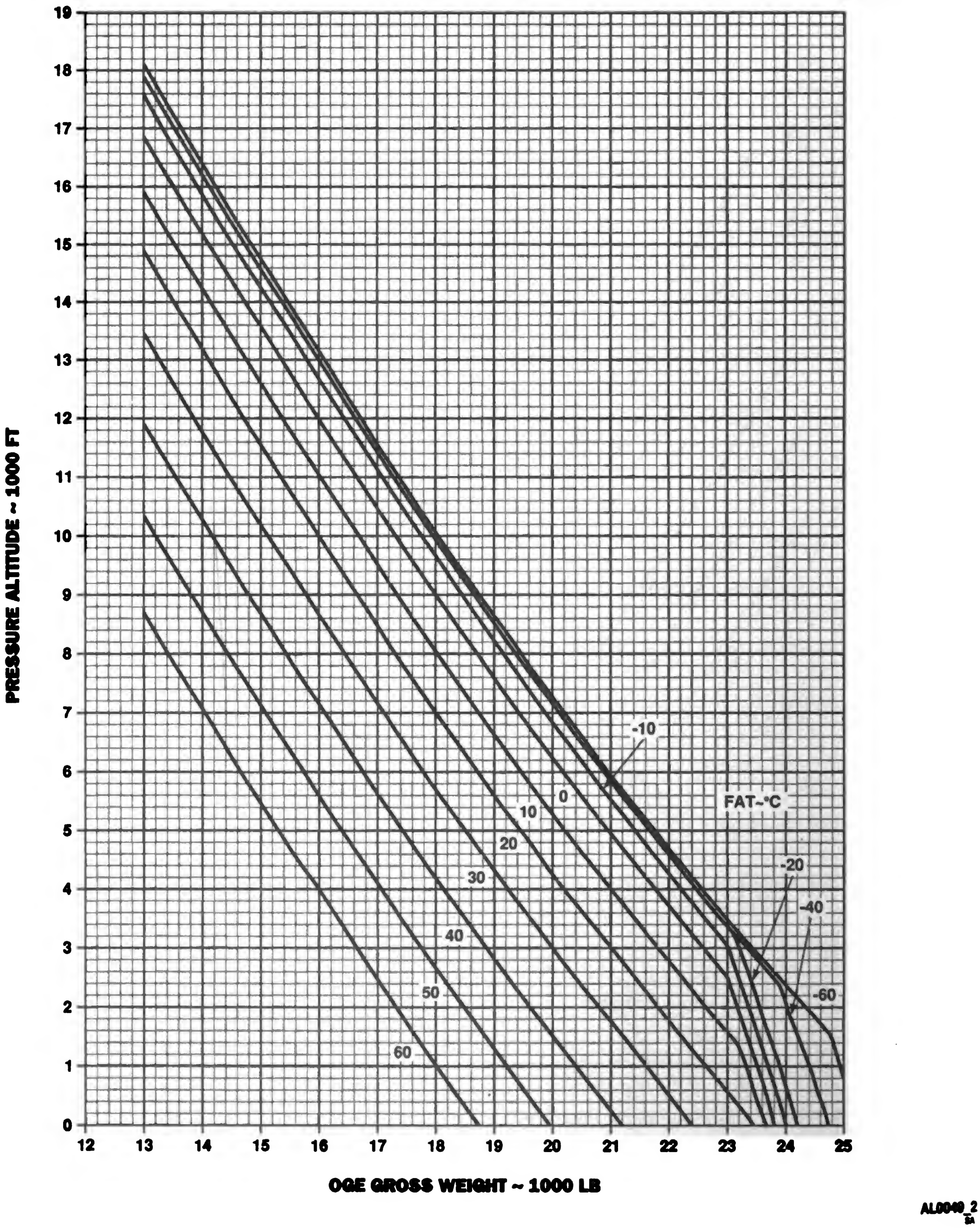


Figure 7.1-6.1.2. Maximum Gross Weight to Hover OGE - High Drag (Sheet 2 of 2)

MAXIMUM GROSS WEIGHT TO HOVER IN GROUND EFFECT

CLEAN CONFIGURATION 100% RPM R

EXAMPLE

WANTED

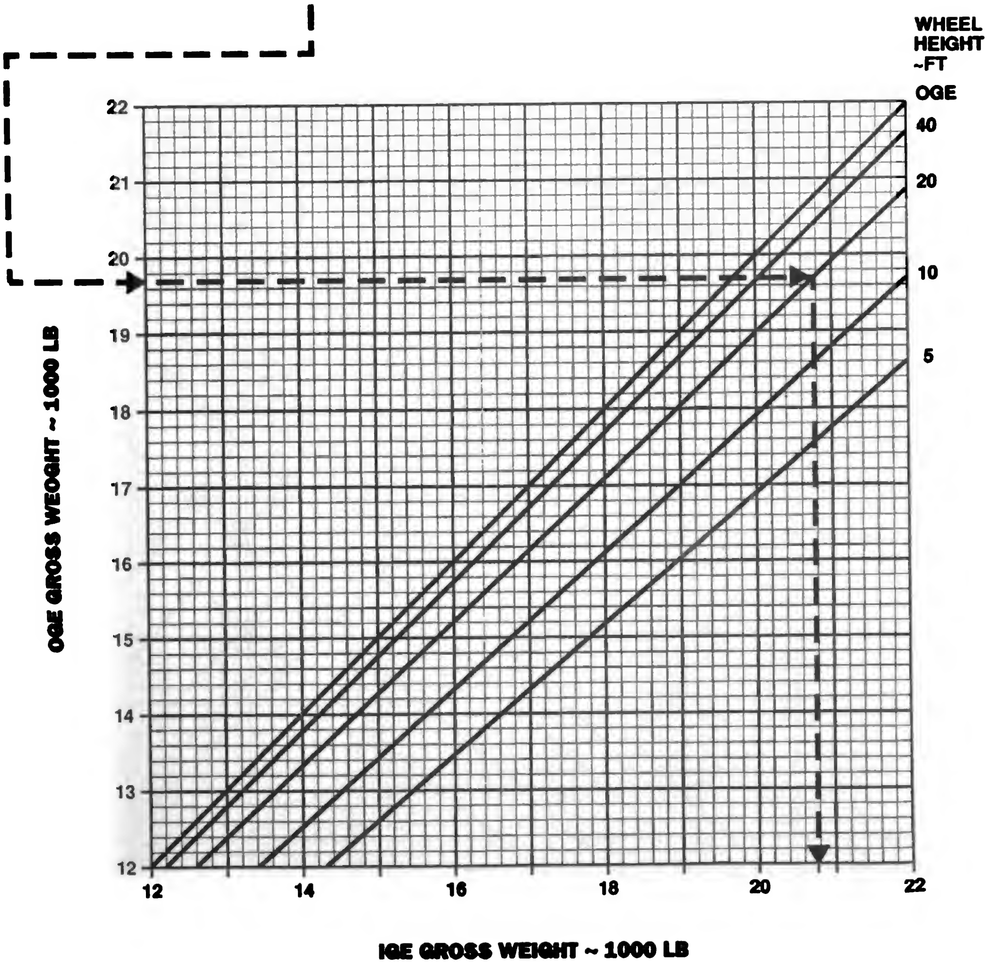
MAXIMUM GROSS WEIGHT TO HOVER AT 20 FEET WHEEL HEIGHT

KNOWN

MAXIMUM OGE GROSS WEIGHT AT 4,000 FT / 30 °C WAS 19,700 LB FROM FIGURE 7.1-6.1

METHOD

ENTER CHART ON OGE GROSS WEIGHT SCALE AT 19,700 LB. MOVE RIGHT TO 20 FT WHEEL HEIGHT LINE, MOVE DOWN READ IGE GROSS WEIGHT = 20,750 LB.



AL0005A

Figure 7.1-6.2. Maximum Gross Weight to Hover IGE - Clean

MAXIMUM GROSS WEIGHT TO HOVER IN GROUND EFFECT

100% RPM R

EXAMPLE

WANTED

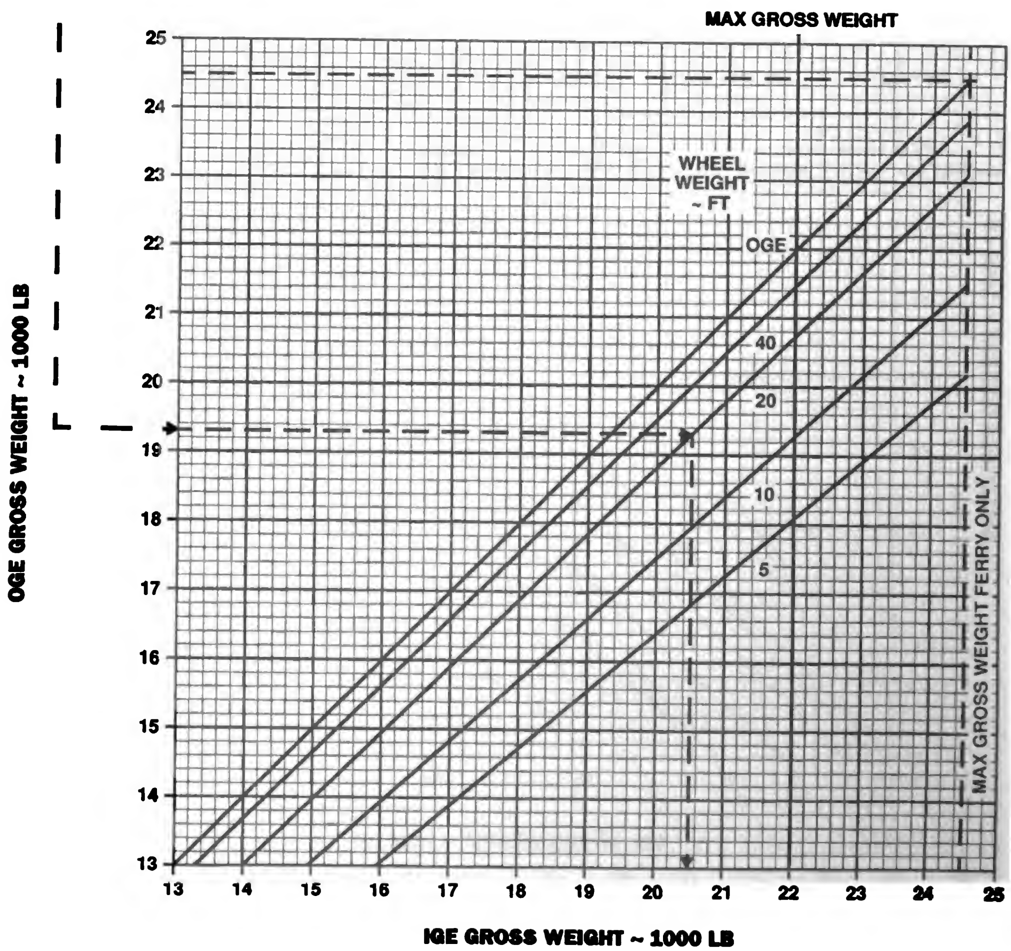
MAXIMUM GROSS WEIGHT TO HOVER AT 20 FEET WHEEL HEIGHT

KNOWN

MAXIMUM OGE GROSS WEIGHT AT 4000 FT / 30 °C WAS 19,300 LB FROM FIGURE 7.1-6.1

METHOD

ENTER CHART ON OGE GROSS WEIGHT SCALE AT 19300 LB. MOVE RIGHT TO 20 FT WHEEL HEIGHT LINE, MOVE DOWN READ IGE GROSS WEIGHT=20500 LB.



AL0050
SA

Figure 7.1-6.3. Maximum Gross Weight to Hover IGE - High Drag

MAXIMUM GROSS WEIGHT TO HOVER IN GROUND EFFECT

100% RPM R

EXAMPLE

WANTED

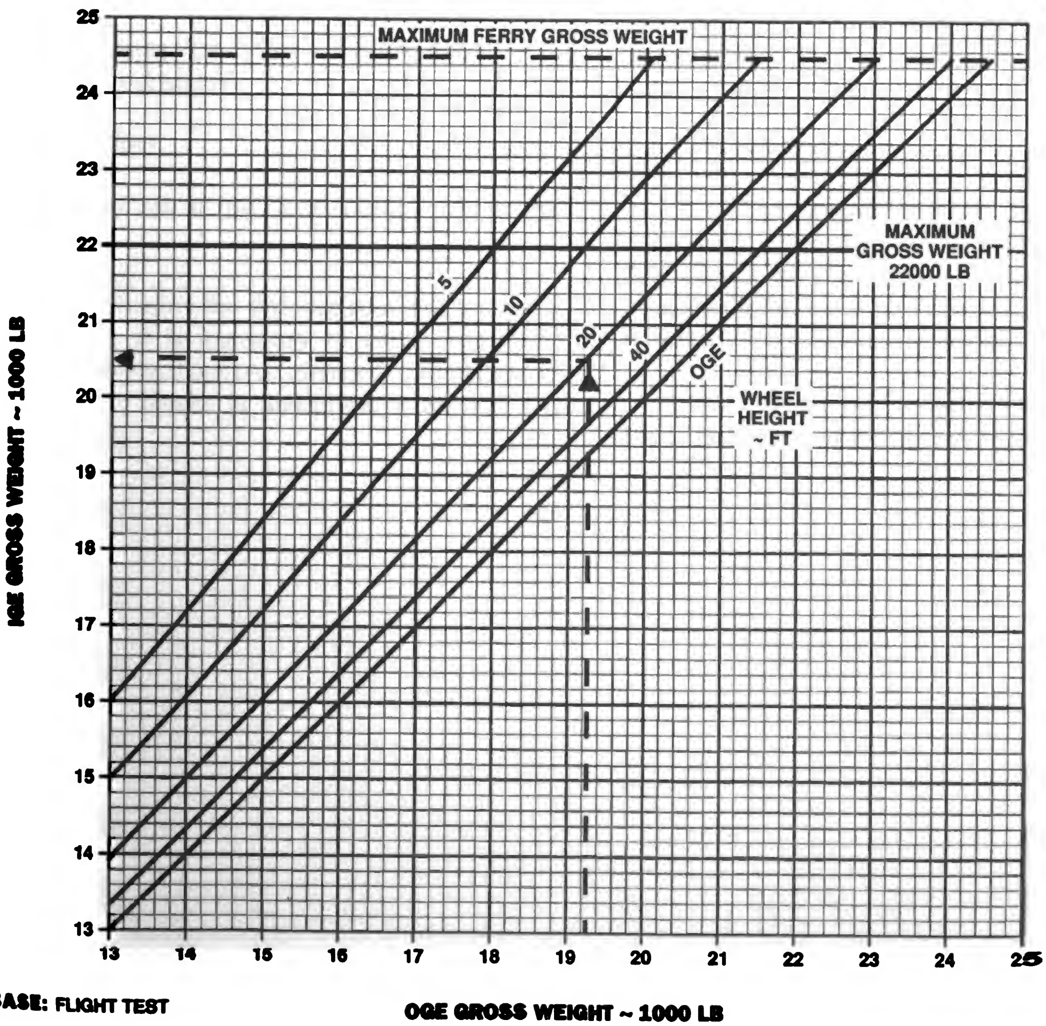
MAXIMUM GROSS WEIGHT TO HOVER AT 20 FEET WHEEL HEIGHT

KNOWN

MAXIMUM OGE GROSS WEIGHT AT 4,000 FT / 30°C WAS 19,300 LB FROM FIGURE 7.1-6.1

METHOD

ENTER CHART ON OGE GROSS WEIGHT SCALE AT 19,300 LB. MOVE UP TO 20 FT WHEEL HEIGHT LINE, MOVE LEFT READ IGE GROSS WEIGHT = 20,500 LB.



DATA BASE: FLIGHT TEST

Figure 7.1-6.2. Maximum Gross Weight to Hover IGE - High Drag

Section IV TAKEOFF

7.1-23. Description.

The takeoff chart (Figure 7.1-7) provides the distances required to clear a 50-foot obstacle, based upon maximum hover wheel height capabilities determined from gross weights, pressure altitude and FAT conditions and torque available or placard limits. Distances are contingent on the use of a takeoff technique as follows: The takeoff profile shown on Figure 7.1-7 and is started with a level flight acceleration from a 5-foot hover, with rotation to climbout attitude initiated at 5 knots below climbout airspeed.

NOTE

The maximum hover heights shown are only a measure of the helicopter's climb capability and do not imply that a hover height greater than 5 feet should be used during actual takeoff.

7.1-24. Use of Chart.

The primary use of the chart is illustrated by the example.

a. To determine the distance required to clear a 50 foot obstacle it is necessary to know maximum hover height and climbout true airspeed. Calculation of maximum hover height is described in Section III, Hover.

NOTE

Indicated airspeeds below 40 KIAS are unreliable. Airspeed conversion data KIAS to KTAS for speeds above 40 KIAS are provided in Section V Cruise.

Select a climbout indicated airspeed of 40 KIAS or greater and determine corresponding true airspeed from applicable cruise chart in Section V.

b. Before takeoff a hover check may be made to verify the hover capability. If winds are present, the hover check may disclose that the helicopter can actually hover at a greater wheel height than the calculated value, since the hover chart is based upon calm wind conditions. The calculated value, however, should be used to determine the takeoff distance required.

7.1-25. Conditions.

a. The takeoff chart is based on calm wind conditions. Since the surface wind velocity and direction cannot be accurately predicted, all takeoff planning should be based on calm wind conditions. Takeoff into the wind will improve the takeoff performance.

b. Takeoff performance data can be obtained based on the use of maximum torque available chart.

TAKEOFF
AT MAXIMUM HOVER CAPABILITY
LEVEL ACCELERATION/CLIMB TECHNIQUE.
ZERO WIND MAXIMUM TORQUE AVAILABLE 100% RPMR

TAKEOFF

EXAMPLE

WANTED:

DISTANCE TO CLEAR 50-FT OBSTACLE

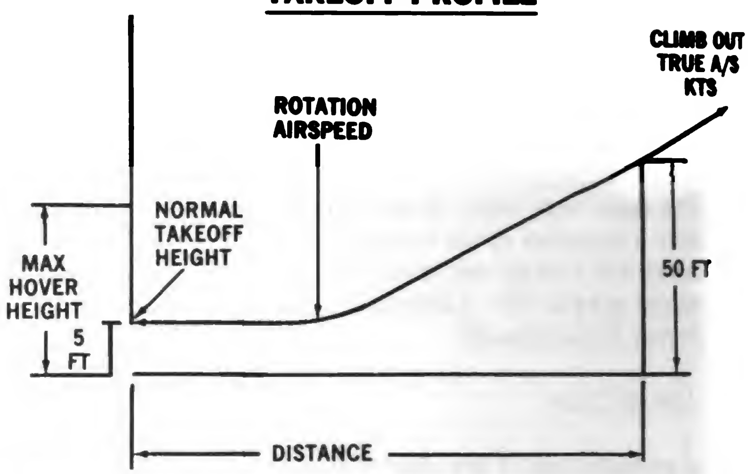
KNOWN:

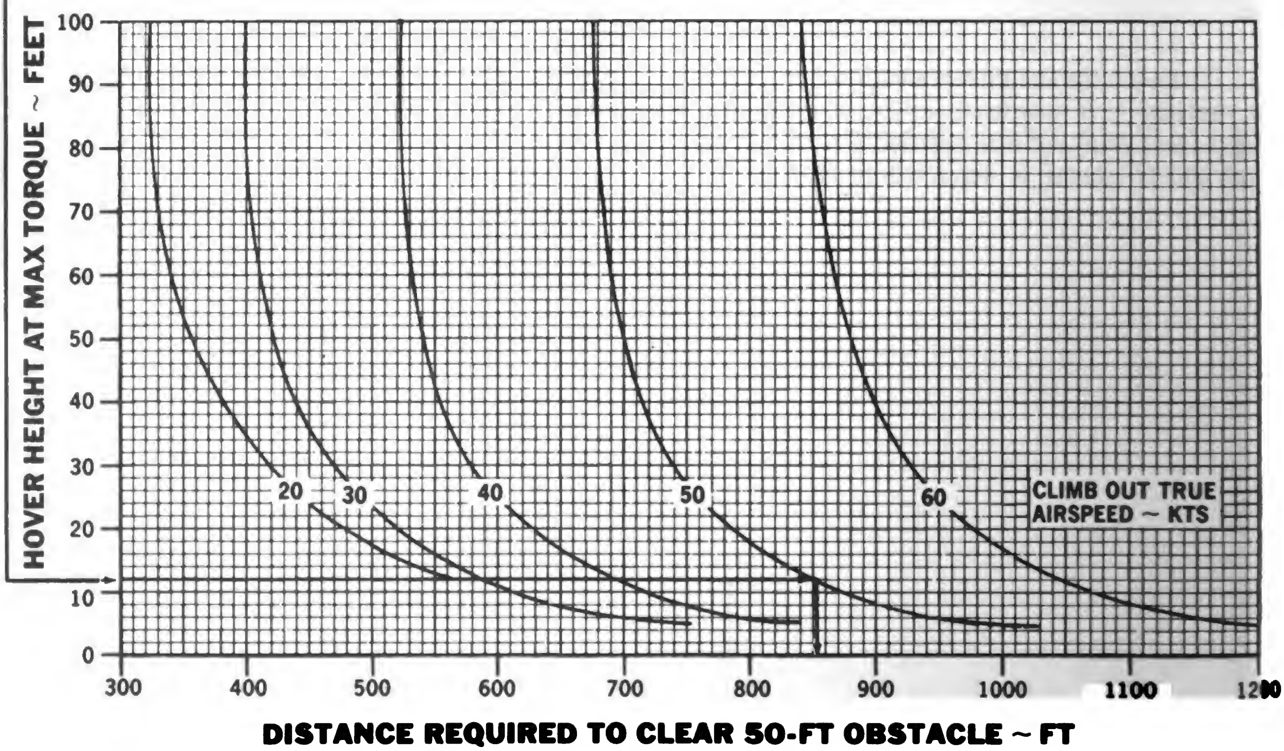
MAXIMUM HOVER HEIGHT AS DETERMINED FROM THE HOVER CHART = 12 FT

METHOD:

ENTER CHART MAXIMUM HOVER HEIGHT MOVE RIGHT TO CLIMB OUT TRUE AIRSPEED 50 KTAS. MOVE DOWN TO READ DISTANCE TO CLEAR 50-FOOT OBSTACLE = 852 FEET WHEN INITIATING NORMAL TAKEOFF TECHNIQUE FROM 5-FOOT HOVER

TAKEOFF PROFILE





DATA BASIS: CALCULATED

UH60L-45281 (R1C12)

Figure 7.1-7. Takeoff

Section V CRUISE

7.1-26. Description.

The cruise charts (Figures 7.1-8 through 7.1-19) present torque required and total fuel flow as a function of airspeed, altitude, temperature, and gross weight at 100% rotor speed. Scales for both true airspeed and indicated airspeed are presented. The baseline aircraft configurations for these charts are "clean and high drag" configuration as defined in Section I. Each cruise chart also presents the change in torque (ΔTRQ) required for 10 sq. ft. of additional flat plate drag with a dashed line on a separate scale. This line is utilized to correct torque required for external loads as discussed in Section VII Drag. Maximum level flight airspeed (V_h) is obtained at the intersection of gross weight arc and torque available - 30 minutes or the transmission torque limit, whichever is lower. Airspeeds that will produce maximum range, maximum endurance, and maximum rate of climb are also shown. Cruise charts are provided from sea level to 20,000 feet pressure altitude in units of 2,000 feet. Each figure number represents a different altitude. The charts provide cruise data for free air temperatures from −50° to +60°C, in units of 10°. Charts with FAT's that exceed the engine ambient temperature limits by more than 10°C are deleted.

7.1-27. Use of Charts.

The primary uses of the charts are illustrated by the examples of Figure 7.1-8. To use the charts, it is usually necessary to know the planned pressure altitude, estimated free air temperature, planned cruise speed, TAS, and gross weight. First, select the proper chart on the basis of pressure altitude and FAT. Enter the chart at the cruise airspeed, IAS, move right and read TAS, move left to the gross weight, move down and read torque required, and then move up and read associated fuel flow. Maximum performance conditions are determined by entering the chart where the maximum range line or the maximum endurance and rate of climb line intersects the gross weight line; then read airspeed, fuel flow, and torque required. Normally, sufficient accuracy can be obtained by selecting the chart nearest the planned cruising altitude and FAT or, more conservatively, by selecting the chart with the next higher altitude and FAT. If greater accuracy is required, interpolation between altitudes and/or temperatures is permissible. To be conservative, use the gross weight at the beginning of the cruise flight. For greater accuracy on long flights, however, it is preferable to determine cruise information for several flight segments to allow for the decreasing gross weight.

a. Airspeed. True and indicated airspeeds are presented at opposite sides of each chart. On any chart, indicated airspeed can be directly converted to true airspeed (or vice versa) by reading directly across the chart without regard for the other chart information. The level flight airspeed calibration for aircraft with the ESSS provisions (hard points only) was used to convert indicated to true airspeed.

b. Torque. Since pressure altitude and temperature are fixed for each chart, torque required varies according to gross weight and airspeed. The torque and torque limits shown on these charts are for dual-engine operation. The maximum torque available is presented on each chart as either the transmission torque limit or torque available - 30 minute for both ATF-1.0 and 0.9 values. The maximum torque available for aircraft with an ATF value between these must be interpolated. The continuous torque available values shown represent the minimum torque available for ATF's of 0.95 or greater. For ATF's less than 0.95 maximum continuous torque available may be slightly reduced. The dual engine torque limit placard value is presented below the torque scale of each chart when applicable. An increase or decrease in torque required because of a drag area change is calculated by adding or subtracting the change in torque from the torque on the curve, and then reading the new fuel flow total.

c. Fuel Flow. Fuel flow scales are provided opposite the torque scales. On any chart, torque may be converted directly to fuel flow without regard to other chart information. Data shown in this section is for two-engine operation. For one-engine fuel flow, refer to Section IX Fuel Flow.

(1) With bleed-air extracted, fuel flow increases:

(a) ENG ANTI-ICE ON - About 100 lbs/hr. Example: (760 lbs/hr + 100 lbs/hr = 860 lbs/ hr.

(b) HEATER ON - About 12 lbs/hr.

(c) Both on - About 112 lbs/hr.

(2) When the cruise or hover IR suppressor system is installed and operating in the benign mode (exhaust baffles removed), the dual-engine fuel flow will decrease about 12 lb/hour.

d. Maximum Range. The maximum range lines (MAX RANGE) indicate the combinations of gross weight and airspeed that will produce the greatest flight range per pound of fuel under zero wind conditions. When maximum range airspeed line is above the maximum torque available, the resulting maximum airspeed should be used for maximum range. A method of estimating maximum range speed in winds is to increase IAS by 2.5 knots per each 10 knots of effective headwind (which reduces flight time and minimizes loss in range) and decrease IAS by 2.5 knots per 10 knots of effective tailwind for economy.

e. Maximum Endurance and Rate of Climb. The maximum endurance and rate of climb lines (MAX END and R/C) indicate the combinations of gross weight and airspeed that will produce the maximum endurance and the maximum rate of climb. The torque required for level flight at this condition is a minimum, providing a minimum fuel flow (maximum endurance) and a maximum torque change available for climb (maximum rate of climb).

f. Change in Frontal Area. Since the cruise information is given for the "clean and high drag configuration," adjustments to torque should be made when operating with external sling loads or aircraft external configuration changes. To determine the change in torque, first obtain the appropriate multiplying factor from the drag load chart (Figure 7.1-21 or 7.1-21.1), then enter the cruise chart at the planned cruise speed TAS, move right to the broken Δ TRQ line, and move up and read Δ TRQ. Multiply Δ TRQ by the multiplying factor to obtain change in torque, then add or subtract change in torque from torque required for the primary mission configuration. Enter the cruise chart at resulting torque required, move up, and read fuel flow. If the resulting torque required exceeds the governing torque limit, the torque required must be reduced to the limit. The resulting reduction in airspeed may be found by subtracting the change in torque from the limit torque; then enter the cruise chart at the reduced torque, and move up to the gross weight. Move left or right to read TAS or IAS. The engine torque setting for maximum range obtained from the clean configuration cruise chart will generally result in cruise at best range airspeed for the higher drag configuration. To determine the approximate airspeed for maximum range for alternative or external load configurations, reduce the value from the cruise chart by 6 knots for each 10 square foot increase in drag area, ΔF. For example, if both cabin doors are open the ΔF increases 6 ft² and the maximum range airspeed would be reduced by approximately 4 knots (6 Kts/10 ft² × 6 ft² = 3.6 Kts).

g. Additional Uses. The low speed end of the cruise change (below 40 knots) is shown primarily to familiarize you with the low speed power requirements of the helicopter. It shows the power margin available for climb or acceleration during maneuvers, such as NOE flight. At zero airspeed, the torque represents the torque required to hover out of ground effect. In general, mission planning for low speed flight should be based on hover out of ground effect.

7.1-28. Single Engine.

The minimum or maximum single engine speeds can be determined by using a combination of the -701C torque available and cruise charts. To calculate single engine speeds, first determine the torque available from Section II at the TGT limit desired and divide by 2. (Example: 90% TRQ ÷ 2 = 45% TRQ.)

Select the appropriate cruise chart for the desired flight condition and enter the torque scale with the torque value derived above. Move up to the intersection of torque available and the mission gross weight arc, and read across for minimum single engine airspeed. Move up to the second intersection of torque and weight, and read across to determine the maximum single engine speed. If no intersections occur, there is no single engine level flight capability for the conditions. Single engine fuel flow at the desired 10 minute, 30 minute, continuous conditions may be obtained by doubling the torque required from the cruise chart and referring to Figure 7.1-25.

CRUISE EXAMPLE

CLEAN CONFIGURATION
100% RPM R

EXAMPLE

WANTED

A. CRUISE CONDITIONS FOR MAXIMUM RANGE
B. CONDITIONS FOR MAXIMUM ENDURANCE
C. MAXIMUM AIRSPEED IN LEVEL FLIGHT
D. DETERMINE TORQUE AND FUEL FLOW REQUIRED TO CRUISE WITH CARGO DOORS OPEN

KNOWN

FAT = +30°C
PRESSURE ALTITUDE = 6000 FT
GW = 17000 LBS
ATF = 0.95
TRQ LIMIT = 90%

METHOD

A. TURN TO CRUISE CHARTS NEAREST KNOWN FLIGHT CONDITIONS, AT INTERSECTION OF MAX RANGE LINE AND KNOWN VALUE OF GROSS WEIGHT:
MOVE LEFT, READ TAS = 137 KTS
MOVE RIGHT, READ IAS = 121 KTS
MOVE DOWN, READ TORQUE = 63% TRQ
MOVE UP, READ TOTAL FUEL FLOW = 970 LBS / HR

B. AT INTERSECTION OF MAX END AND R / C LINE AND KNOWN VALUE OF GROSS WEIGHT:
MOVE LEFT, READ TAS = 81 KTS
MOVE RIGHT, READ IAS = 66 KTS
MOVE DOWN, READ TORQUE = 40% TRQ
MOVE UP, READ TOTAL FUEL FLOW = 740 LBS / HR

C. THE 30 MINUTE TORQUE AVAILABLE FOR AN ATF OF 0.95 IS ABOVE THE PLACARD TORQUE LIMIT. THEREFORE, AT THE INTERSECTION OF GROSS WEIGHT AND 90% TRQ:
MOVE LEFT, READ MAXIMUM TAS = 157 KTS
MOVE RIGHT, READ MAXIMUM IAS = 139 KTS
MOVE DOWN, READ MAXIMUM TORQUE = 90% TRQ
MOVE UP, READ TOTAL FUEL FLOW = 1250 LBS / HR

D. ENTER △TRQ% PER 10 SQ FT SCALE AT 137 KTAS
MOVE UP READ △TRQ = 9.0%
TURN TO DRAG TABLE IN SECTION VII
NOTE CARGO DOORS OPEN = 6.0 SQ FT△F AND HAS A DRAG MULTIPLYING FACTOR VALUE OF 0.60, CALCULATE TOTAL TORQUE REQUIRED USING THE CONDITIONS OF EXAMPLE A:
63% + (0.6 X 9.0%) = 68.4% TRQ
READ FUEL FLOW AT TOTAL TORQUE = 1025 LBS / HR

E. PLACARDED TORQUE LIMITS APPLY TO UH-60L HELICOPTERS NOT EQUIPPED WITH IMPROVED MAIN ROTOR FLIGHT CONTROLS AND DUAL ENGINE TORQUE LIMITS PLACARD INSTALLED ON INSTRUMENT PANEL.

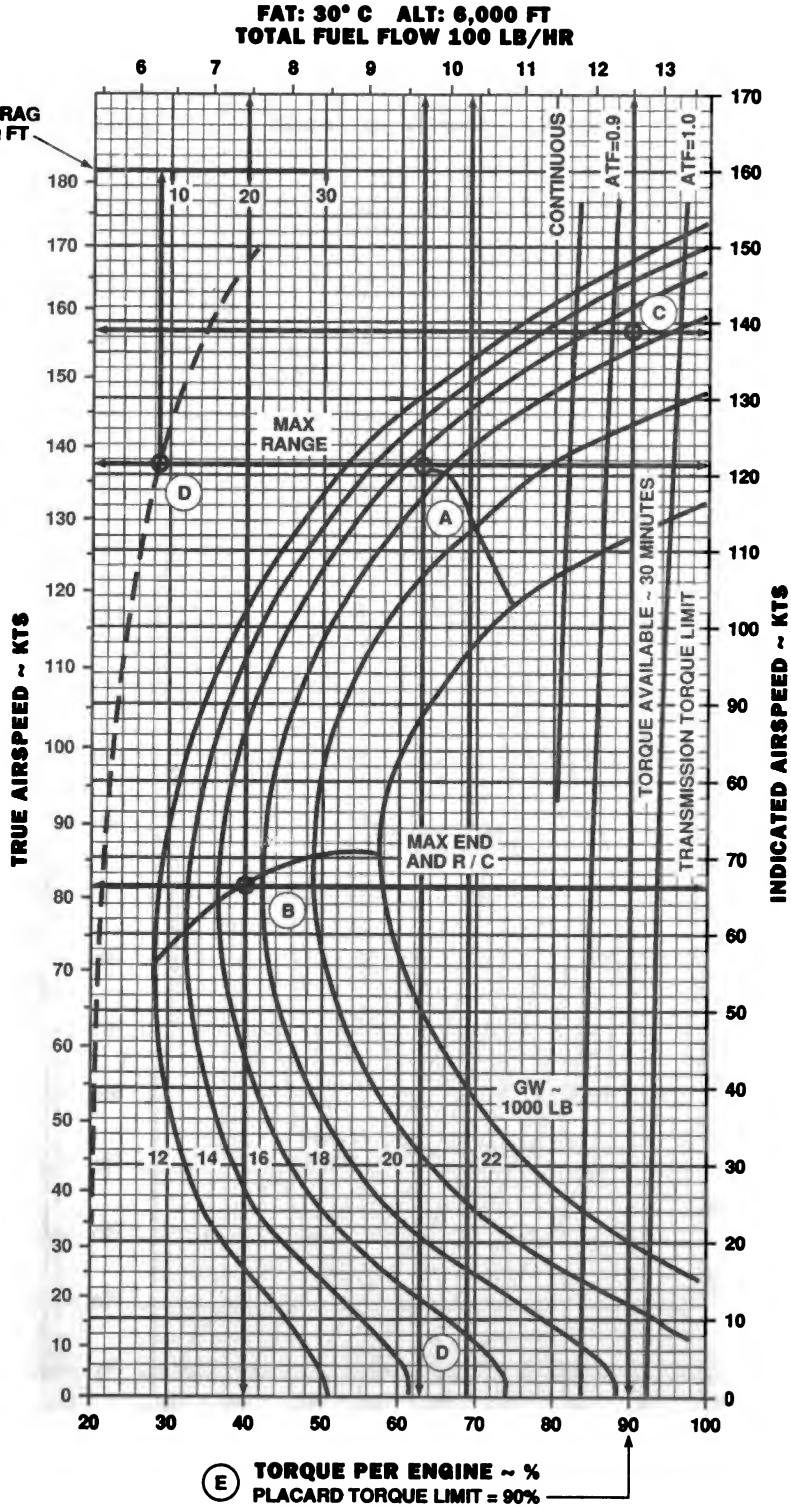
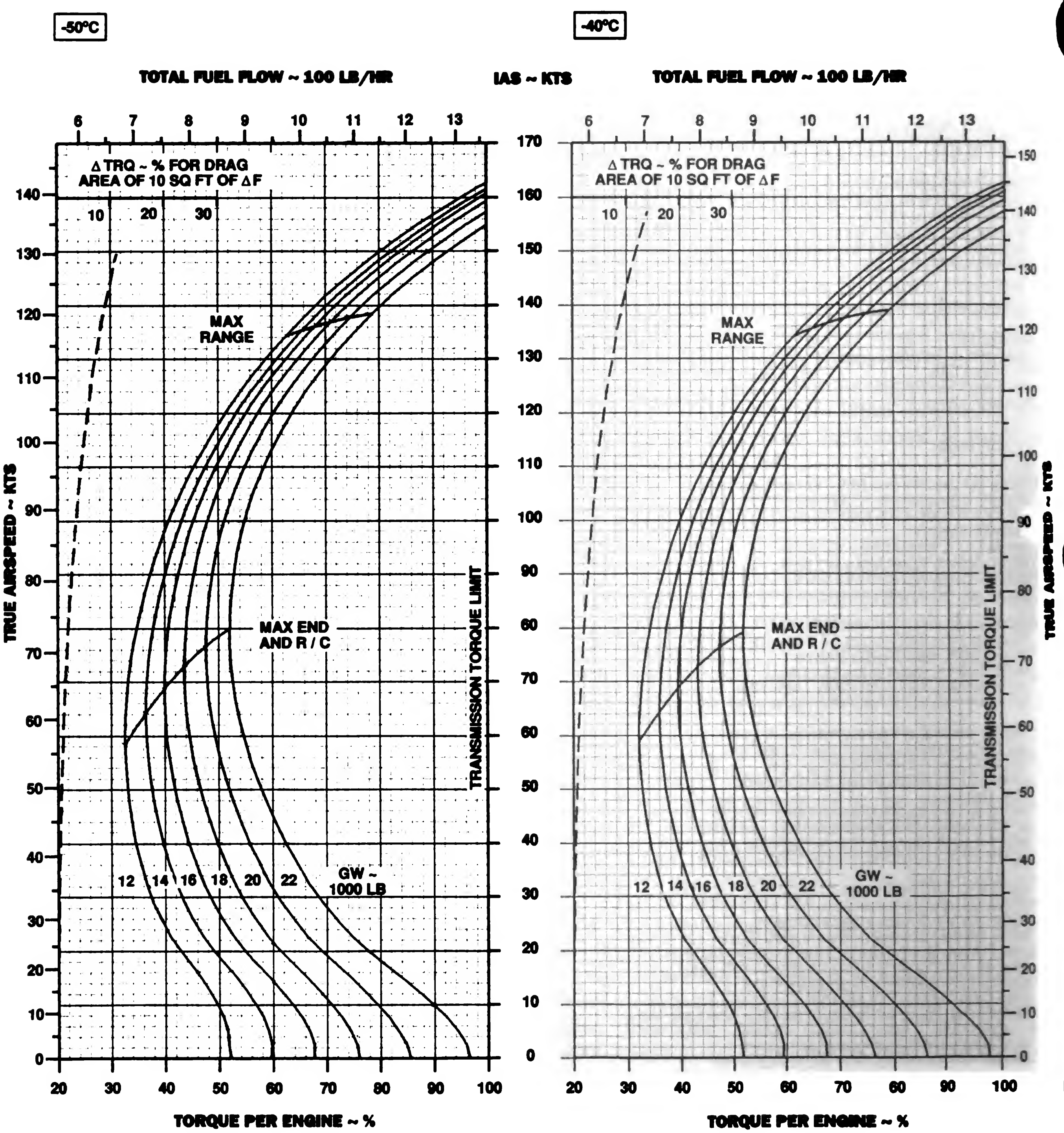


Figure 7.1-8. Sample Cruise Chart

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE 0 FT T701C (2)



DATA BASE: FLIGHT TEST

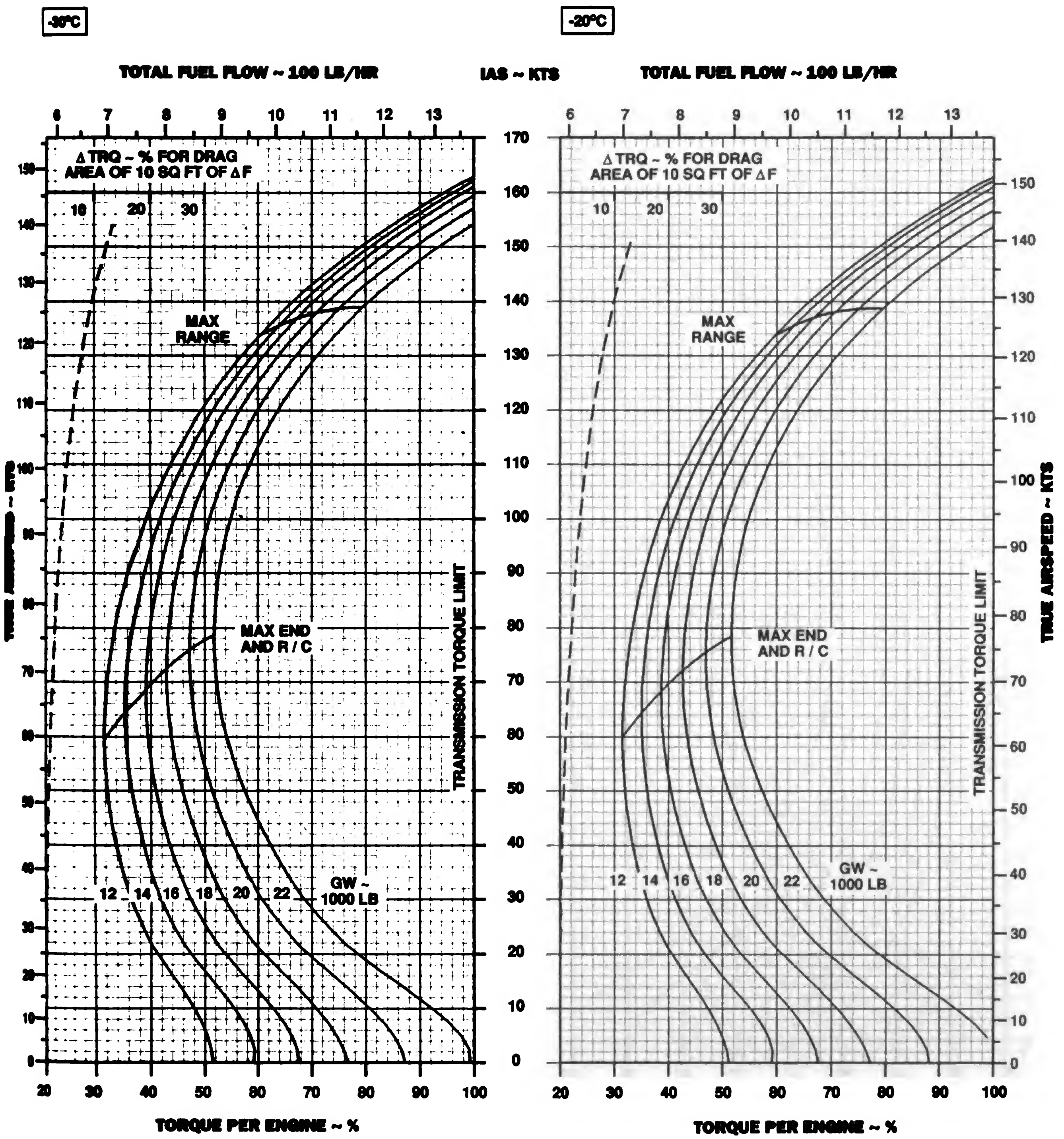
UH60A -156466.1 (C7)

Figure 7.1-9. Cruise - Pressure Altitude Sea Level (Sheet 1 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T701C (2)



DATA BASE: FLIGHT TEST

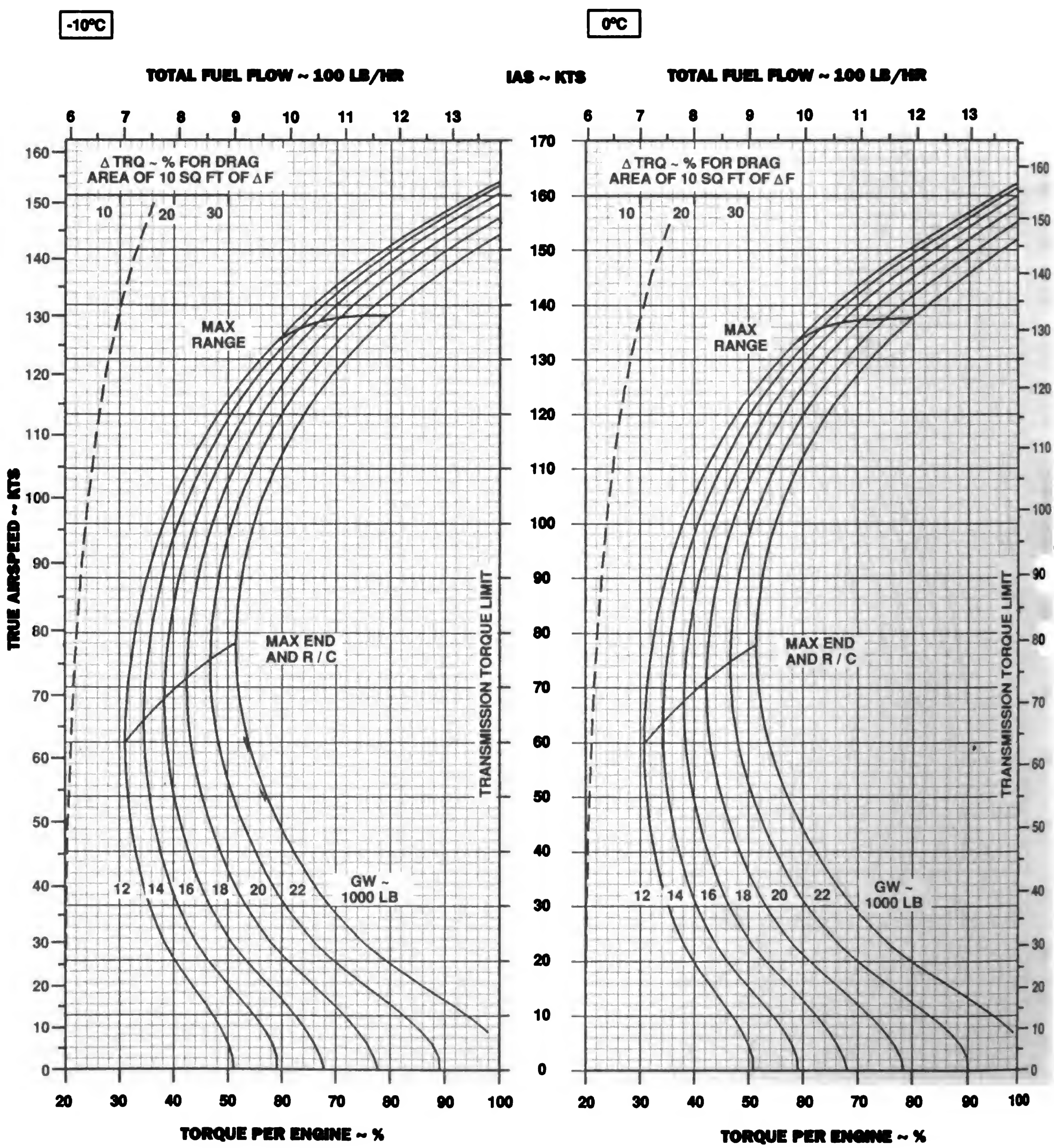
UH60A-156466.2 (C7)

Figure 7.1-9. Cruise - Pressure Altitude Sea Level (Sheet 2 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T701C (2)



DATA BASE: FLIGHT TEST

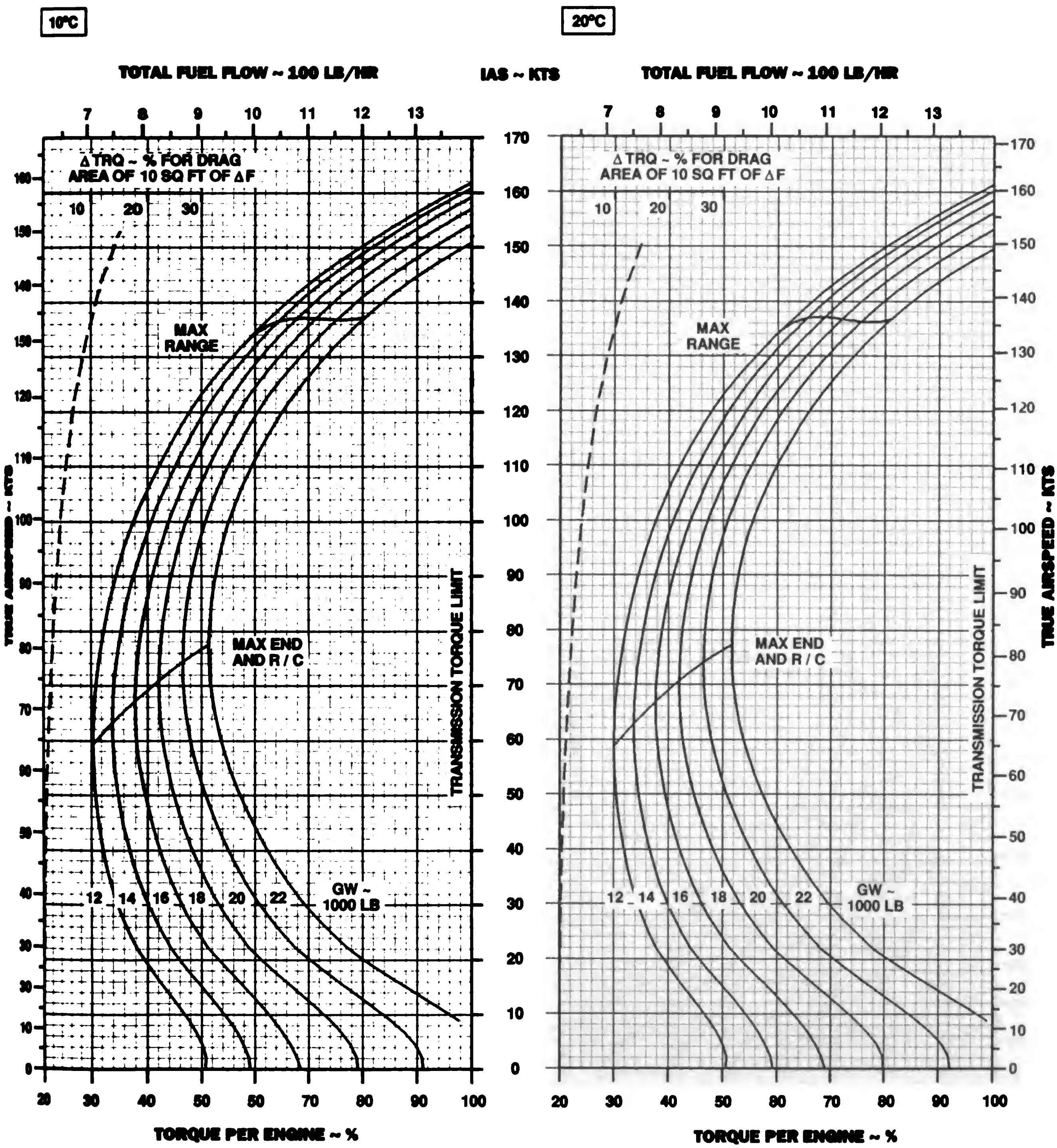
UH60A-156466.3 (C7)

Figure 7.1-9. Cruise - Pressure Altitude Sea Level (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T701C (2)



DATA BASE: FLIGHT TEST

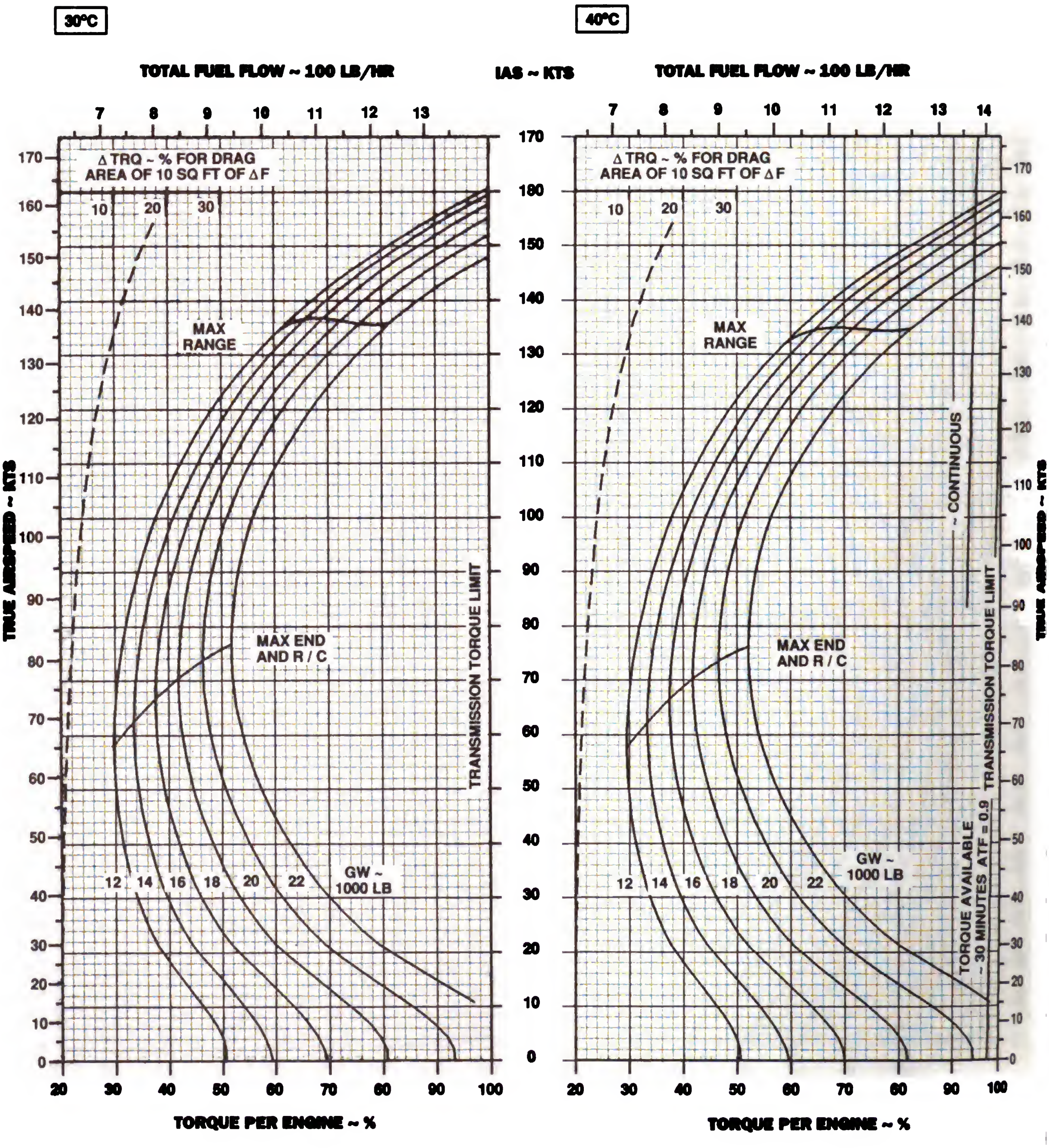
UH60A-156406.4 (C7)

Figure 7.1-9. Cruise - Pressure Altitude Sea Level (Sheet 4 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT

CRUISE
0 FT
T701C (2)



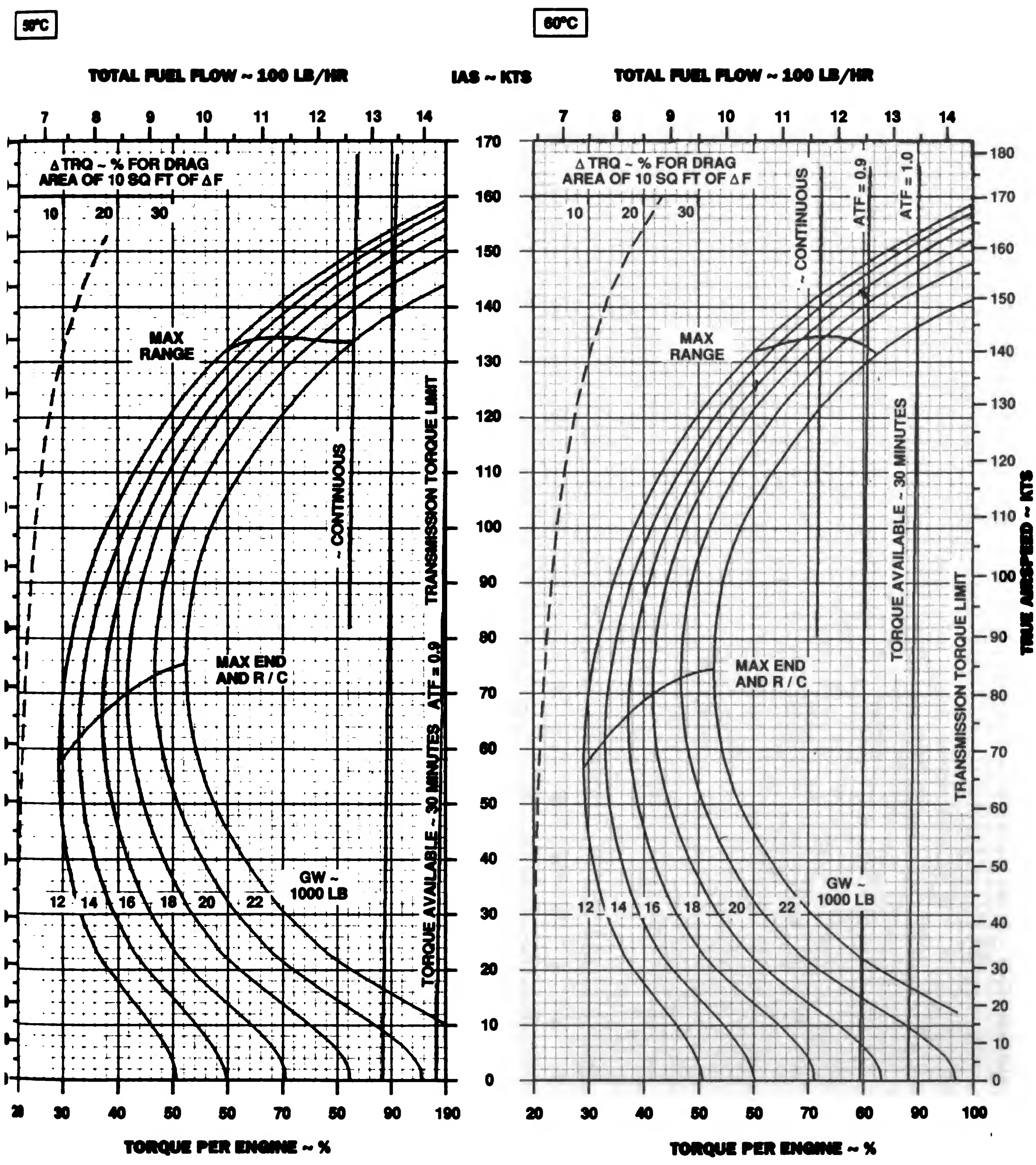
DATA BASE: FLIGHT TEST

UH60A-1S0496.5 (C7)

Figure 7.1-9. Cruise - Pressure Altitude Sea Level (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 0 FT



DATA BASE: FLIGHT TEST

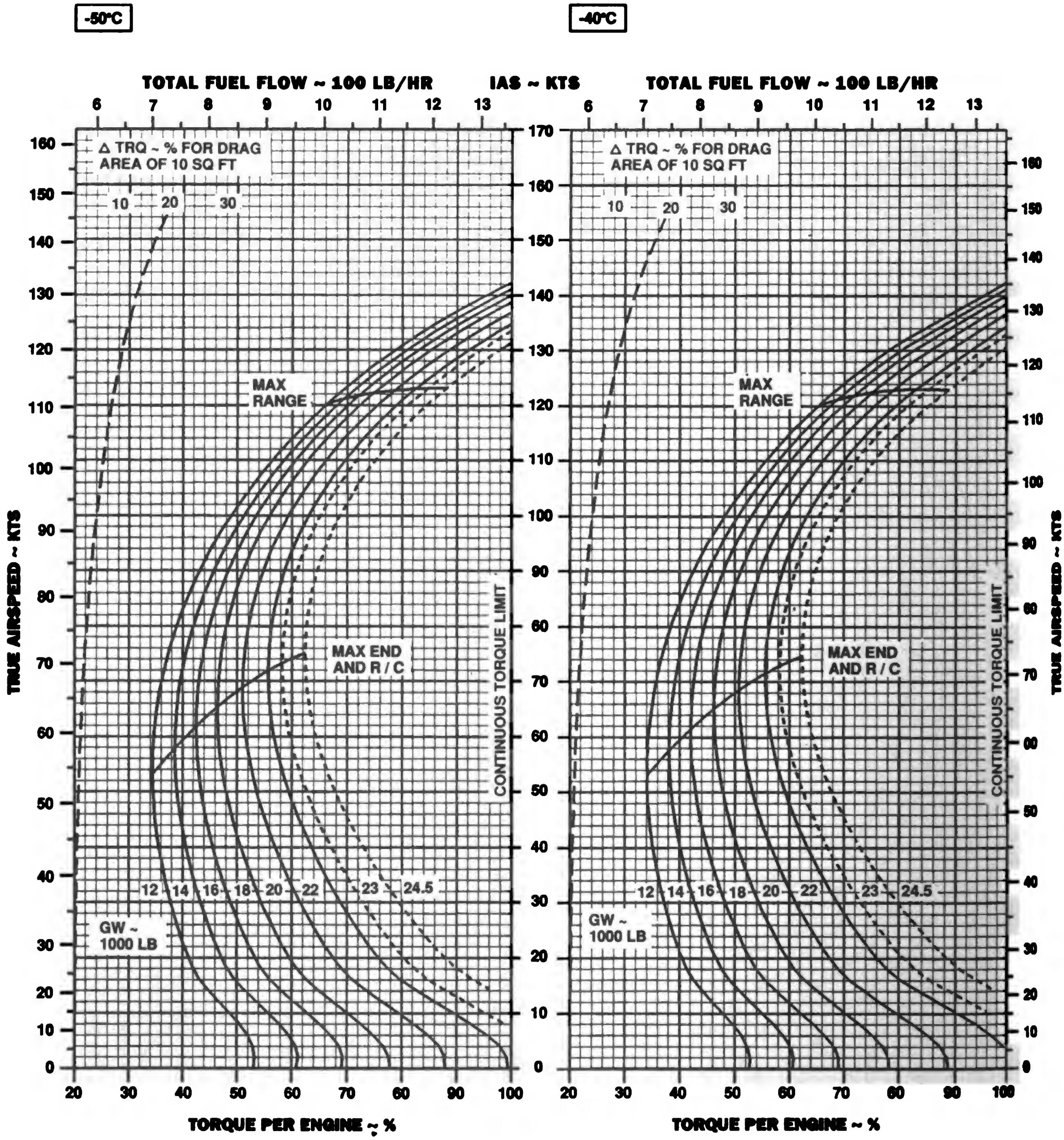
UH60A -156466.6 (C7)

Figure 7.1-9. Cruise - Pressure Altitude Sea Level (Sheet 6 of 6)

CRUISE

CRUISE
0 FT
T701C (2)

PRESS ALT: 0 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

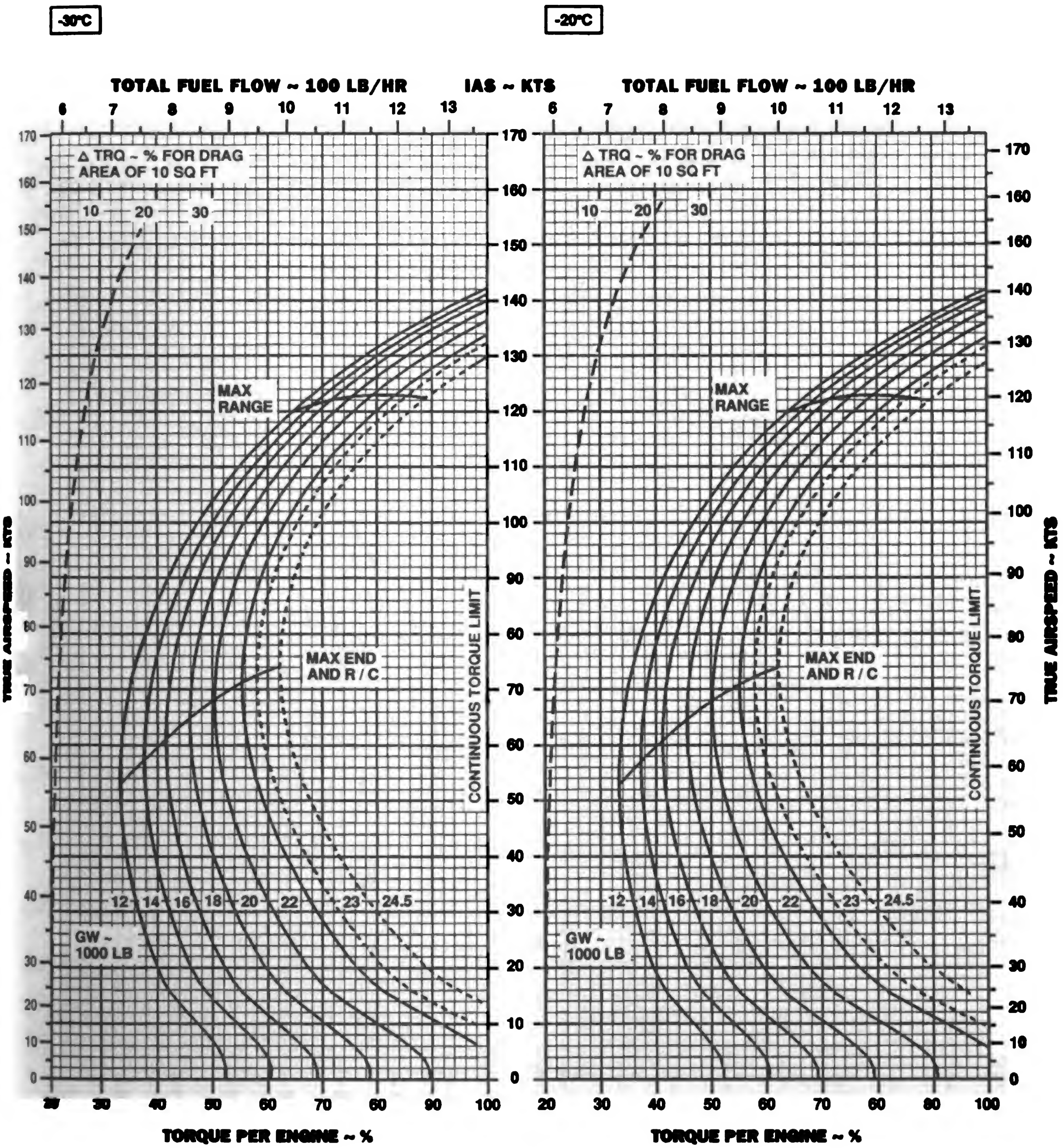
UH60A_167593_1 (R1C13)

Figure 7.1-9.1. Cruise High Drag - Pressure Altitude Sea Level (Sheet 1 of 6)

CRUISE

CRUISE
0 FT
T701C (2)

PRESS ALT: 0 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

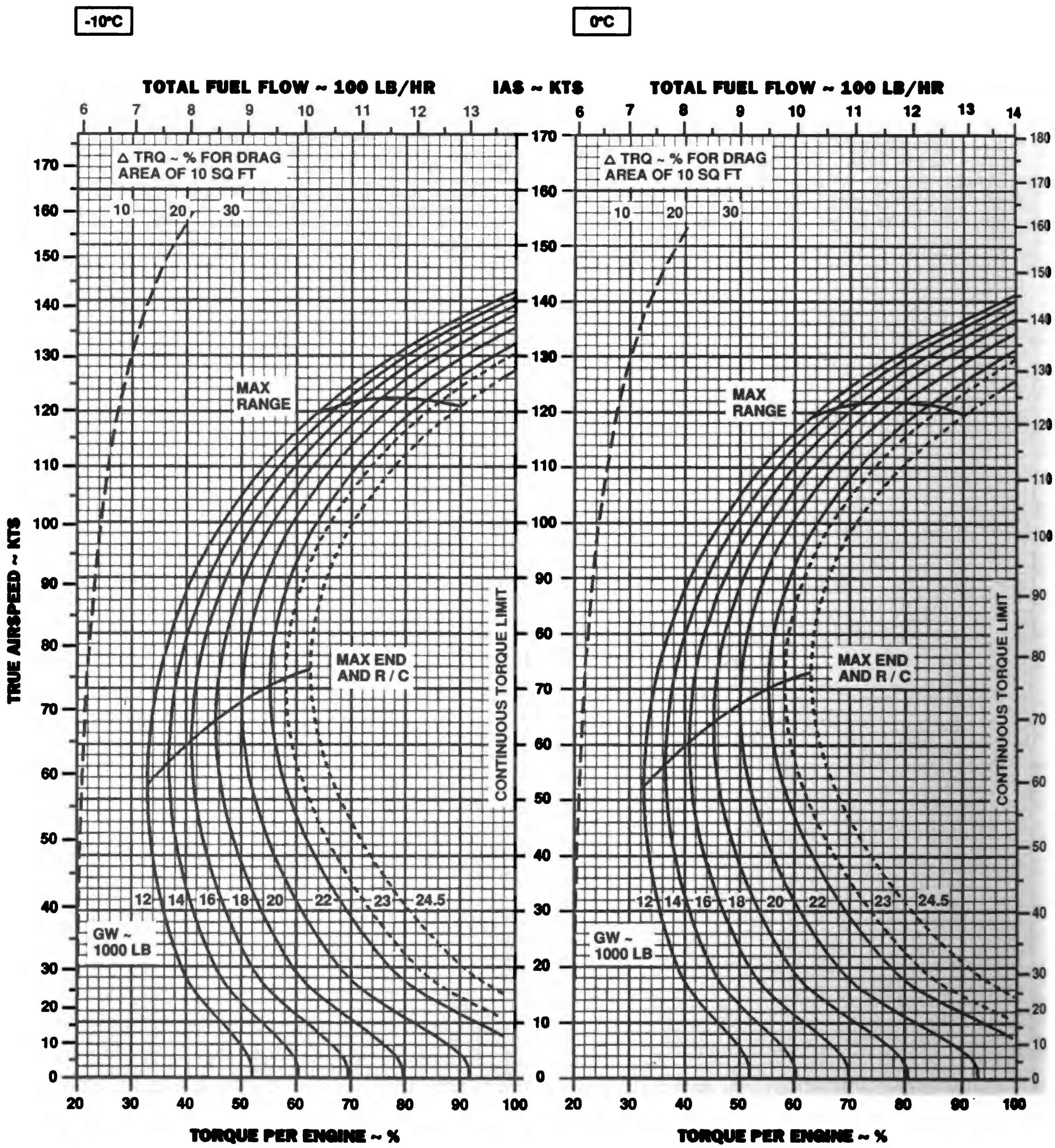
UH60A_167593_2 (R1C13)

Figure 7.1-9.1. Cruise High Drag - Pressure Altitude Sea Level (Sheet 2 of 6)

CRUISE

PRESS ALT: 0 FT

CRUISE
0 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

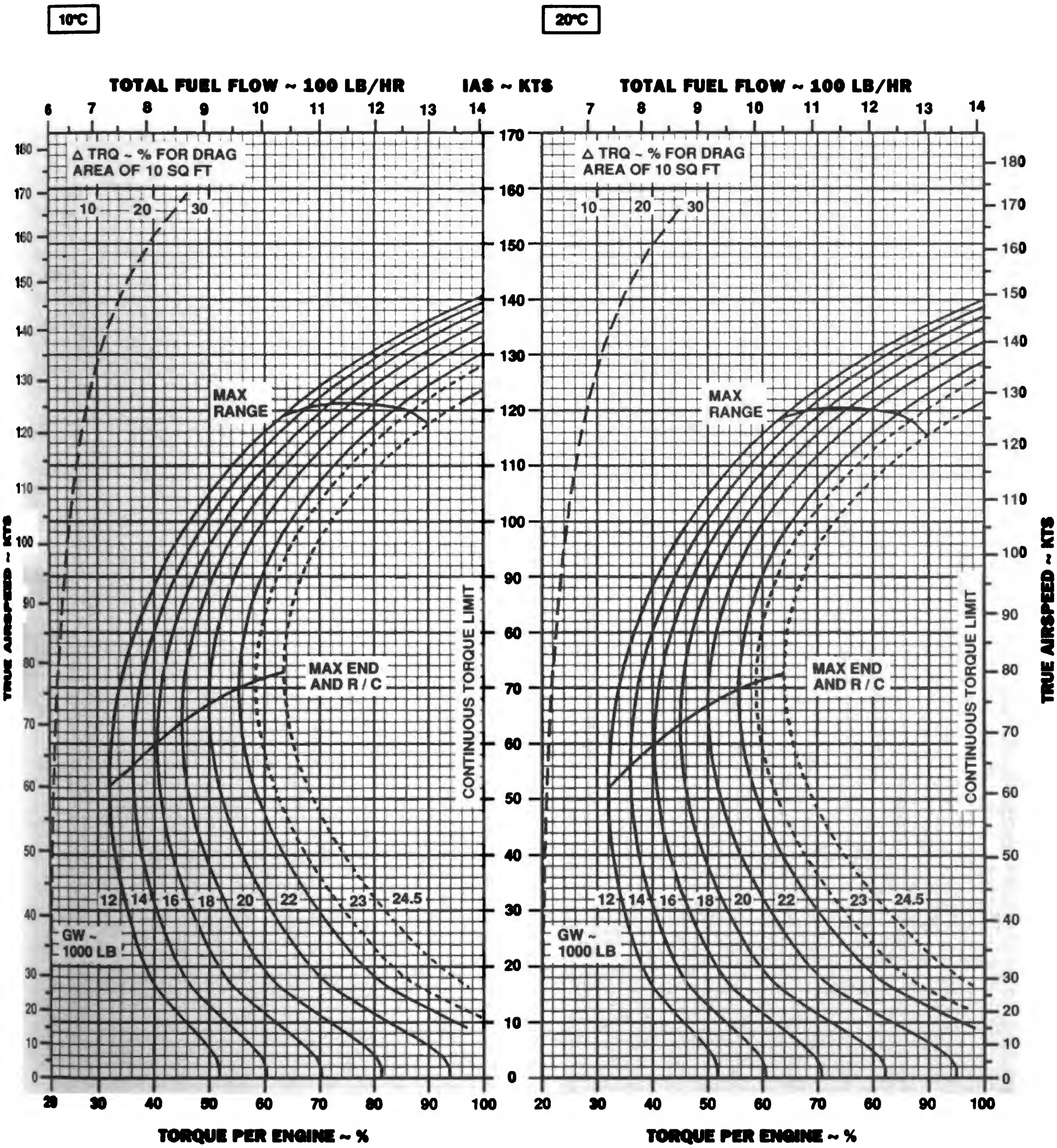
UH60A_167593_3 (R1C13)

Figure 7.1-9.1. Cruise High Drag - Pressure Altitude Sea Level (Sheet 3 of 6)

CRUISE

PRESS ALT: 0 FT

CRUISE
0 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

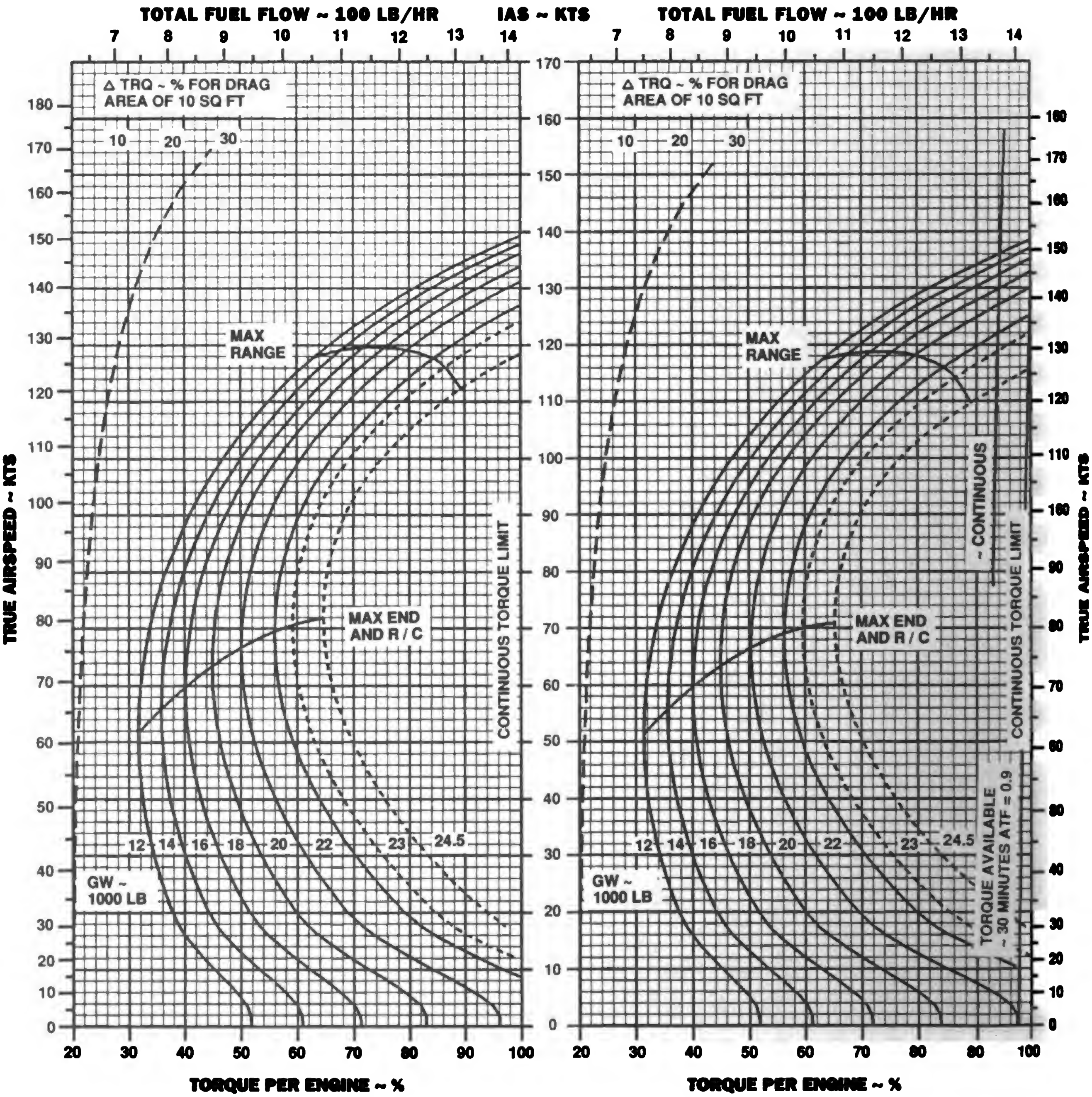
UH60A_167593_4 (R1C13)

Figure 7.1-9.1. Cruise High Drag - Pressure Altitude Sea Level (Sheet 4 of 6)

CRUISE

CRUISE
0 FT
T701C (2)

PRESS ALT: 0 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

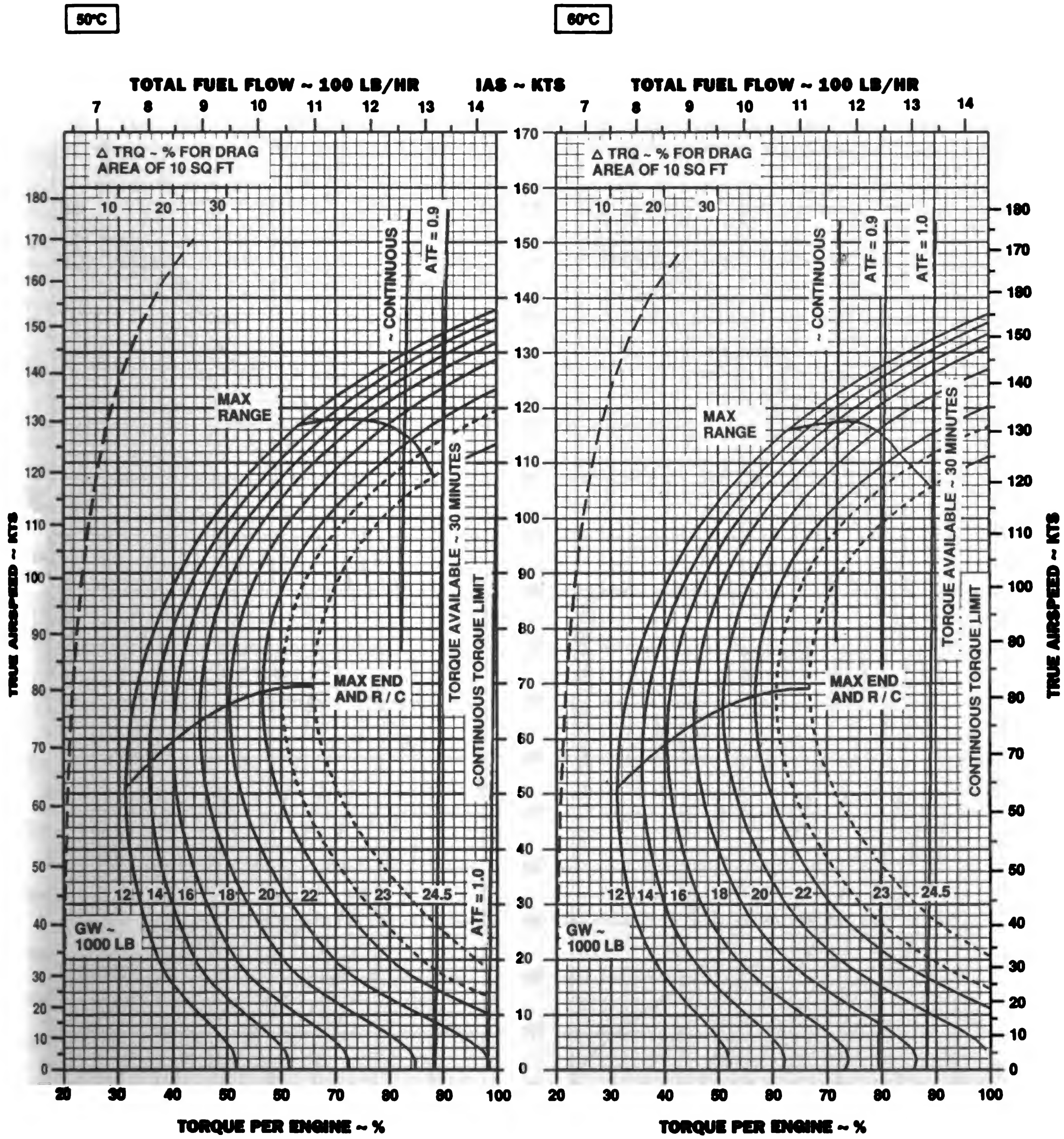
UH60A_167593_5 (R1C13)

Figure 7.1-9.1. Cruise High Drag - Pressure Altitude Sea Level (Sheet 5 of 6)

CRUISE

CRUISE
0 FT
T701C (2)

PRESS ALT: 0 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

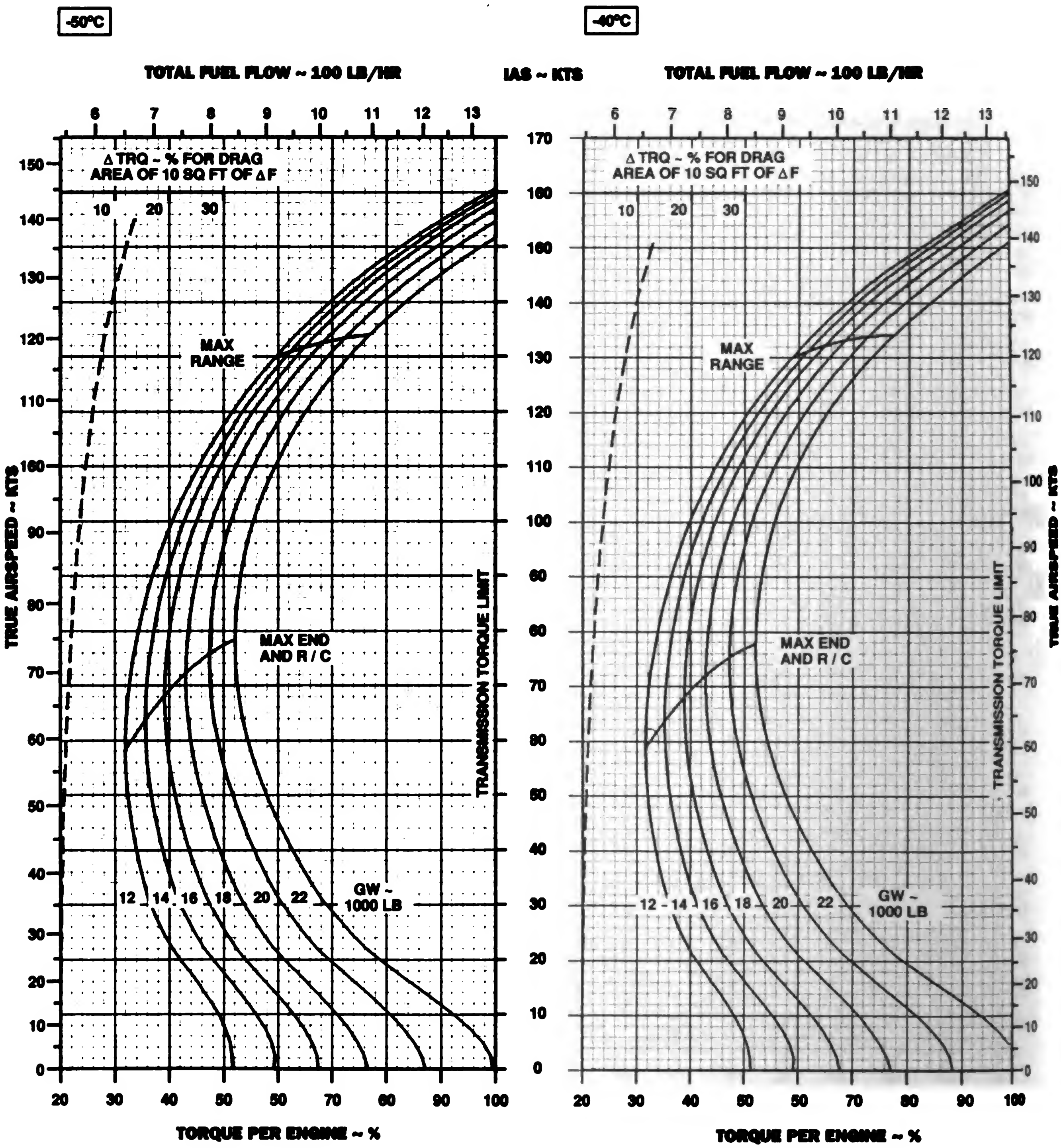
UH60A_167593_6 (R1C13)

Figure 7.1-9.1. Cruise High Drag - Pressure Altitude Sea Level (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2,000 FT

CRUISE
2,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

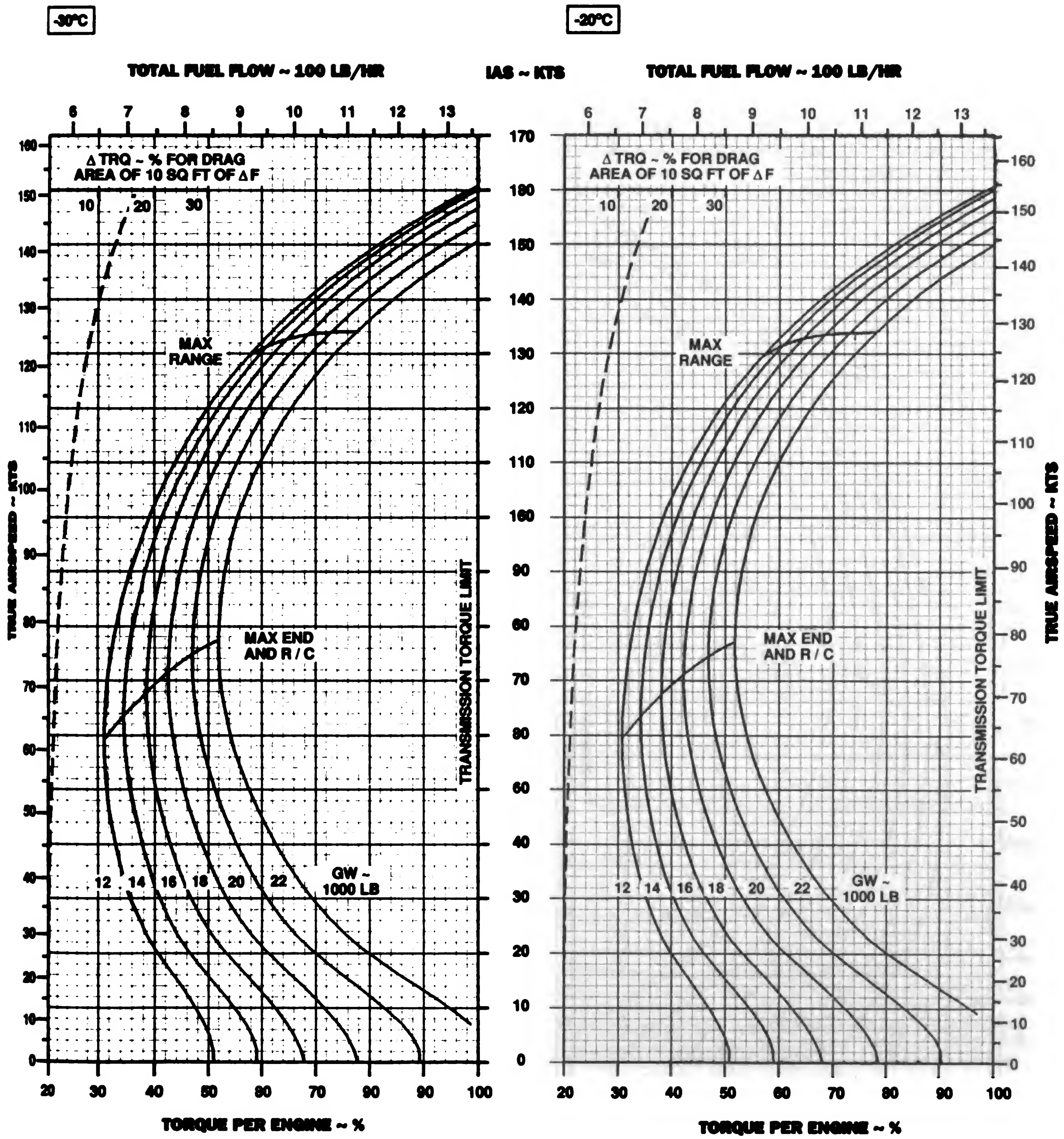
UH60A-156467.1 (C7)

Figure 7.1-10. Cruise - Pressure Altitude 2,000 Feet (Sheet 1 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2,000 FT

CRUISE
2,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

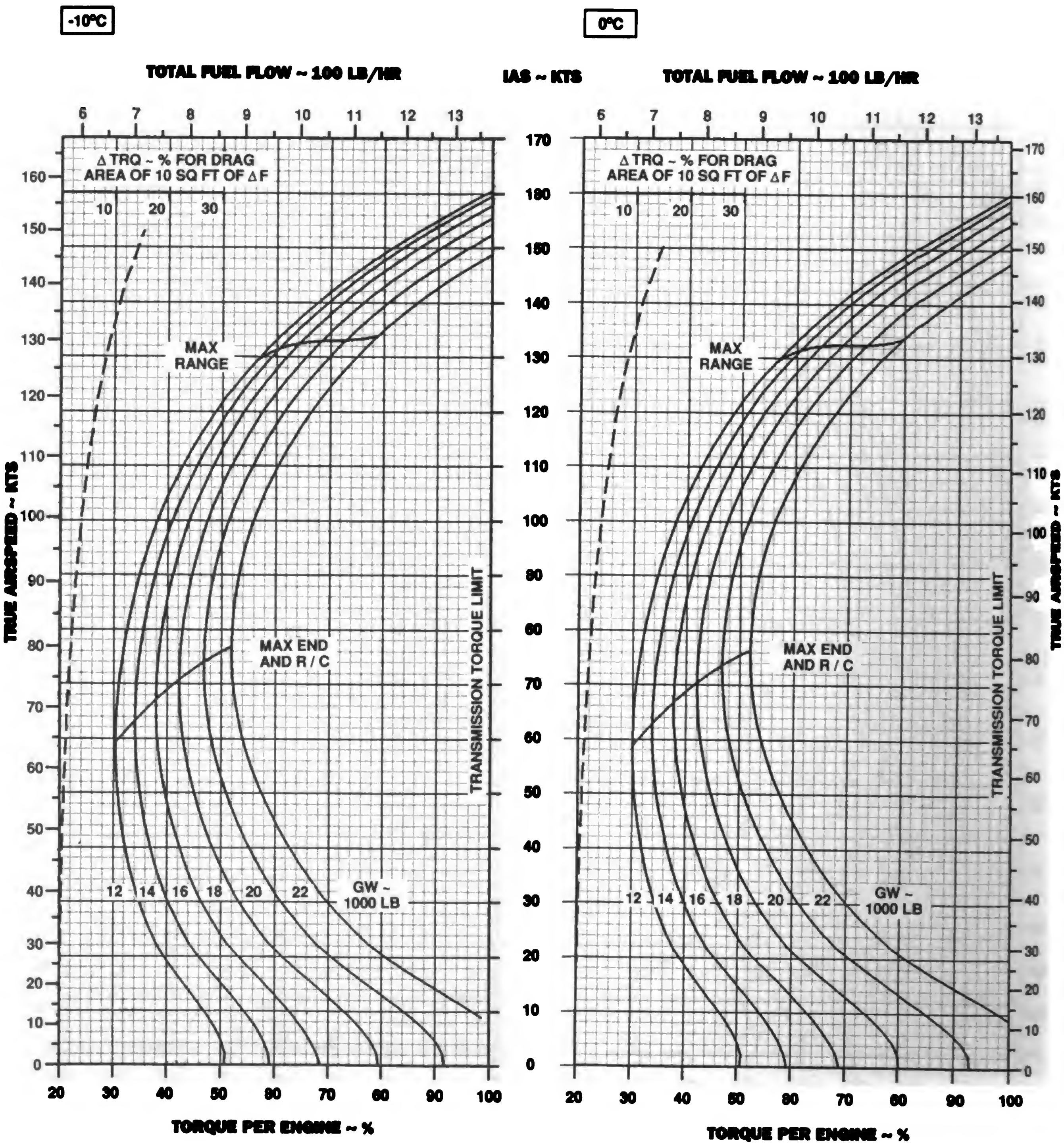
UH60A-158467.2 (C7)

Figure 7.1-10. Cruise - Pressure Altitude 2,000 Feet (Sheet 2 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2,000 FT

CRUISE
2,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

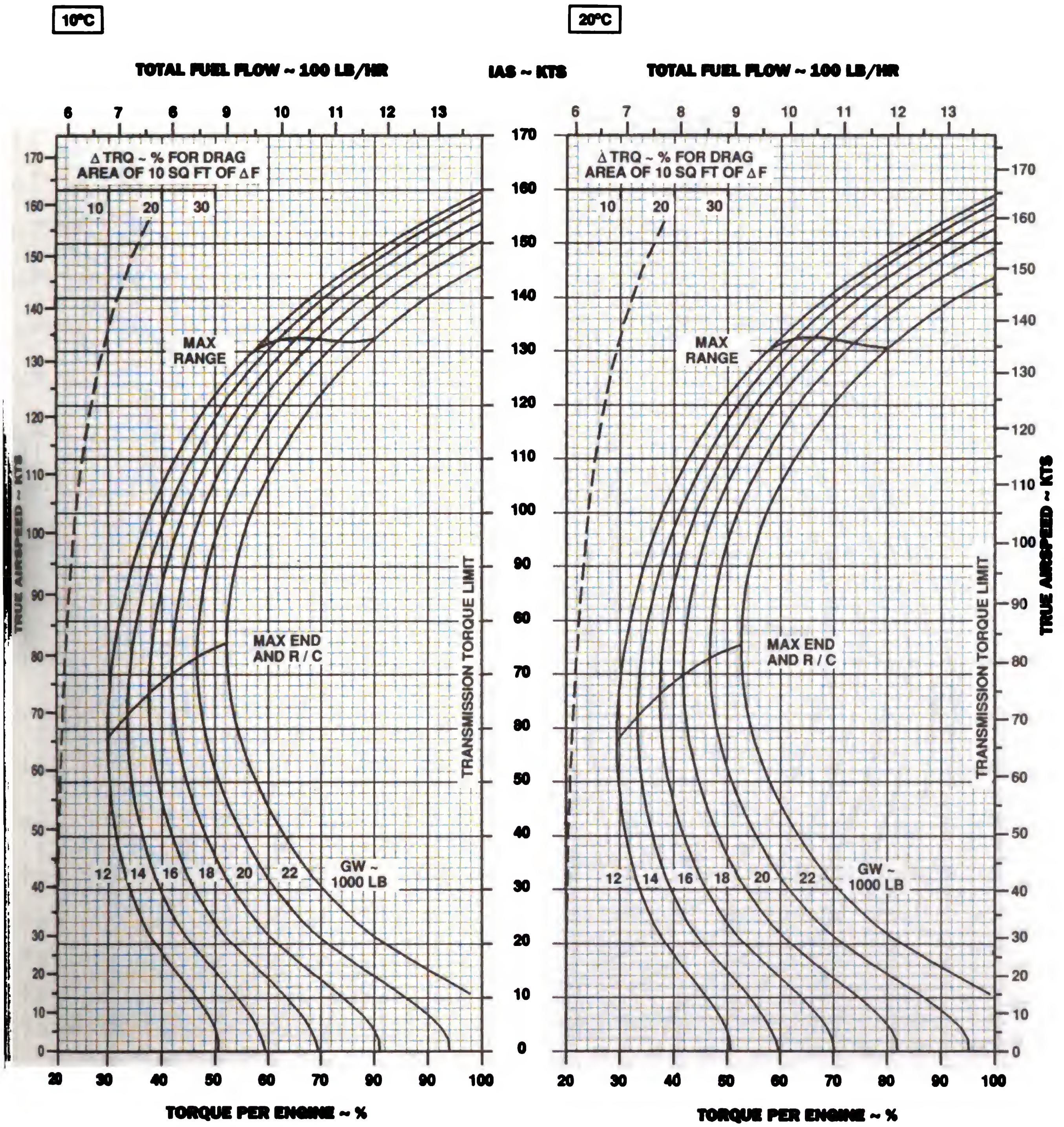
UH60A -158467.3 (C7)

Figure 7.1-10. Cruise - Pressure Altitude 2,000 Feet (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2,000 FT

CRUISE
2,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

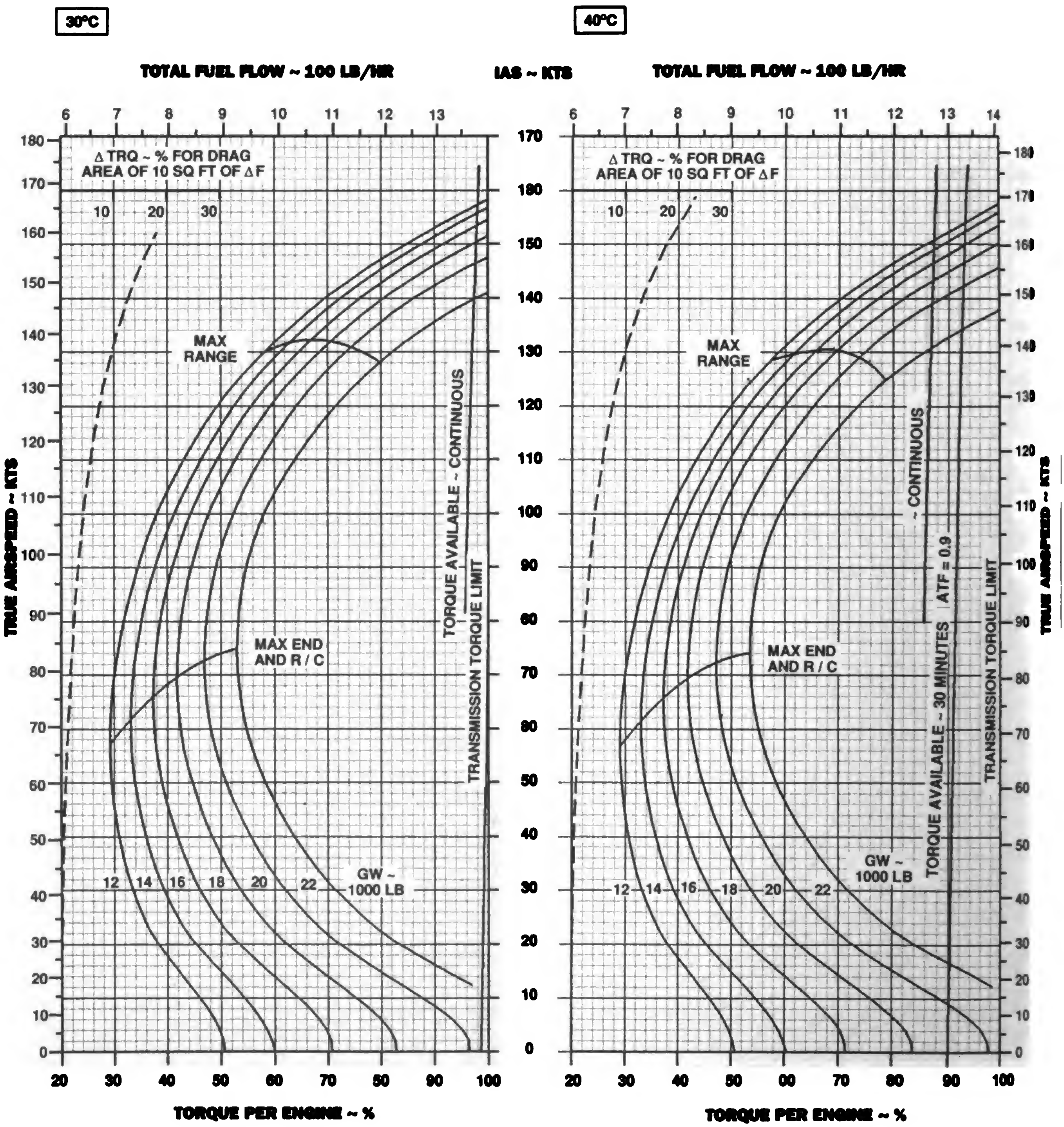
UH60A-158467.4 (C7)

Figure 7.1-10. Cruise - Pressure Altitude 2,000 Feet (Sheet 4 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2,000 FT

CRUISE
2,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

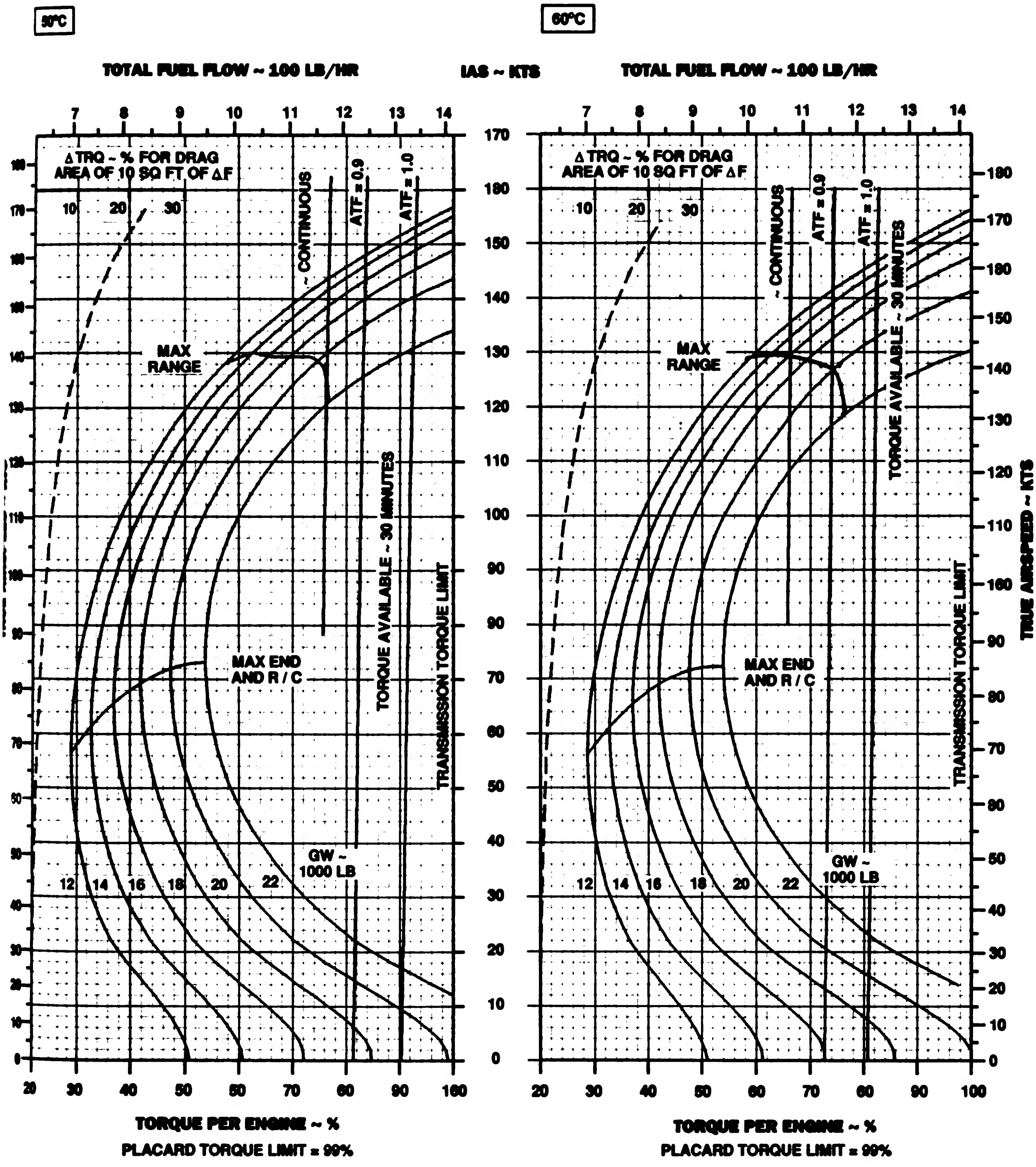
UH60A-156467.5 (C7)

Figure 7.1-10. Cruise - Pressure Altitude 2,000 Feet (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 2,000 FT

CRUISE
2,000 FT
T701C (2)



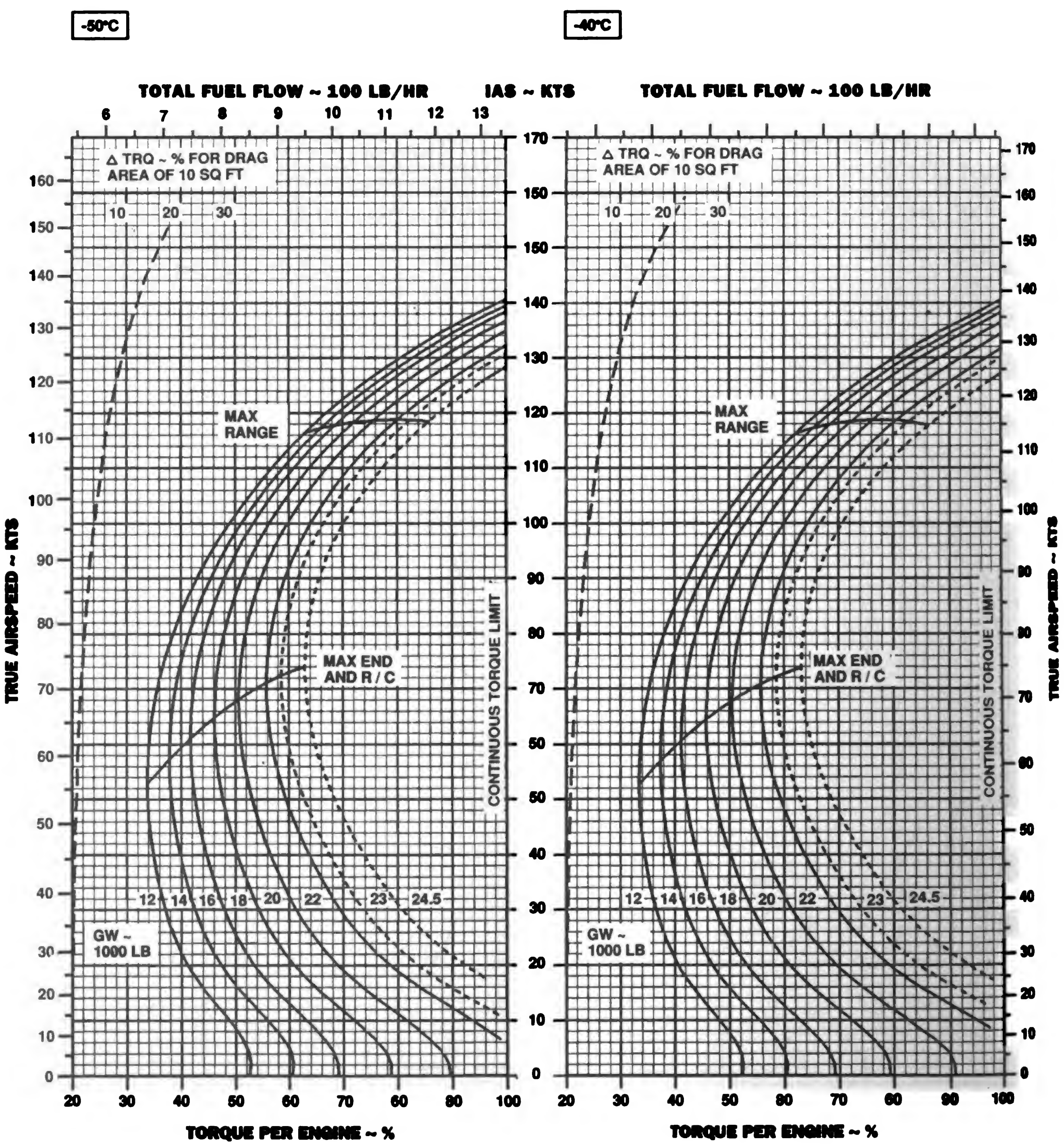
DATA BASE: FLIGHT TEST

UH60A-156467.6 (C7)

Figure 7.1-10. Cruise - Pressure Altitude 2,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 2000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

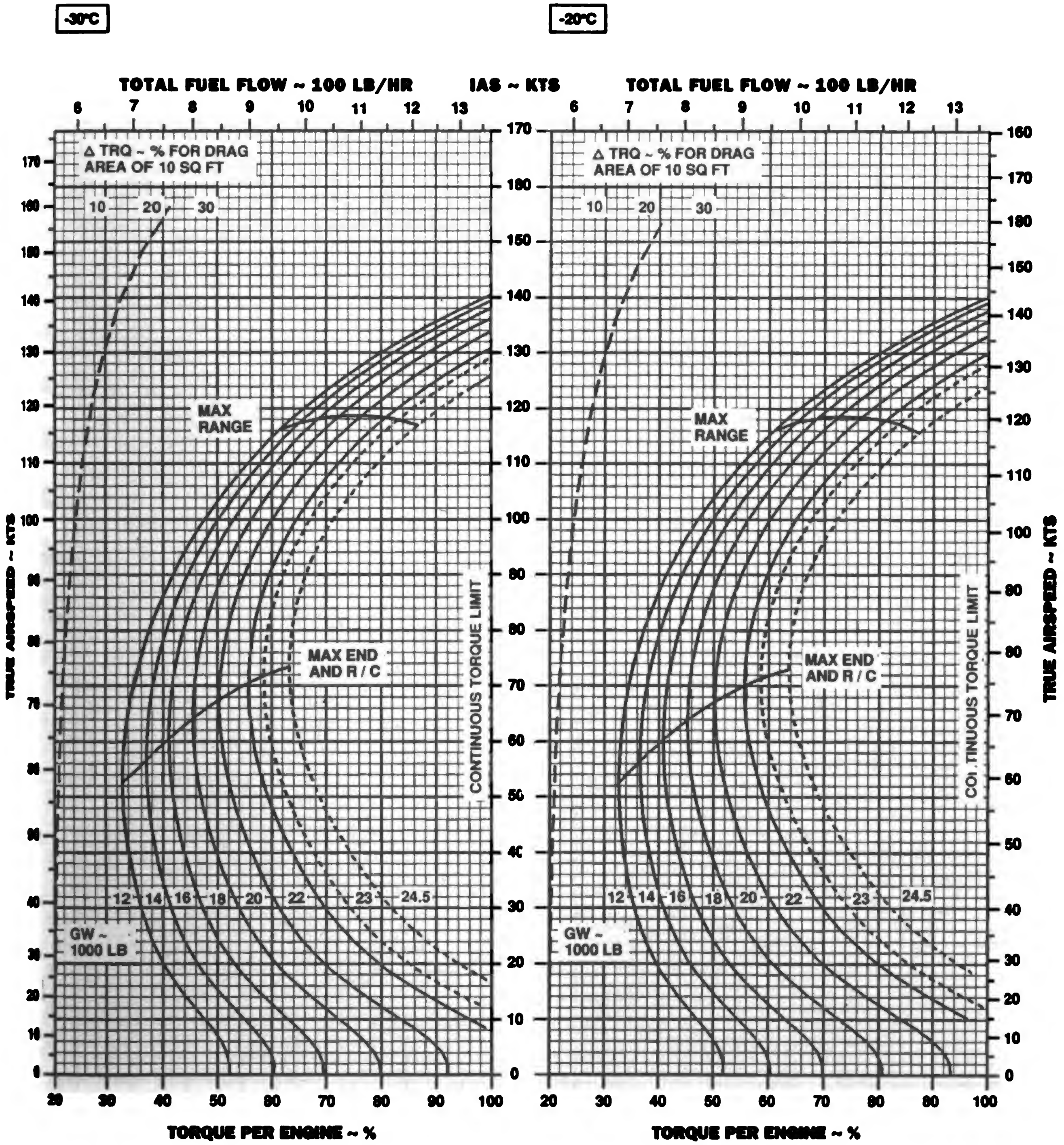
UH60A_167594_1 (R1C13)

Figure 7.1-10.1. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 1 of 6)

CRUISE

CRUISE
2000 FT
T701C (2)

PRESS ALT: 2000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

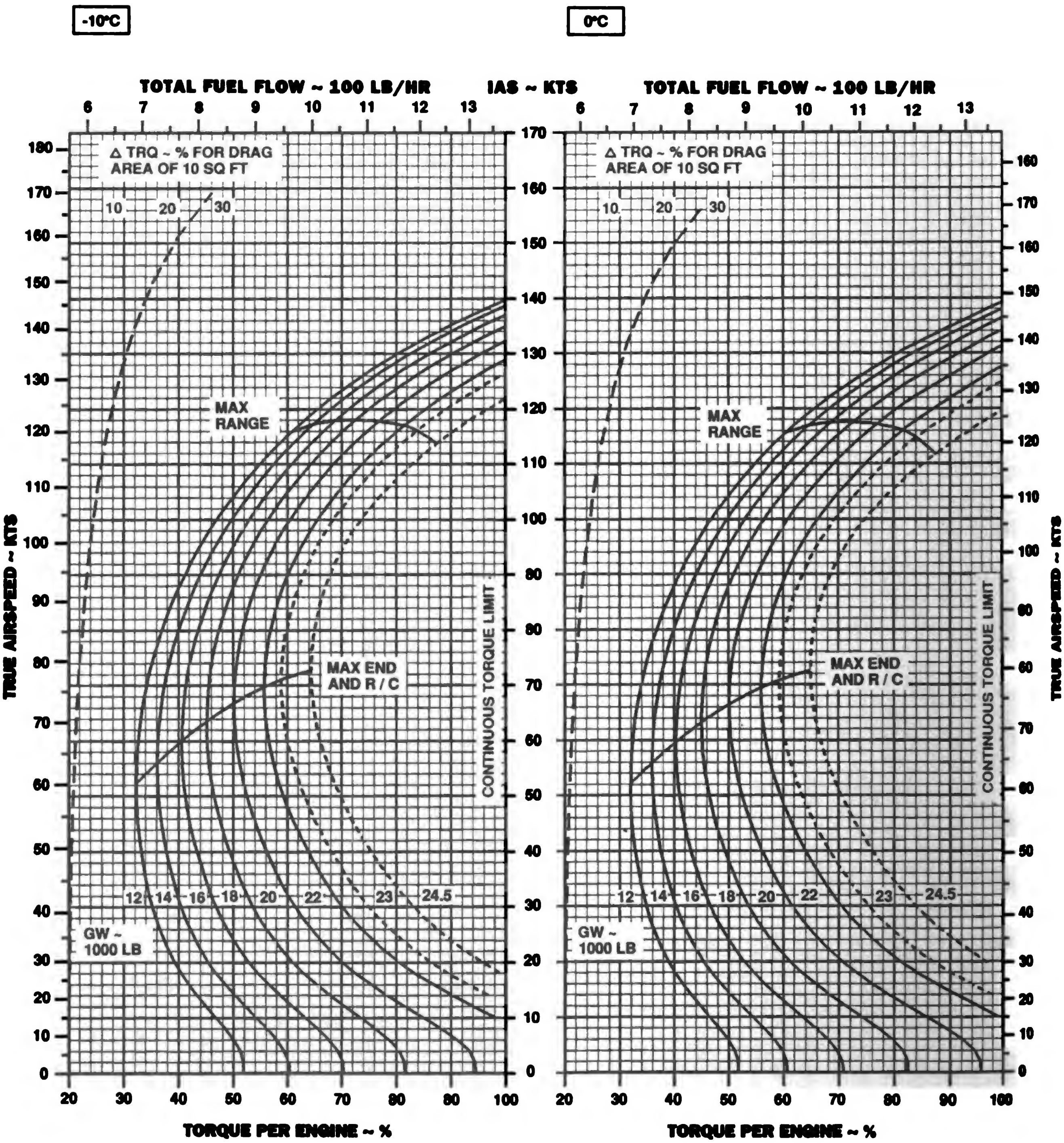
UH60A_167594_2 (R1C13)

Figure 7.1-10.1. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 2 of 6)

CRUISE

CRUISE
2000 FT
T701C (2)

PRESS ALT: 2000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

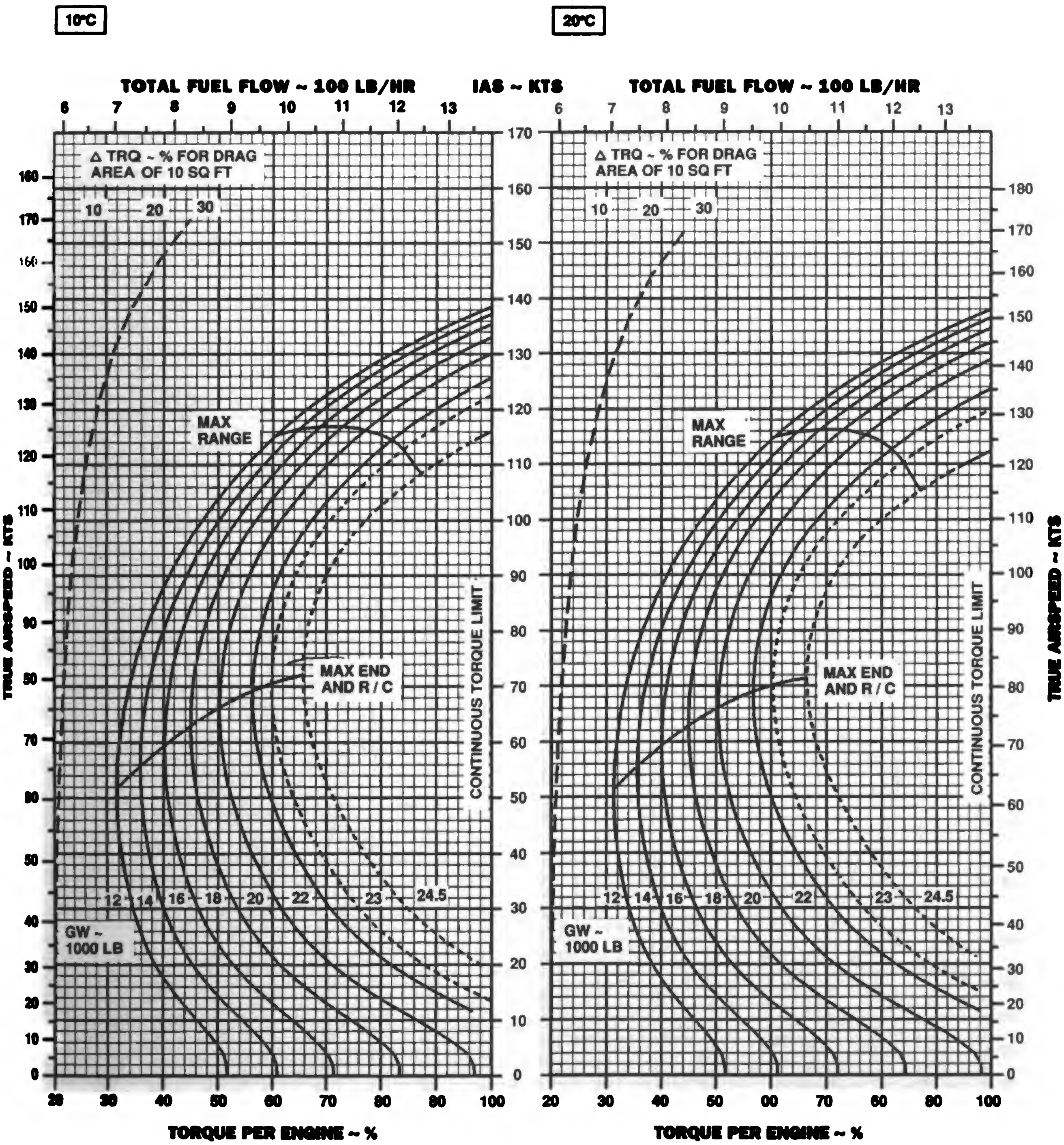
UH60A_167594_3 (R1C13)

Figure 7.1-10.1. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 3 of 6)

CRUISE

CRUISE
2000 FT
T701C (2)

PRESS ALT: 2000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

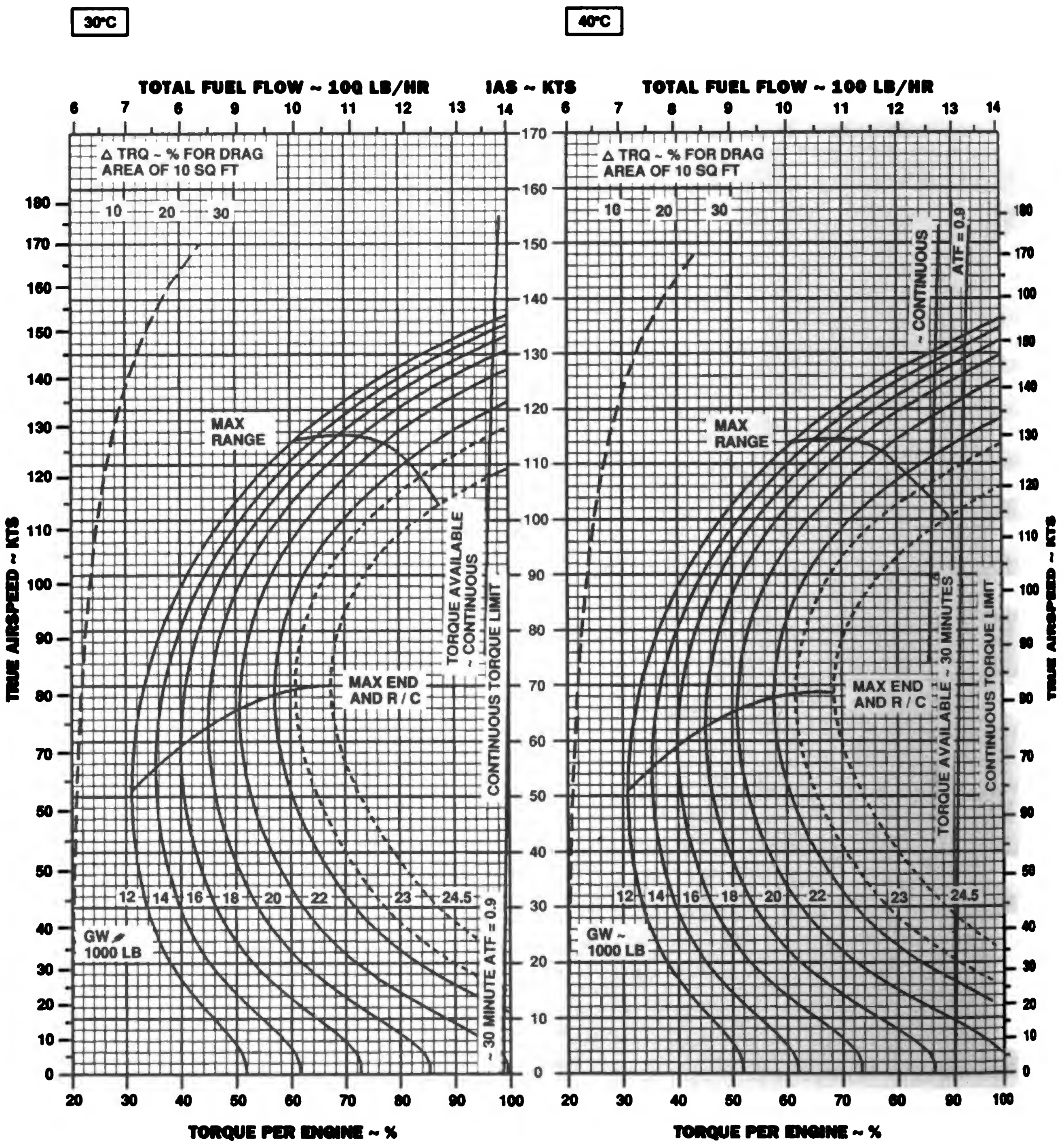
UH60A_167594_4 (R1C13)

Figure 7.1-10.1. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 2000 FT

CRUISE
2000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

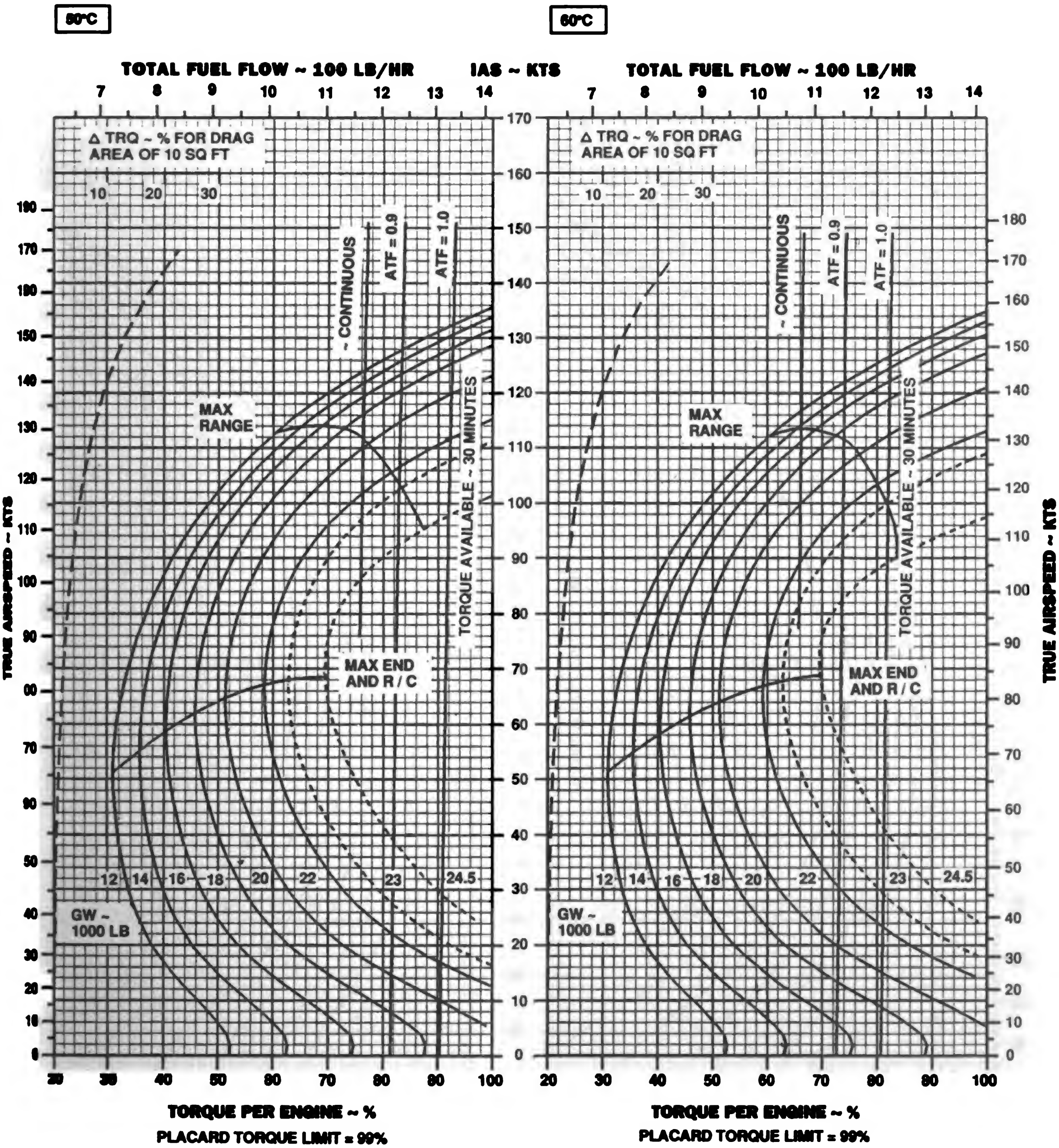
UH60A_167594_5 (R1C13)

Figure 7.1-10.1. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 5 of 6)

CRUISE

CRUISE
2000 FT
T701C (2)

PRESS ALT: 2000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

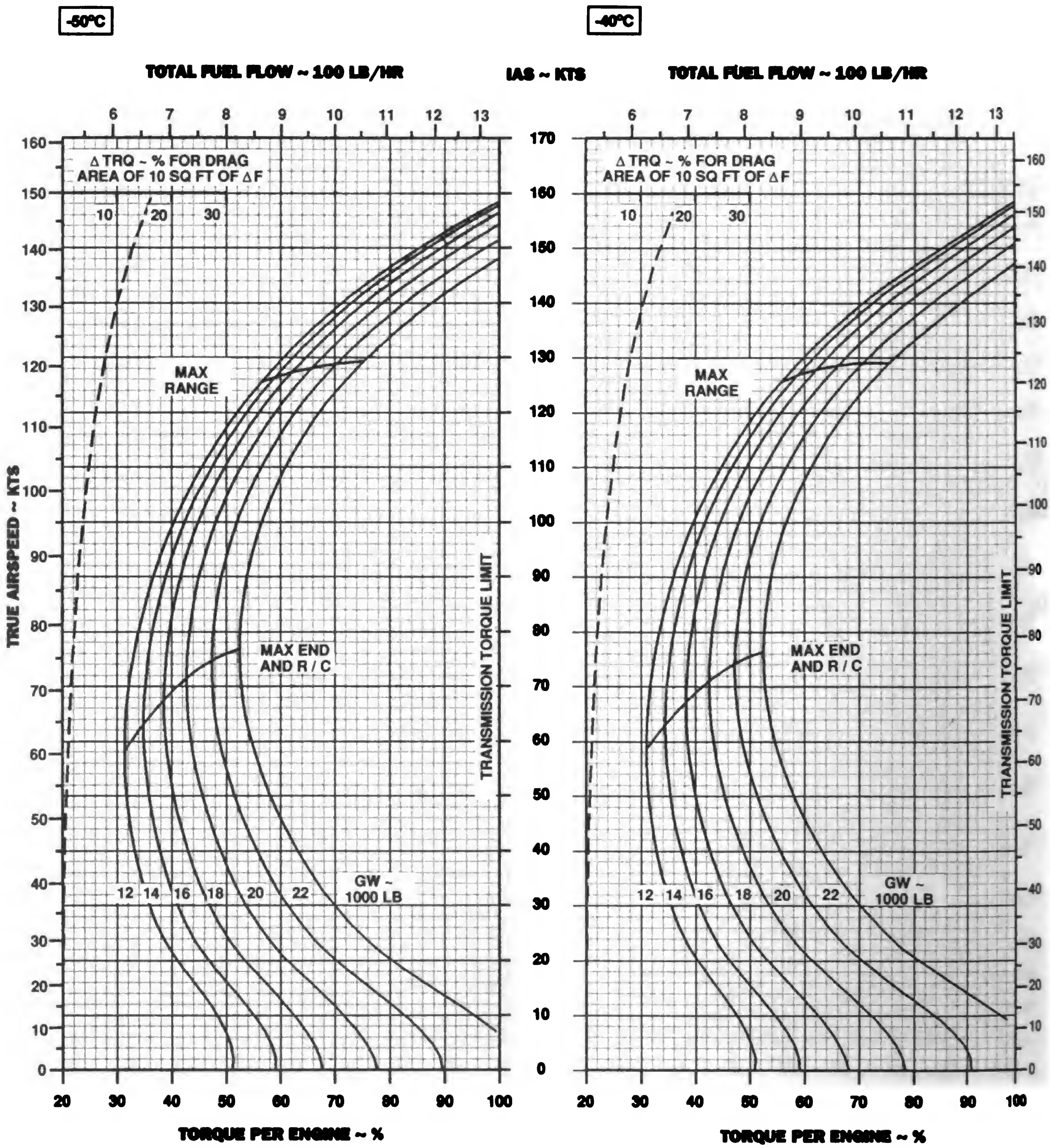
UH60A_167594_6 (R1C13)

Figure 7.1-10.1. Cruise High Drag - Pressure Altitude 2,000 Feet (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 4,000 FT

CRUISE 4,000 FT T701C (2)



DATA BASE: FLIGHT TEST

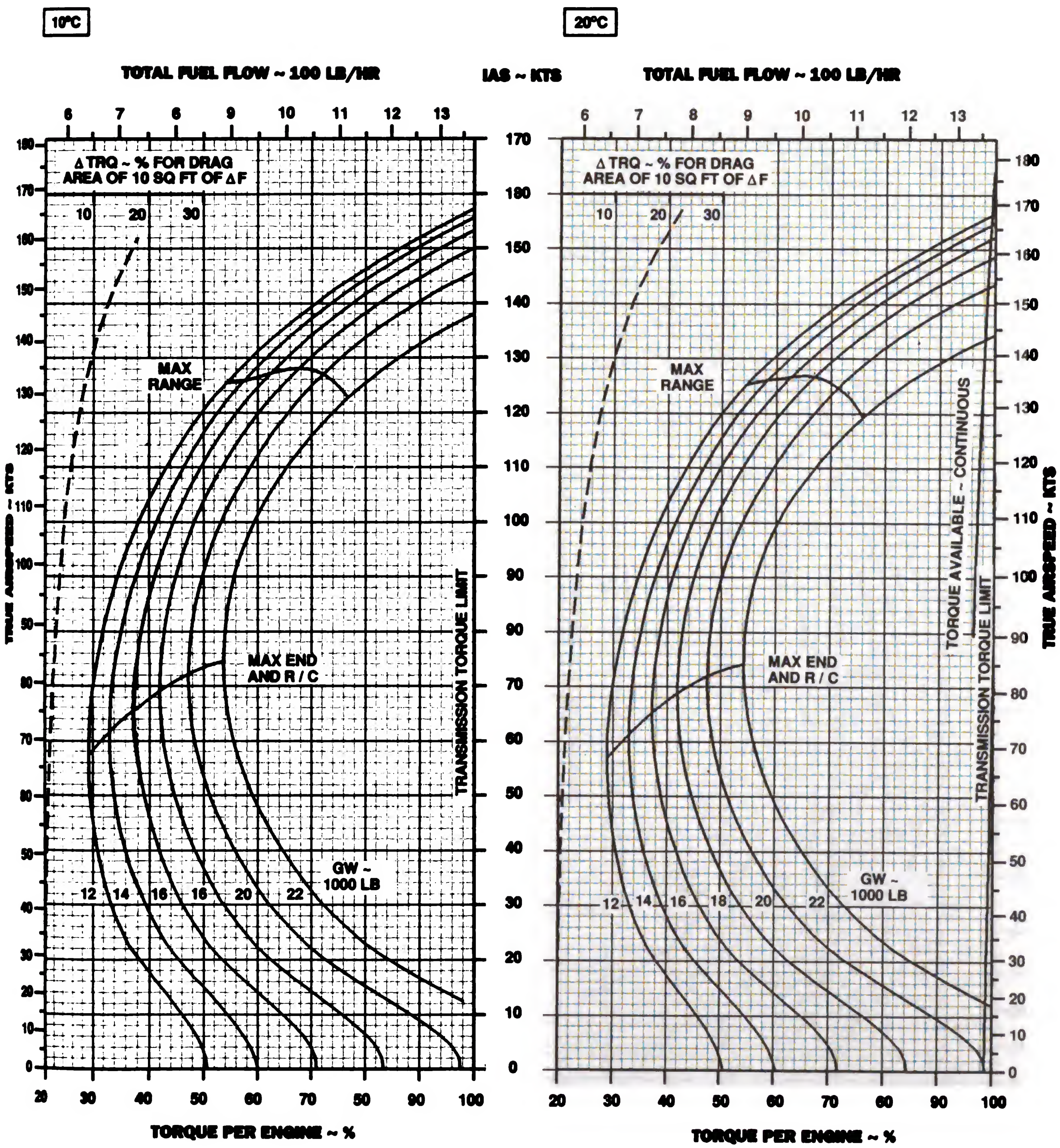
UH60A-159468.1 (C7)

Figure 7.1-11. Cruise - Pressure Altitude 4,000 Feet (Sheet 1 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 4,000 FT

CRUISE
4,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

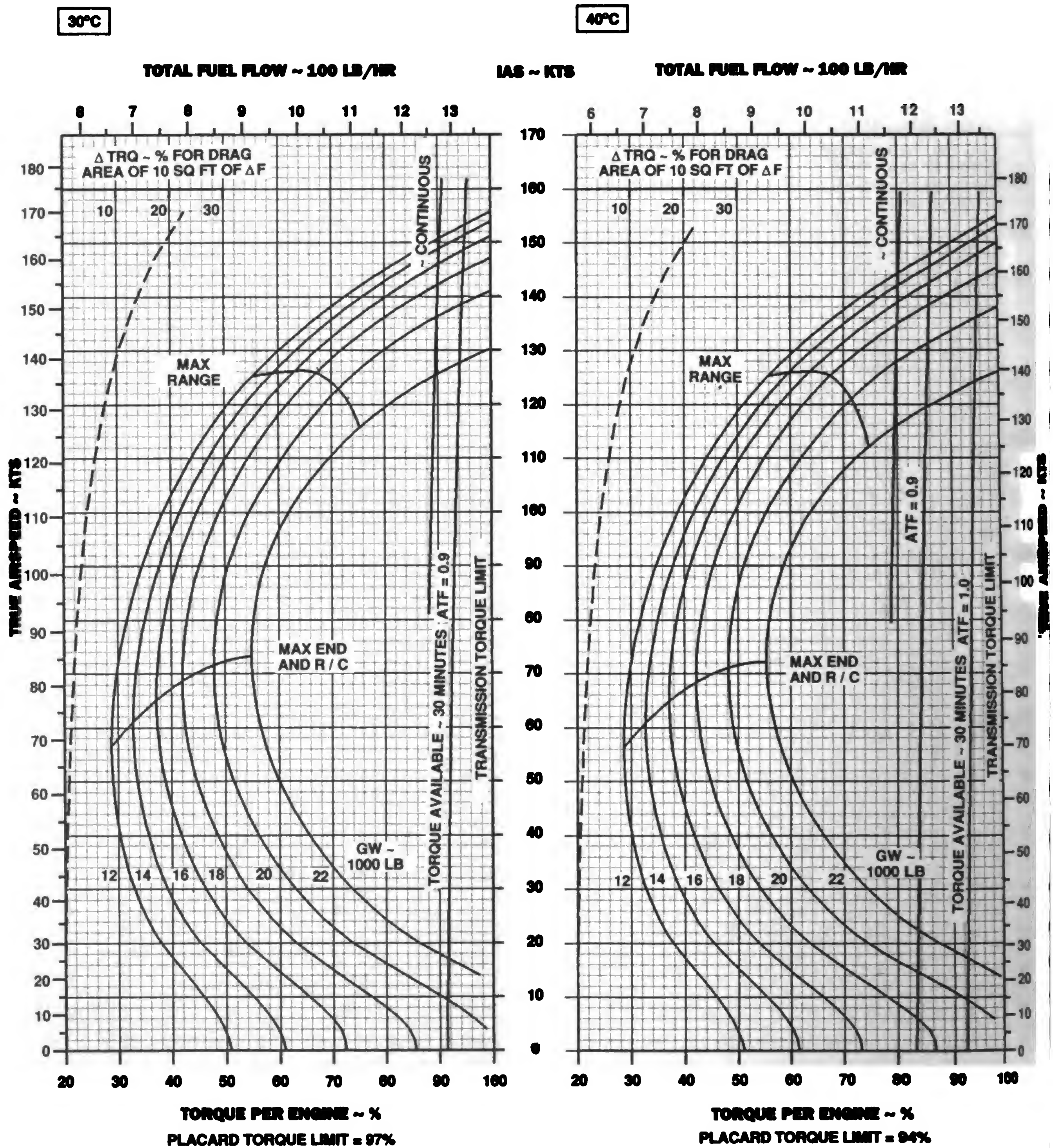
UH60A-156468.4 (C7)

Figure 7.1-11. Cruise - Pressure Altitude 4,000 Feet (Sheet 4 of 6)

CRUISE

CRUISE 4,000 FT T701C (2)

CLEAN CONFIGURATION
PRESS ALT: 4,000 FT



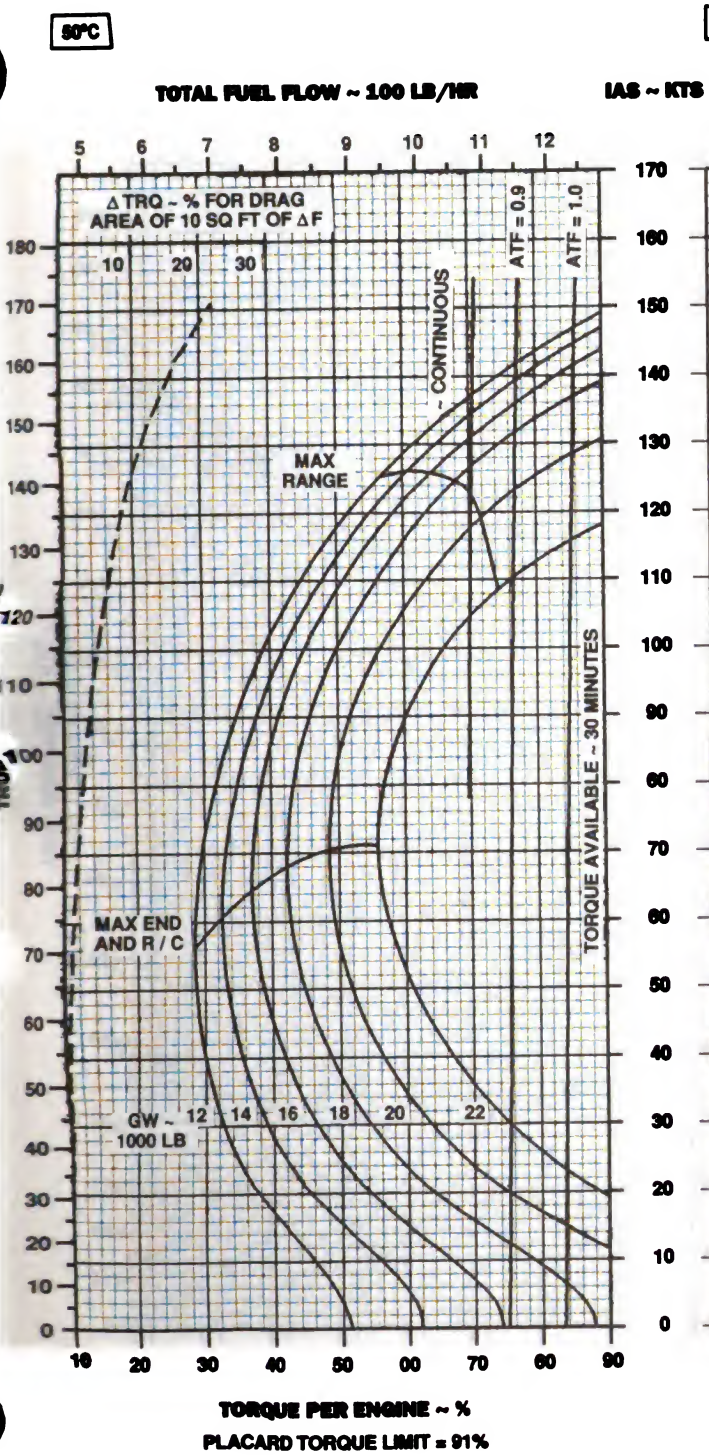
DATA BASE: FLIGHT TEST

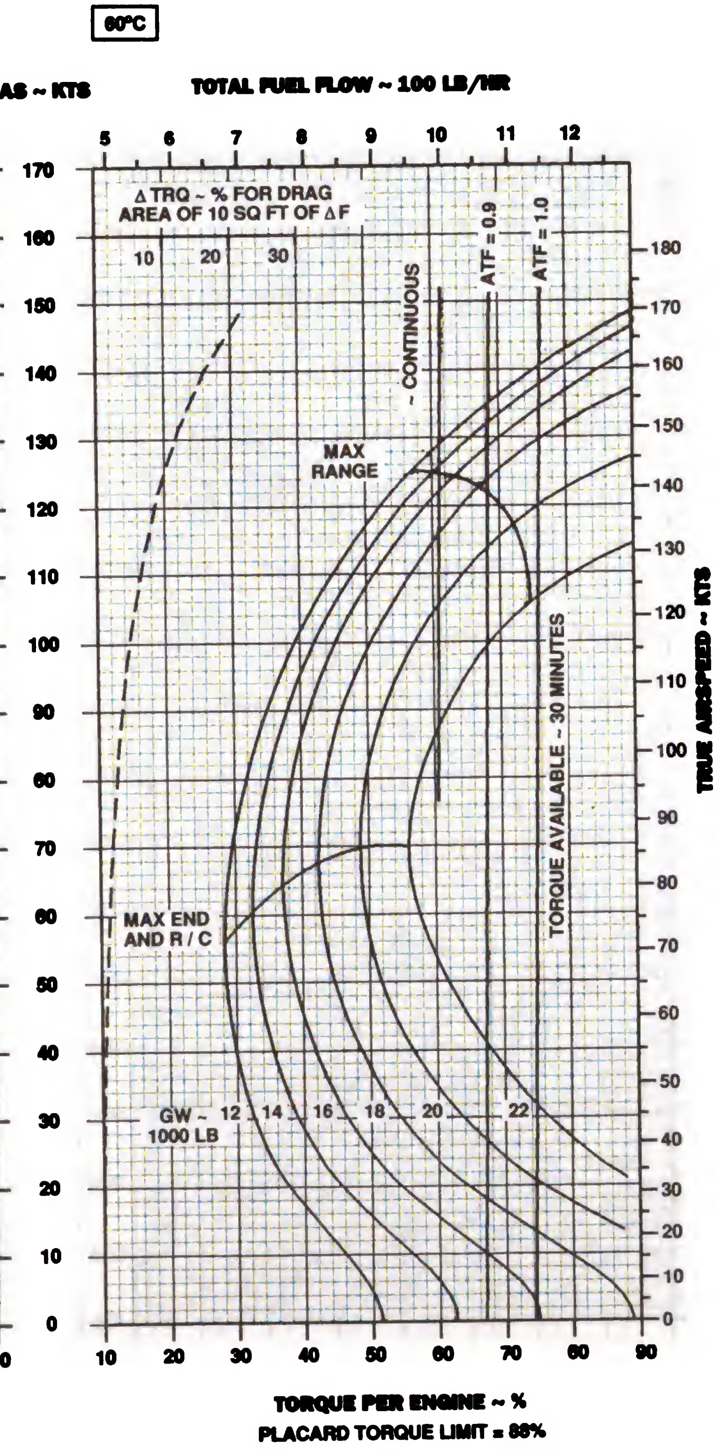
UH60A-155498.5 (C7)

Figure 7.1-11. Cruise - Pressure Altitude 4,000 Feet (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 4,000 FT





DATA BASE: FLIGHT TEST

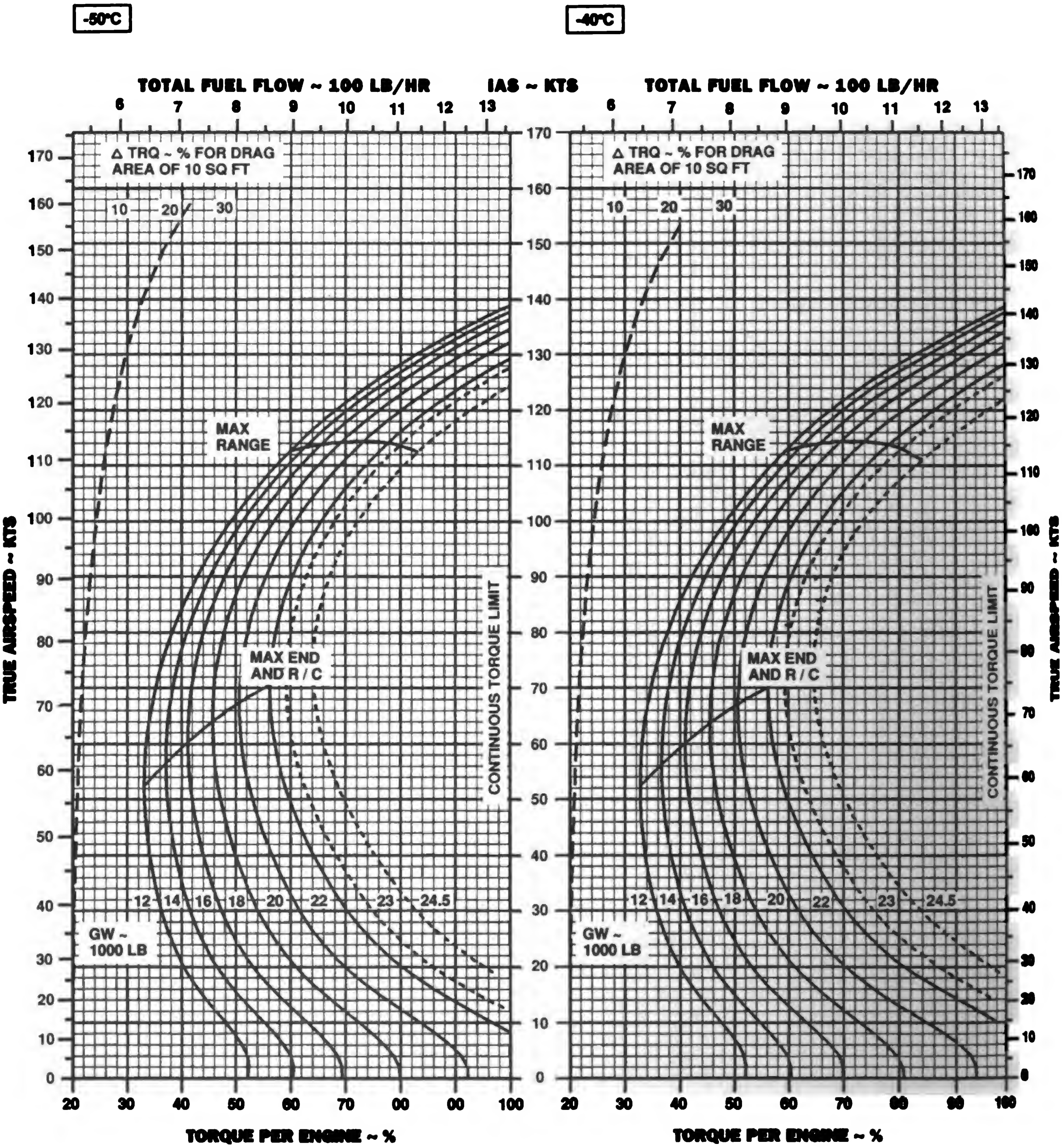
UH60A -156468.6 (C7)

Figure 7.1-11. Cruise - Pressure Altitude 4,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

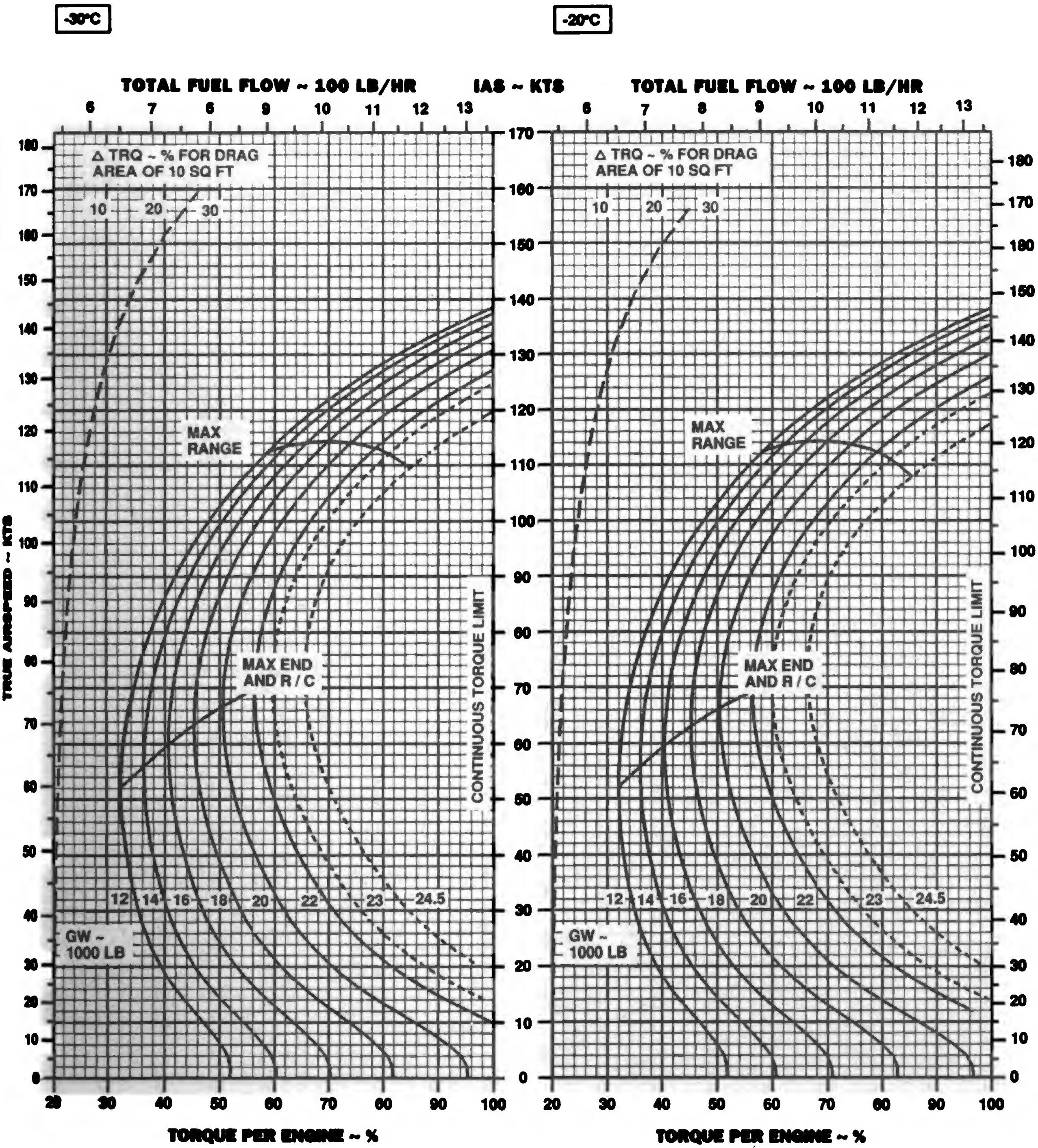
UH60A_167595_1 (R1C1

Figure 7.1-11.1. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

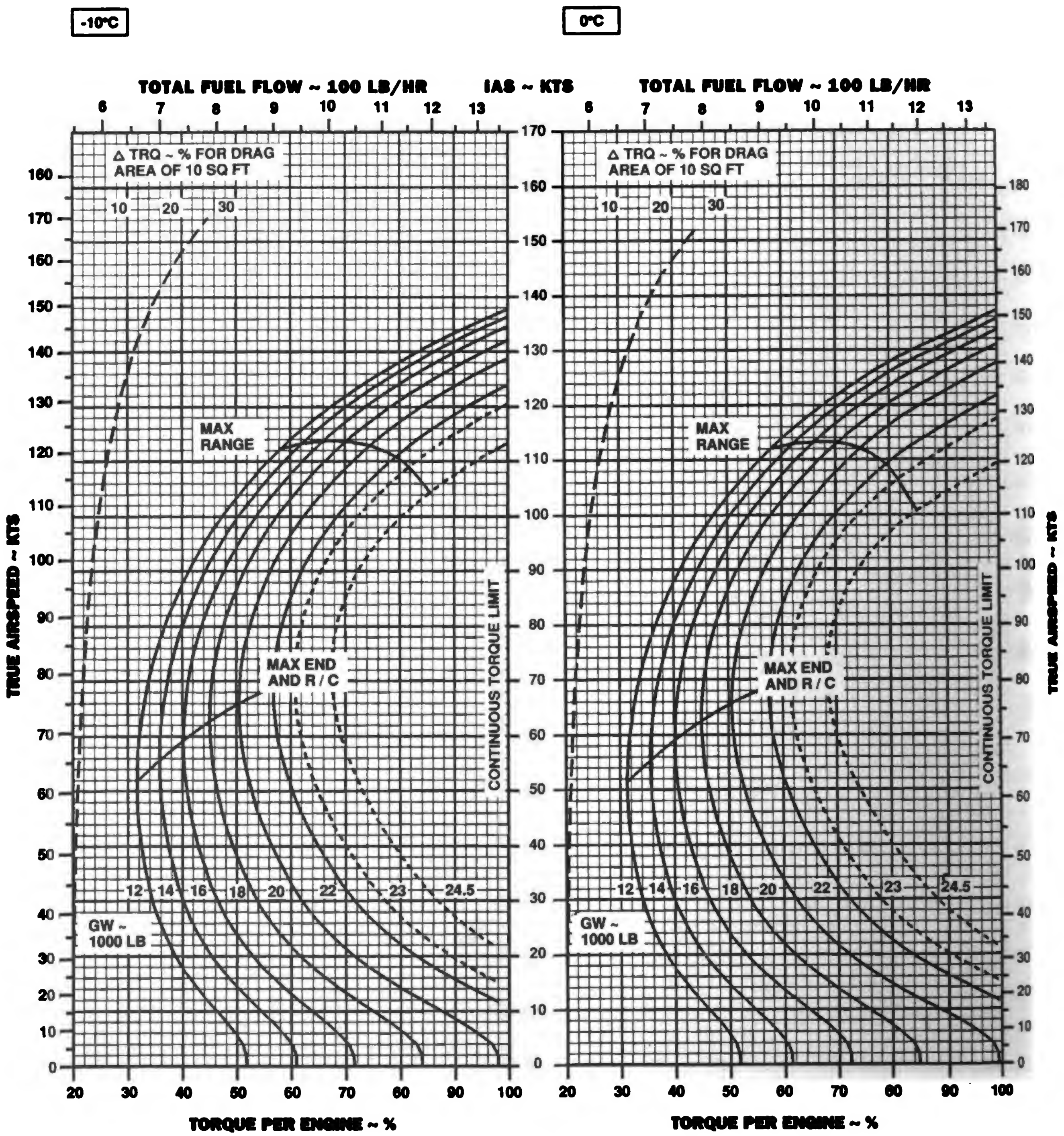
UH60A_157595_2 (R1C13)

Figure 7.1-11.1. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

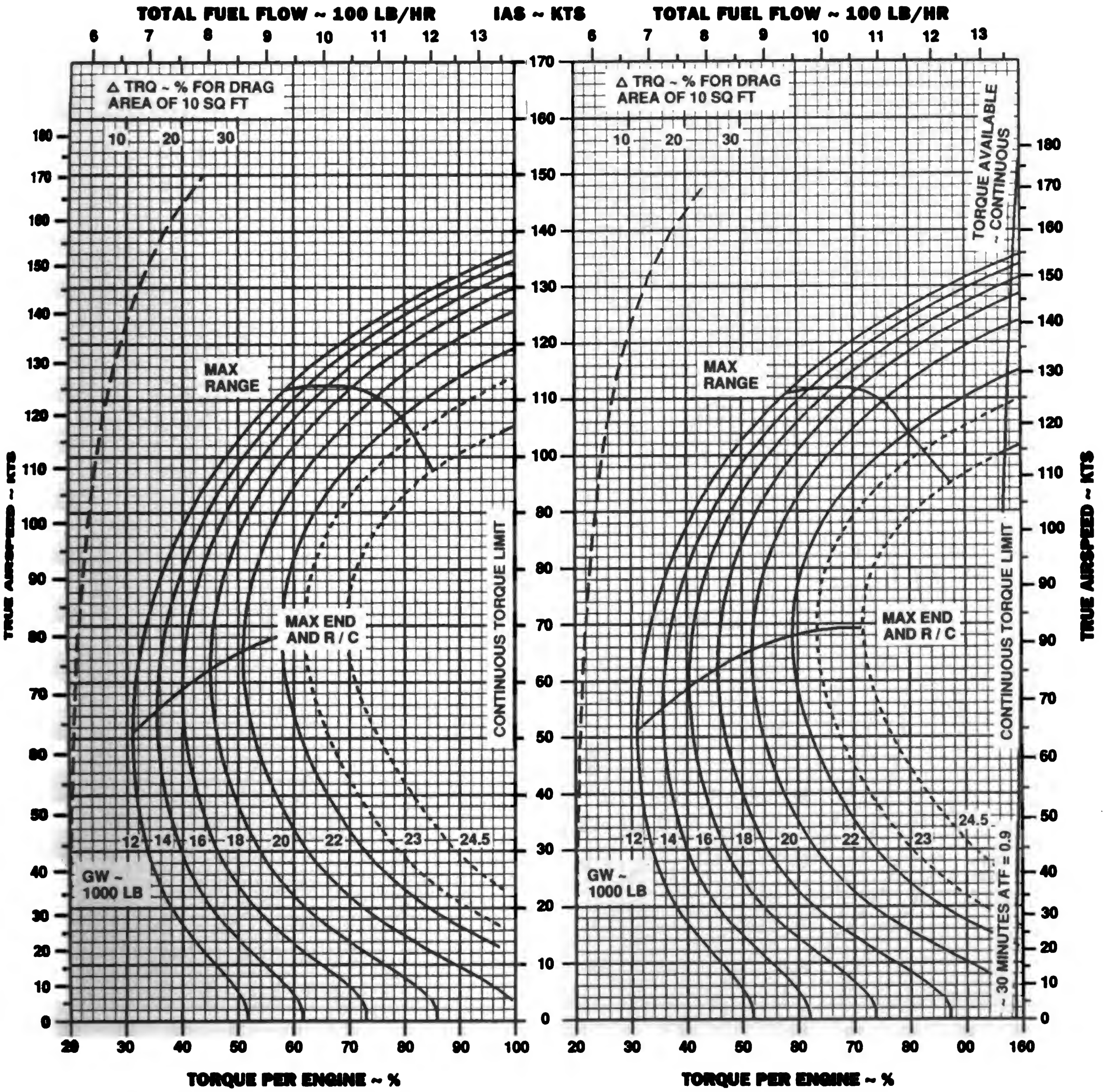
UH60A_167595_3 (R1C13)

Figure 7.1-11.1. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 3 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

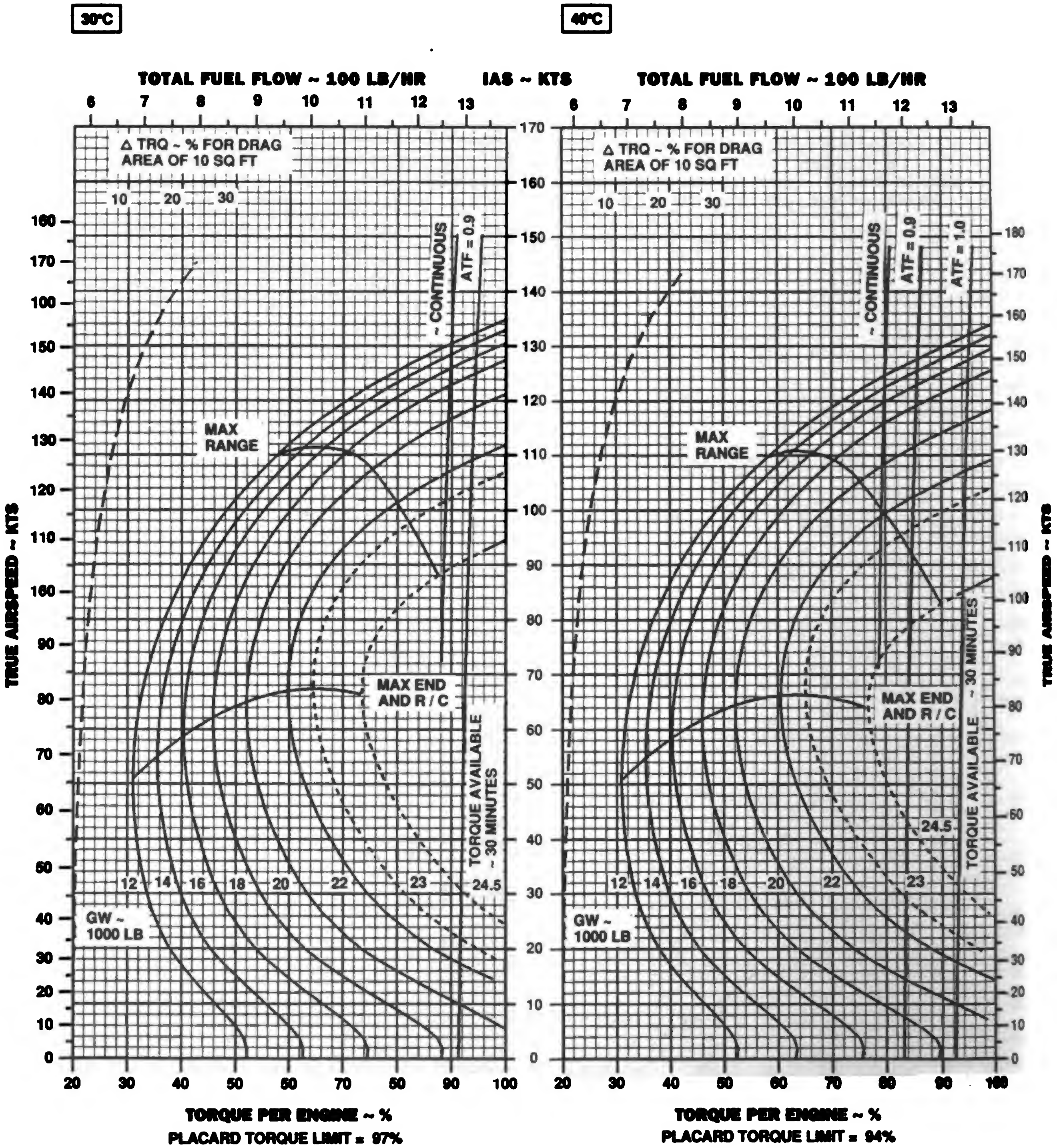
UH60A_167596_4 (R1C13)

Figure 7.1-11.1. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 4000 FT

CRUISE
4000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

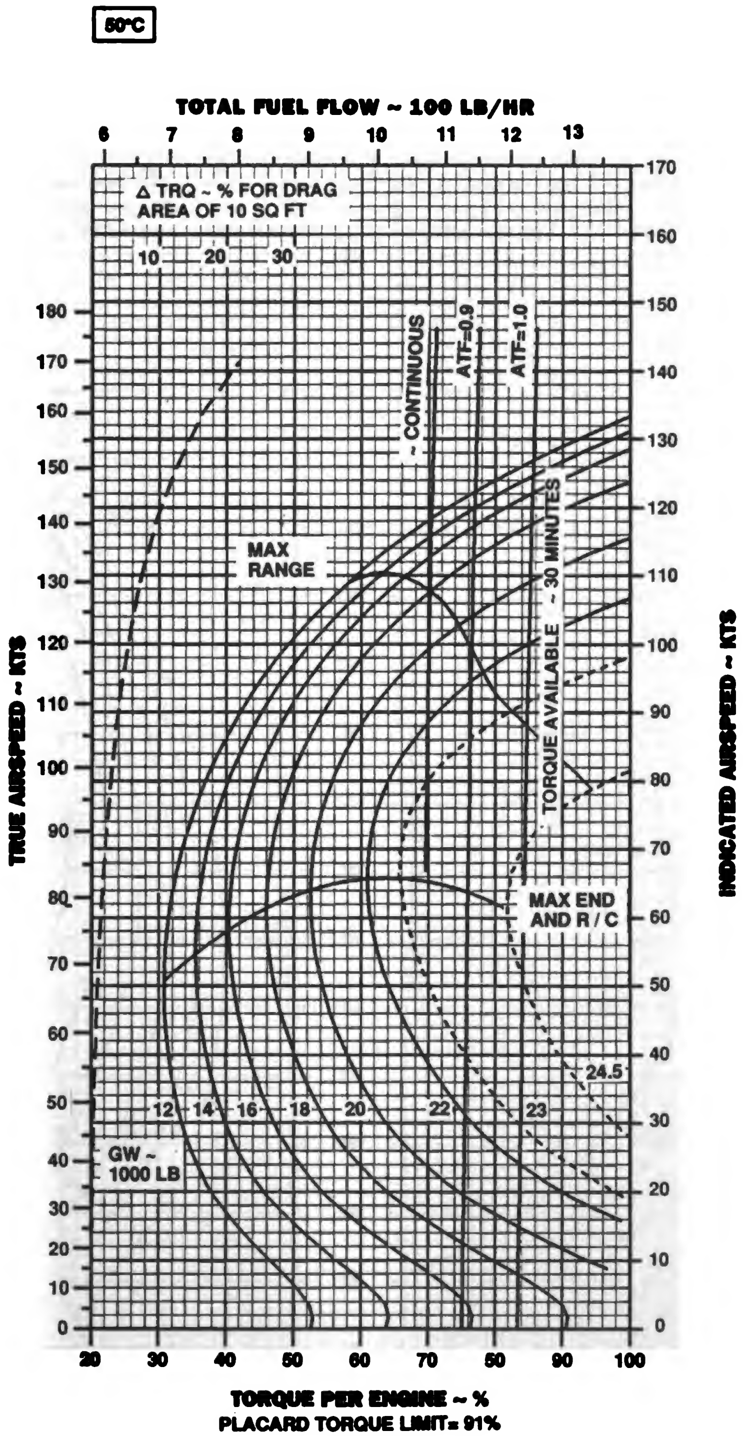
DATA BASE: FLIGHT TEST

UH60A_167595_5 (R1C13)

Figure 7.1-11.1. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 5 of 6)

CRUISE

PRESS ALT: 4000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

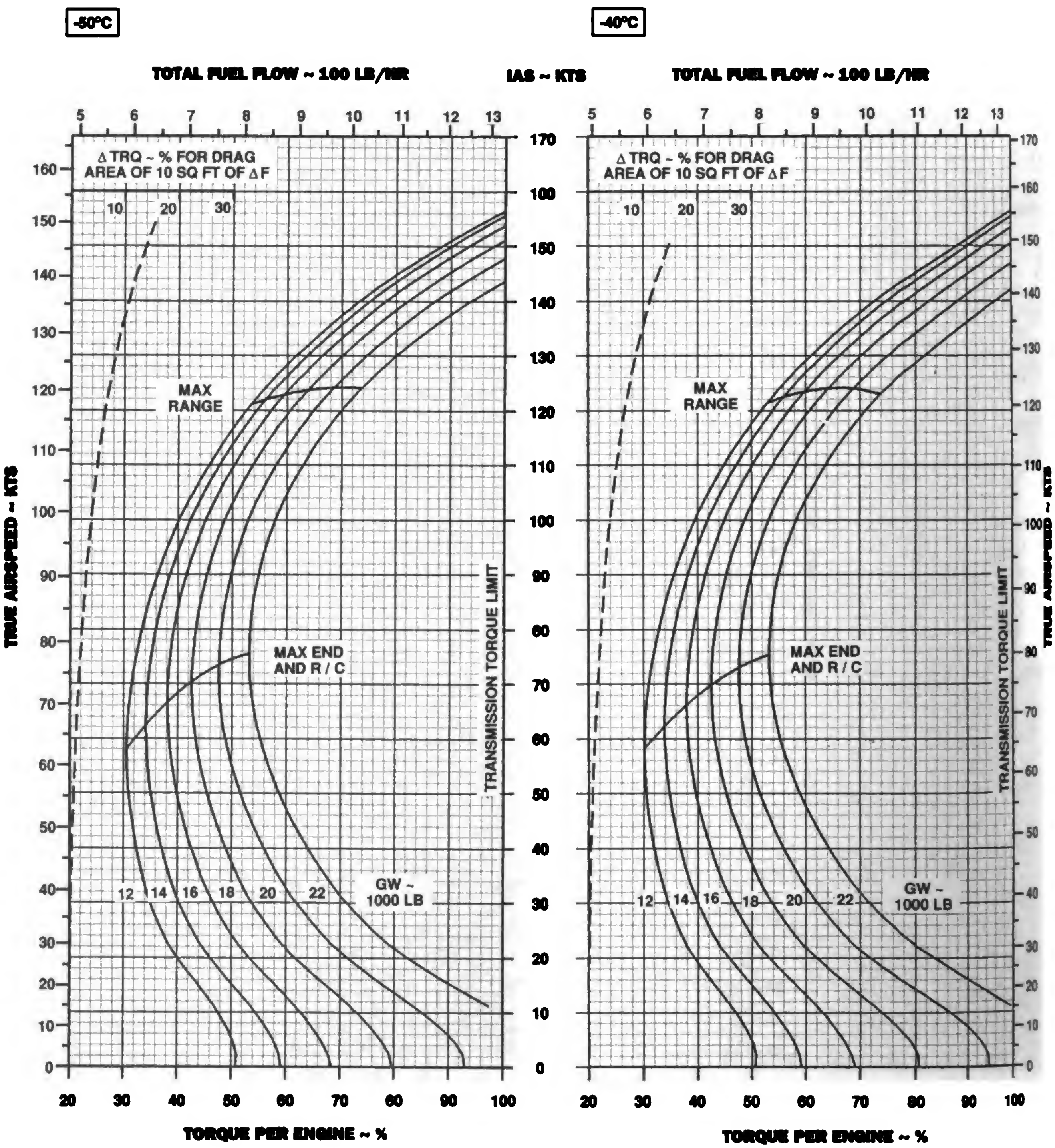
UH60A_167595_6 (R1C13)

Figure 7.1-11.1. Cruise High Drag - Pressure Altitude 4,000 Feet (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6,000 FT

CRUISE
6,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

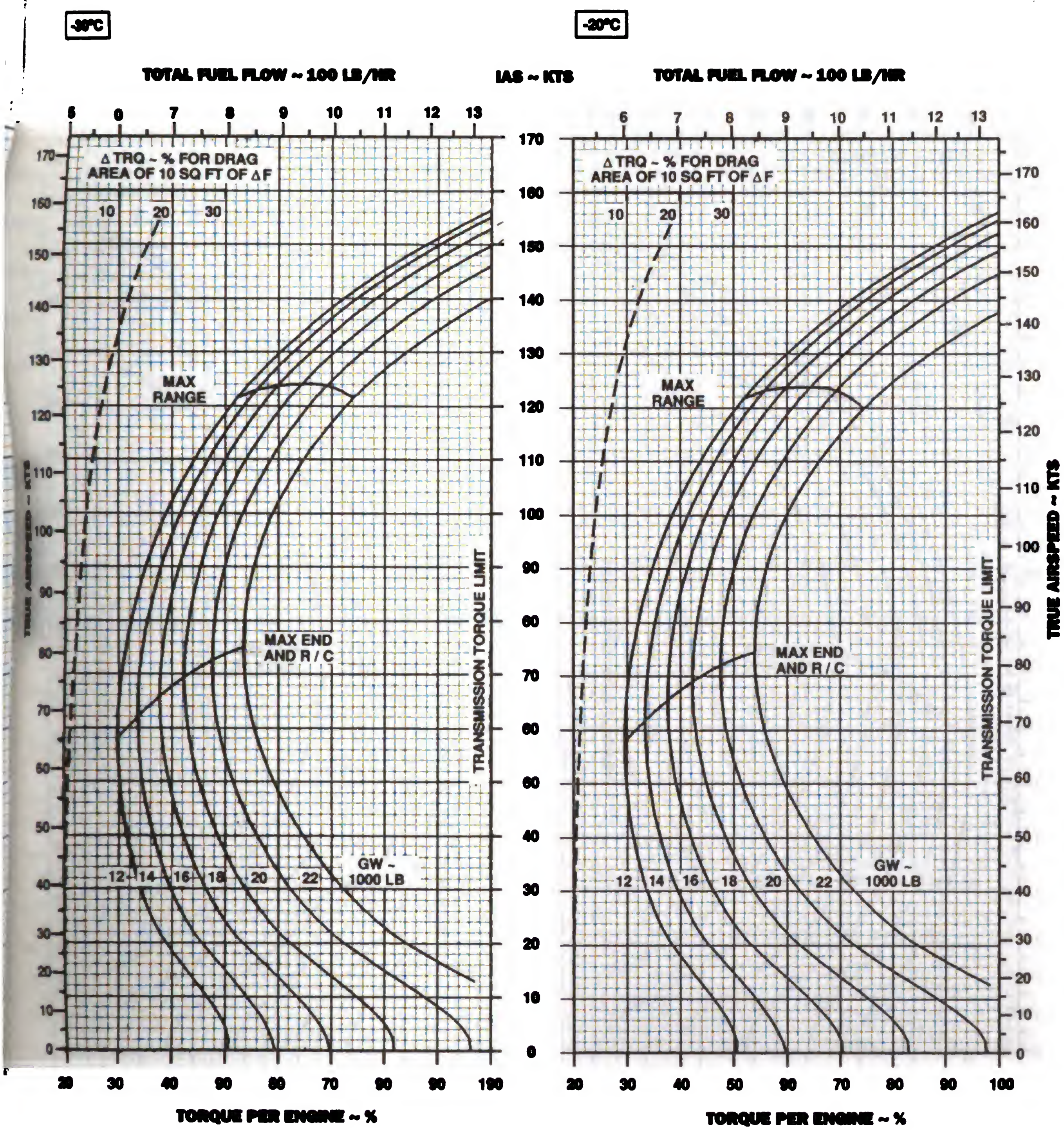
UH60A-156469.1 (C7)

Figure 7.1-12. Cruise - Pressure Altitude 6,000 Feet (Sheet 1 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6,000 FT

CRUISE
6,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

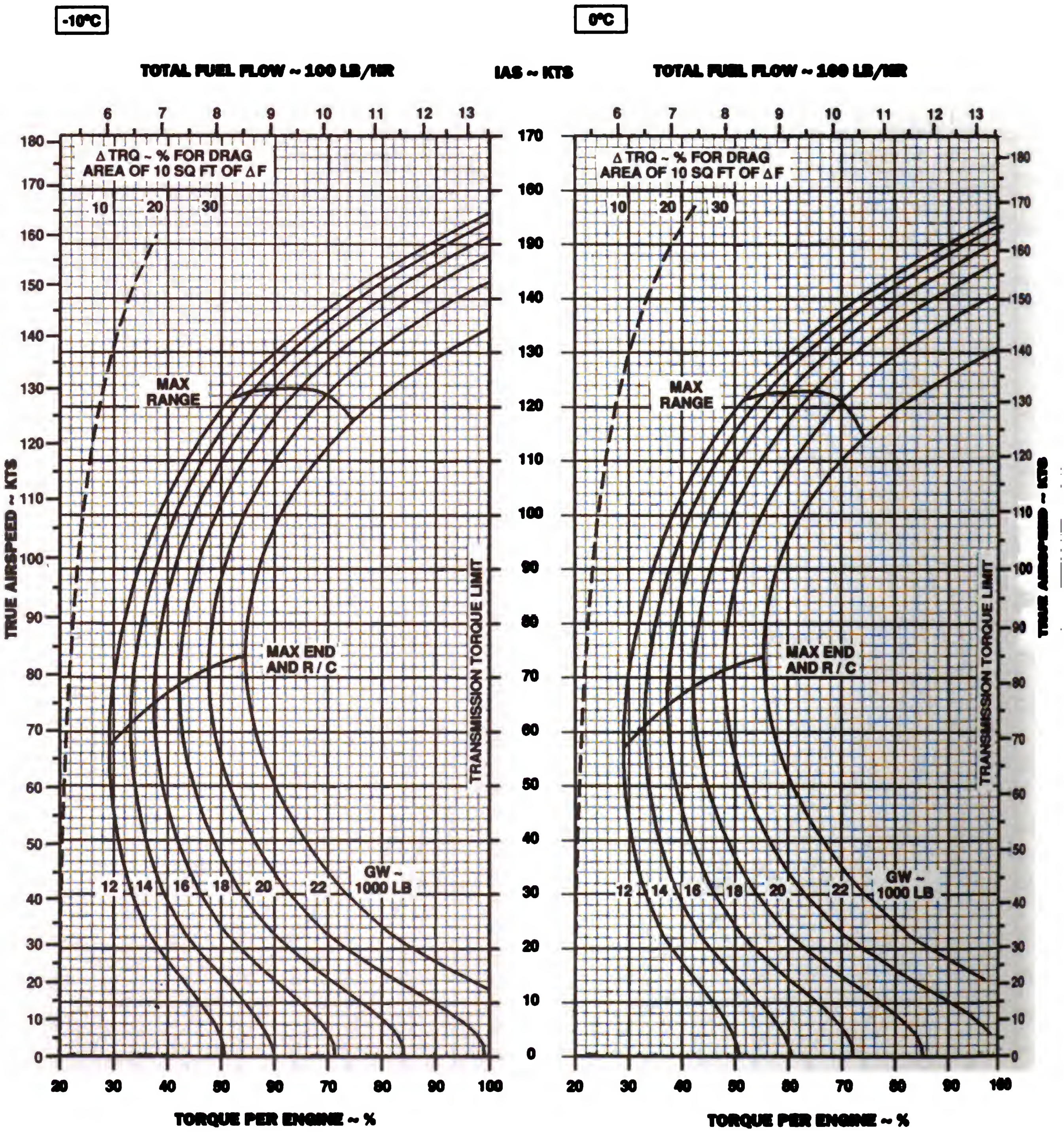
UH60A-150480.2 (C7)

Figure 7.1-12. Cruise - Pressure Altitude 6,000 Feet (Sheet 2 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6,000 FT

CRUISE 6,000 FT T701C (2)



DATA BASE: FLIGHT TEST

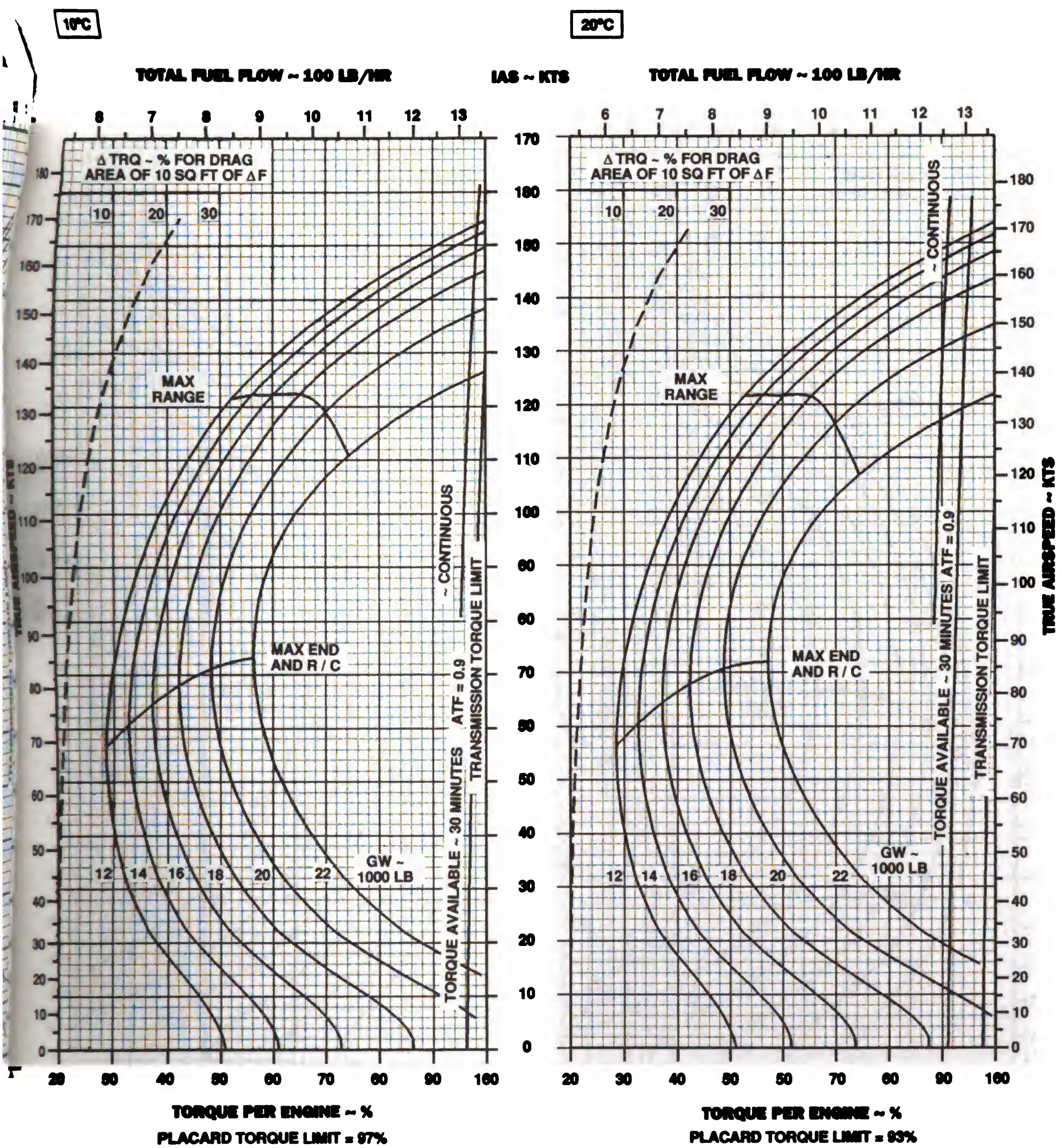
UH60A-159469.3 (C7)

Figure 7.1-12. Cruise - Pressure Altitude 6,000 Feet (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6,000 FT

CRUISE
6,000 FT
T701C (2)



DATA BASIS: FLIGHT TEST

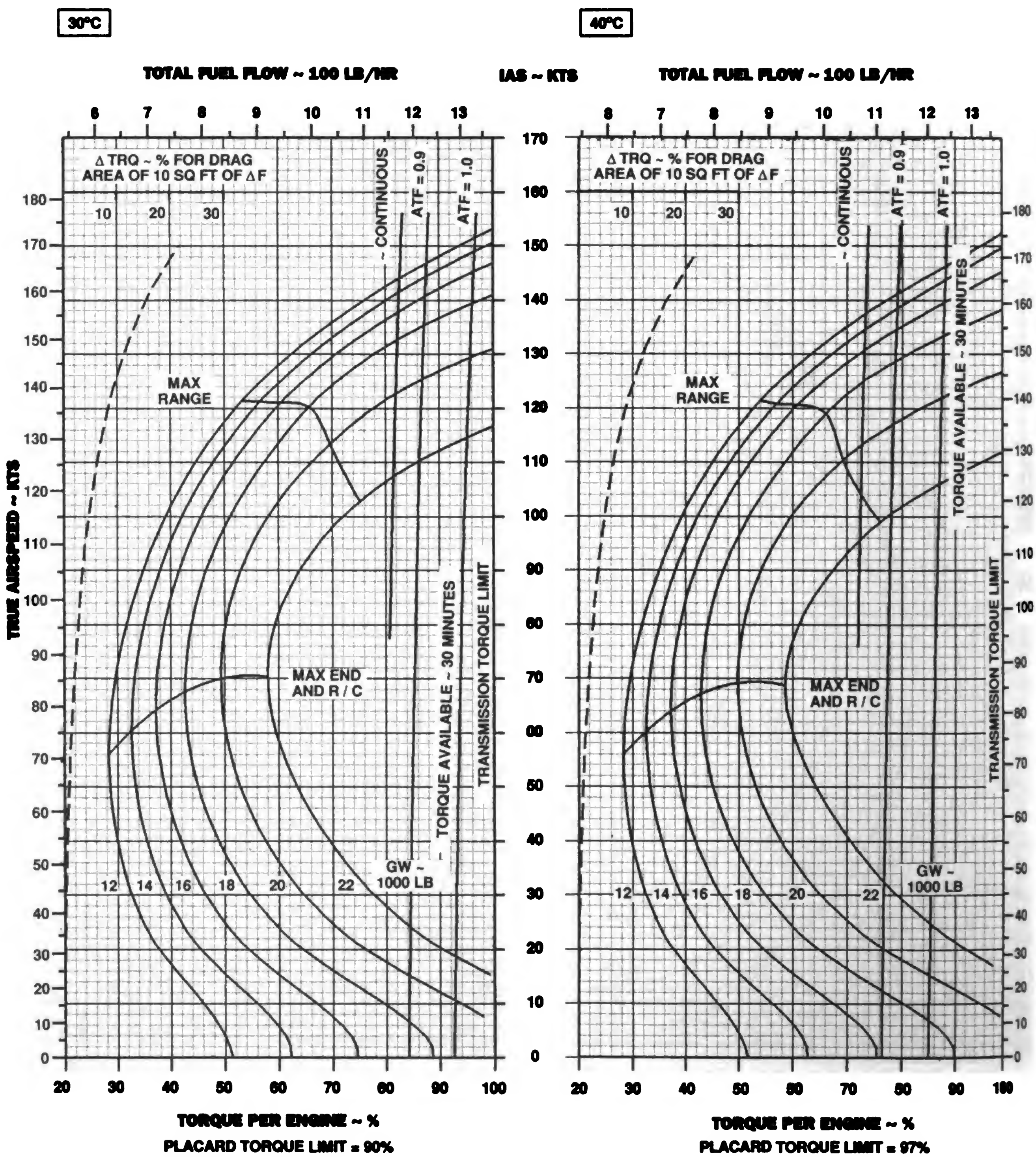
UH60A-188489.4 (C7)

Figure 7.1-12. Cruise - Pressure Altitude 6,000 Feet (Sheet 4 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6,000 FT

CRUISE 6,000 FT T701C (2)



DATA BASE: FLIGHT TEST

UH60A-158489.5 (C7)

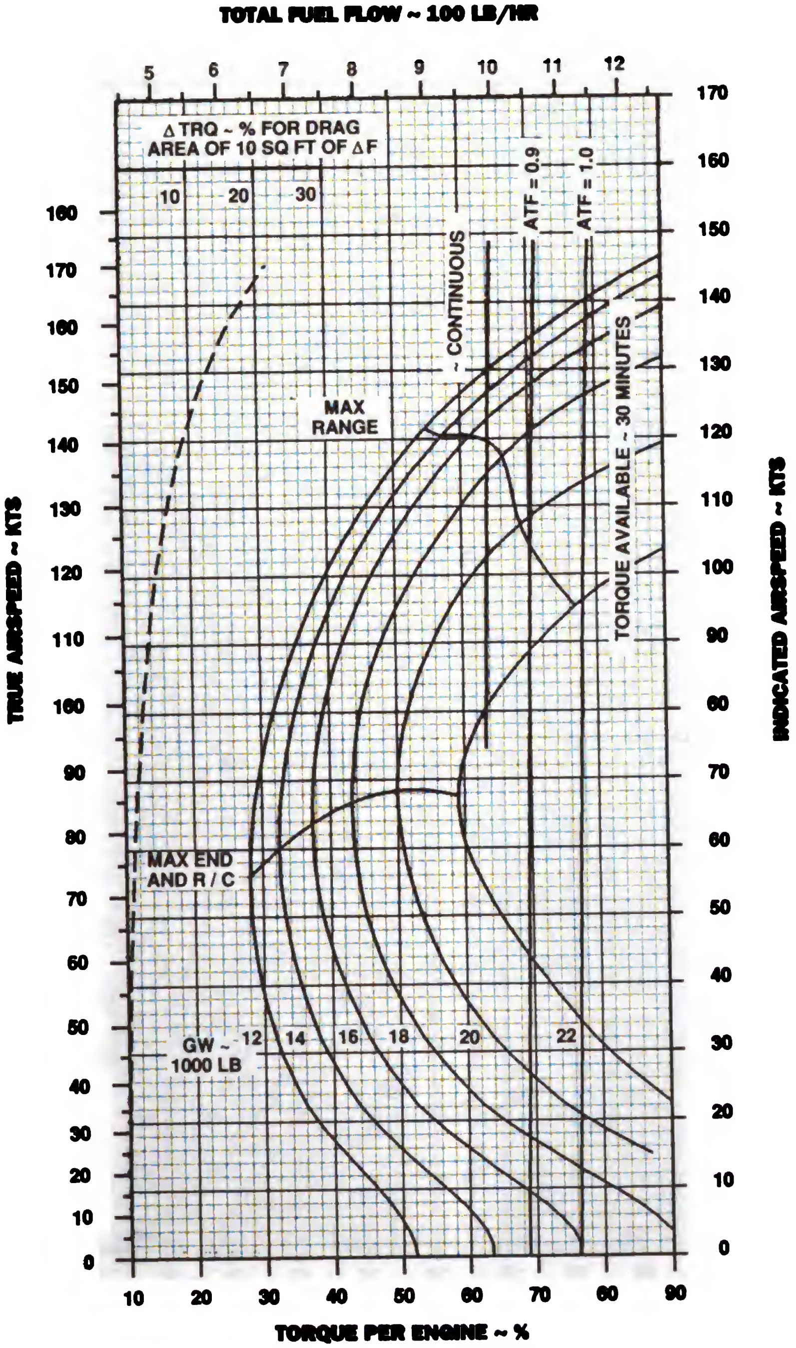
Figure 7.1-12. Cruise - Pressure Altitude 6,000 Feet (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 6,000 FT

CRUISE
6,000 FT
T701C (2)

60°C



DATA BASE: FLIGHT TEST

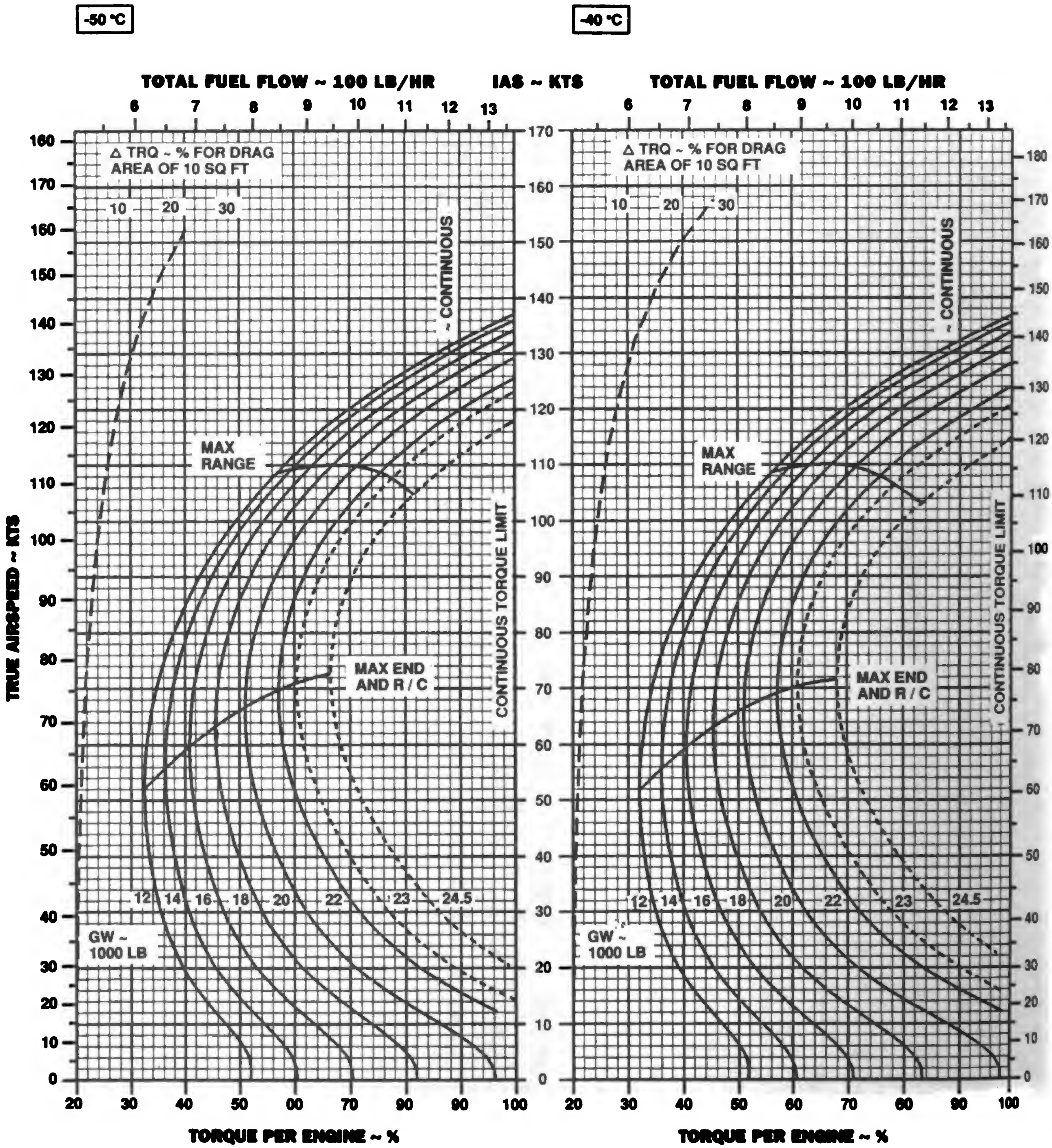
UH60A-156469.6 (C7)

Figure 7.1-12. Cruise - Pressure Altitude 6,000 Feet (Sheet 6 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY
DATA BASE: FLIGHT TEST

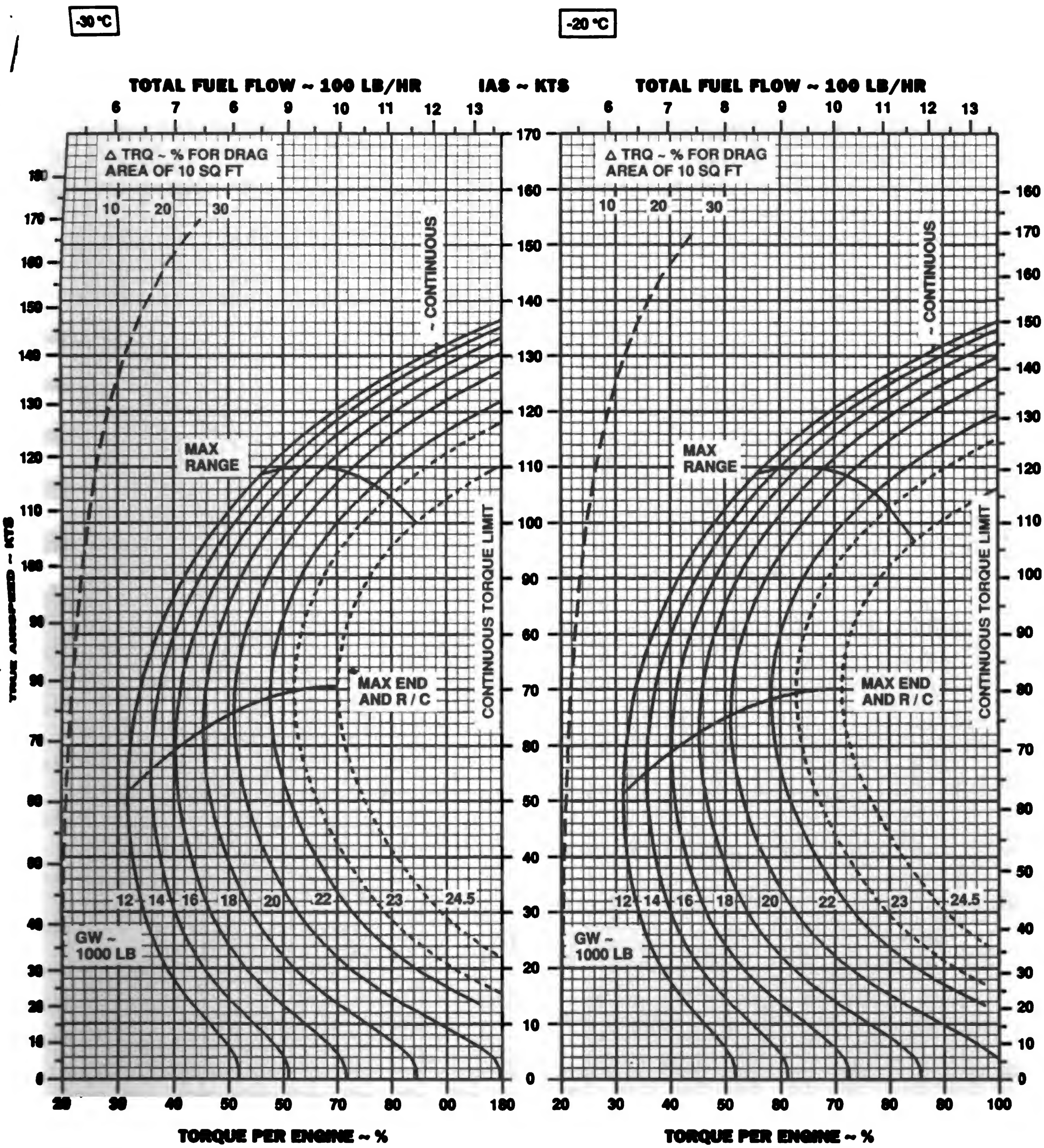
UH60A_167596_1 (R1C13)

Figure 7.1-12.1. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY
DATA BASE: FLIGHT TEST

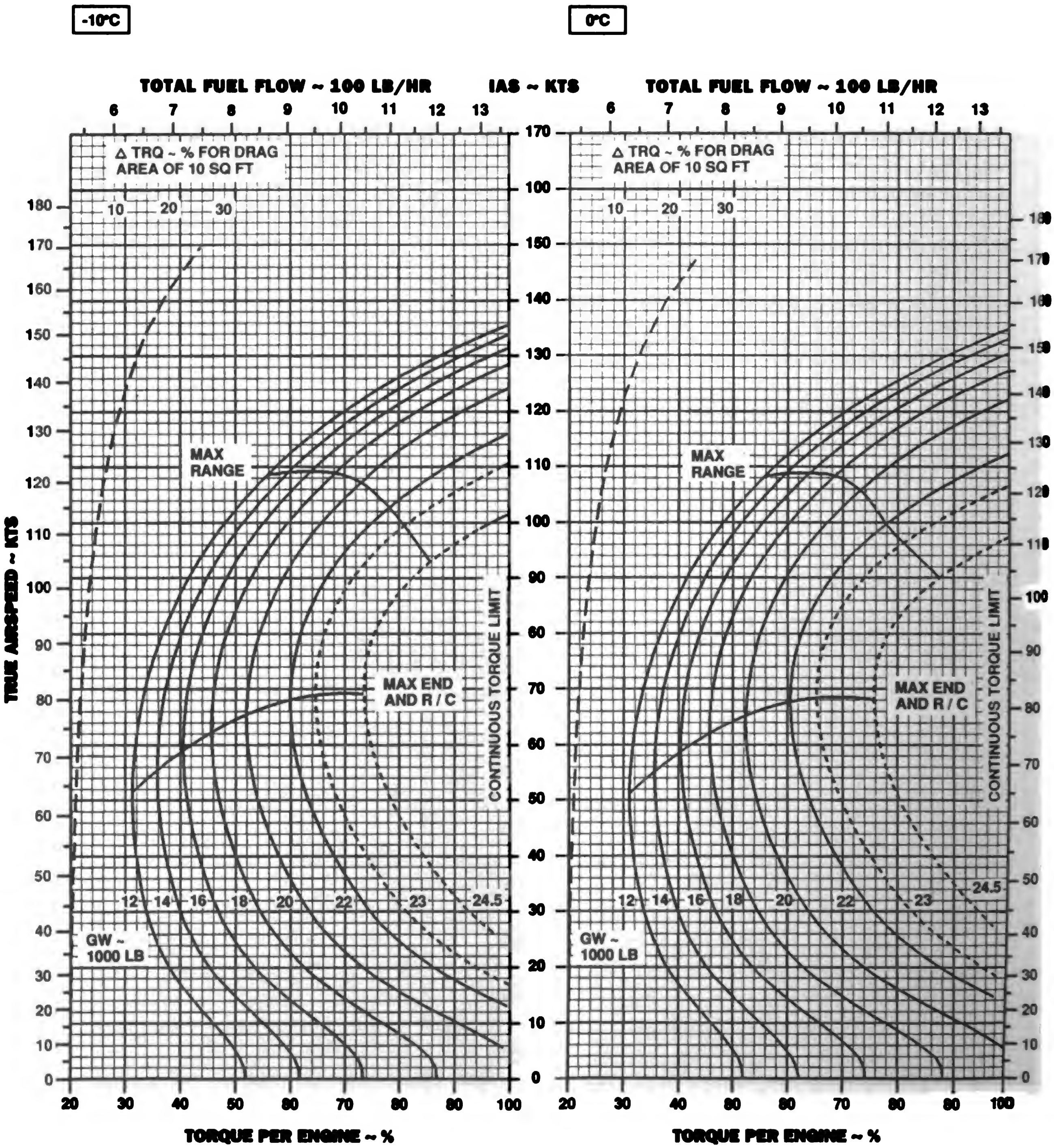
UH60A_167596_2 (R1C13)

Figure 7.1-12.1. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

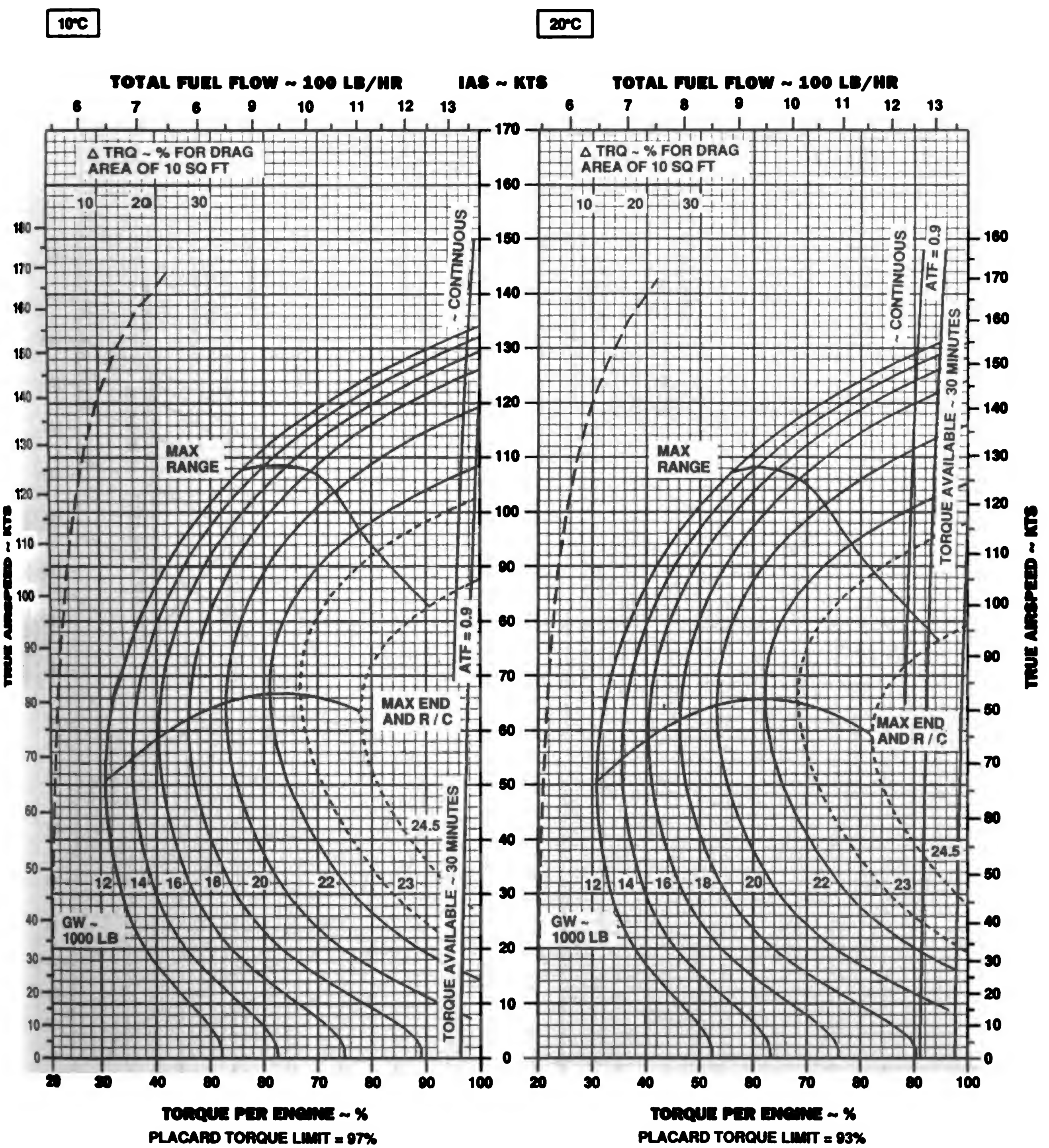
UH60A_167898_3 (R1C13)

Figure 7.1-12.1. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 3 of 6)

CRUISE

CRUISE
6000 FT
T701C (2)

PRESS ALT: 6000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

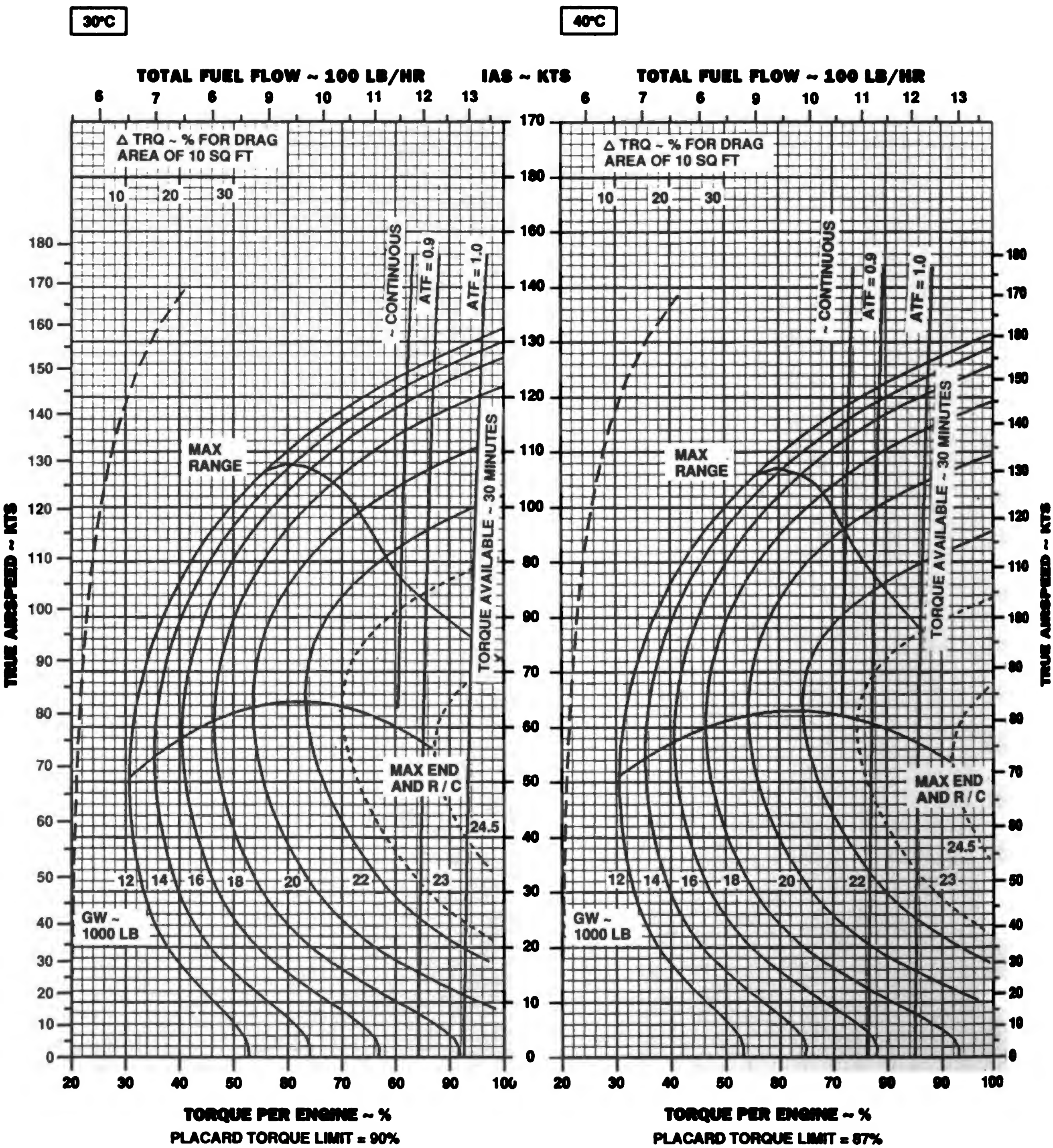
UH60A_167596_4 (R1C13)

Figure 7.1-12.1. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 4 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

UH60A_167596_5 (R1C13)

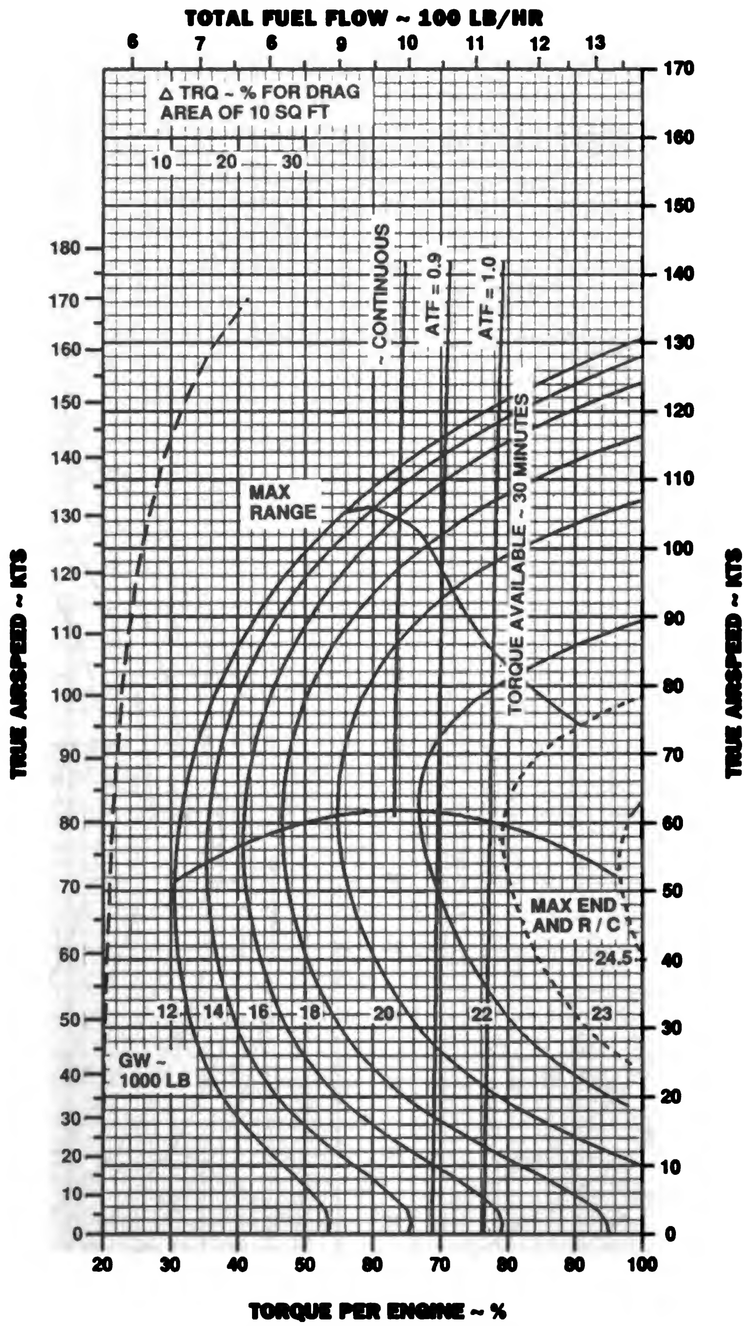
Figure 7.1-12.1. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 5 of 6)

CRUISE

PRESS ALT: 6000 FT

CRUISE
6000 FT
T701C (2)

50°C



PLACARD TORQUE LIMIT = 83%

NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

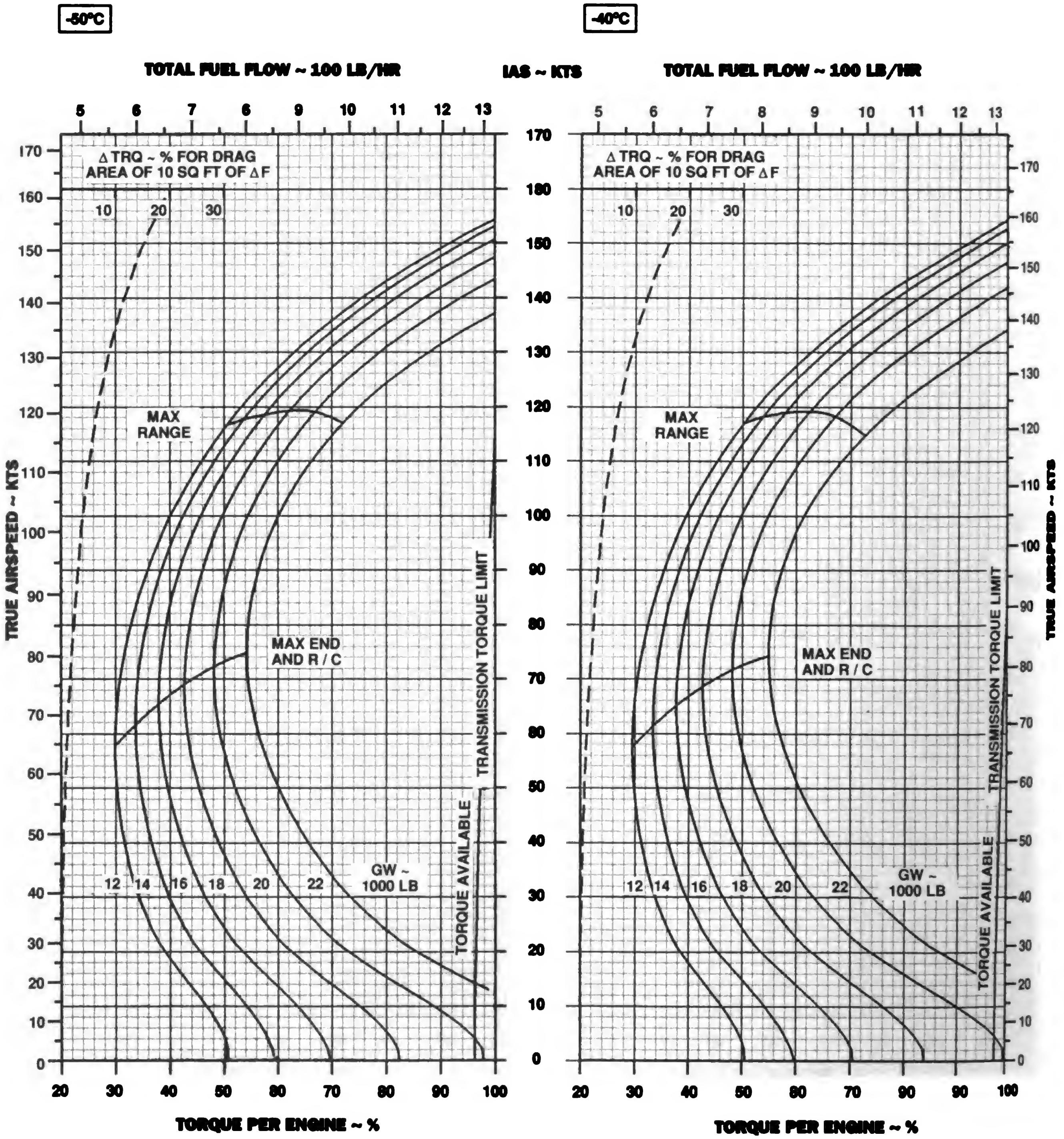
UH60A_167596_6 (R1C13)

Figure 7.1-12.1. Cruise High Drag - Pressure Altitude 6,000 Feet (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8,000 FT

CRUISE
8,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

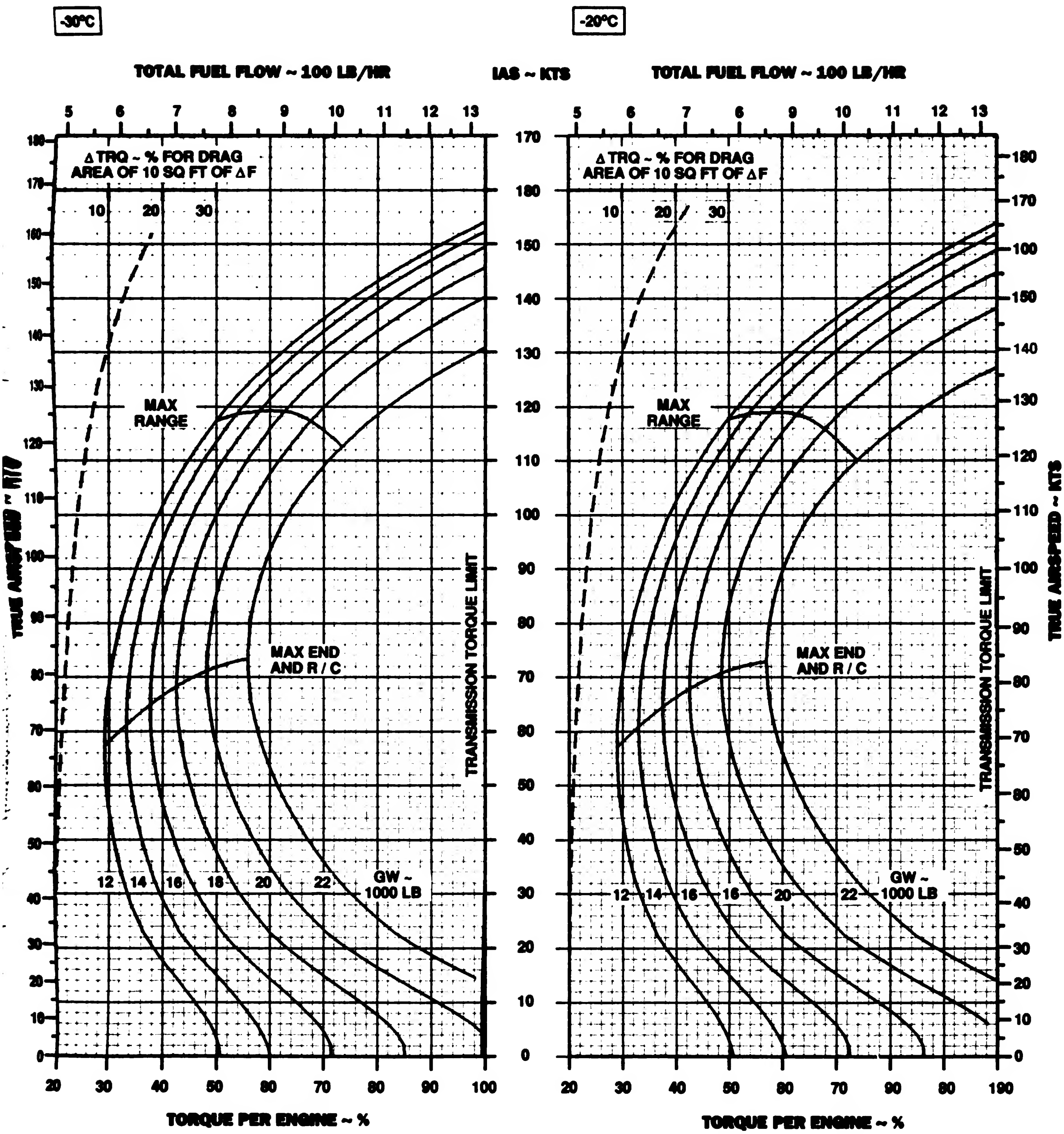
UH60A-158470.1 (C7)

Figure 7.1-13. Cruise - Pressure Altitude 8,000 Feet (Sheet 1 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8,000 FT

CRUISE
8,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

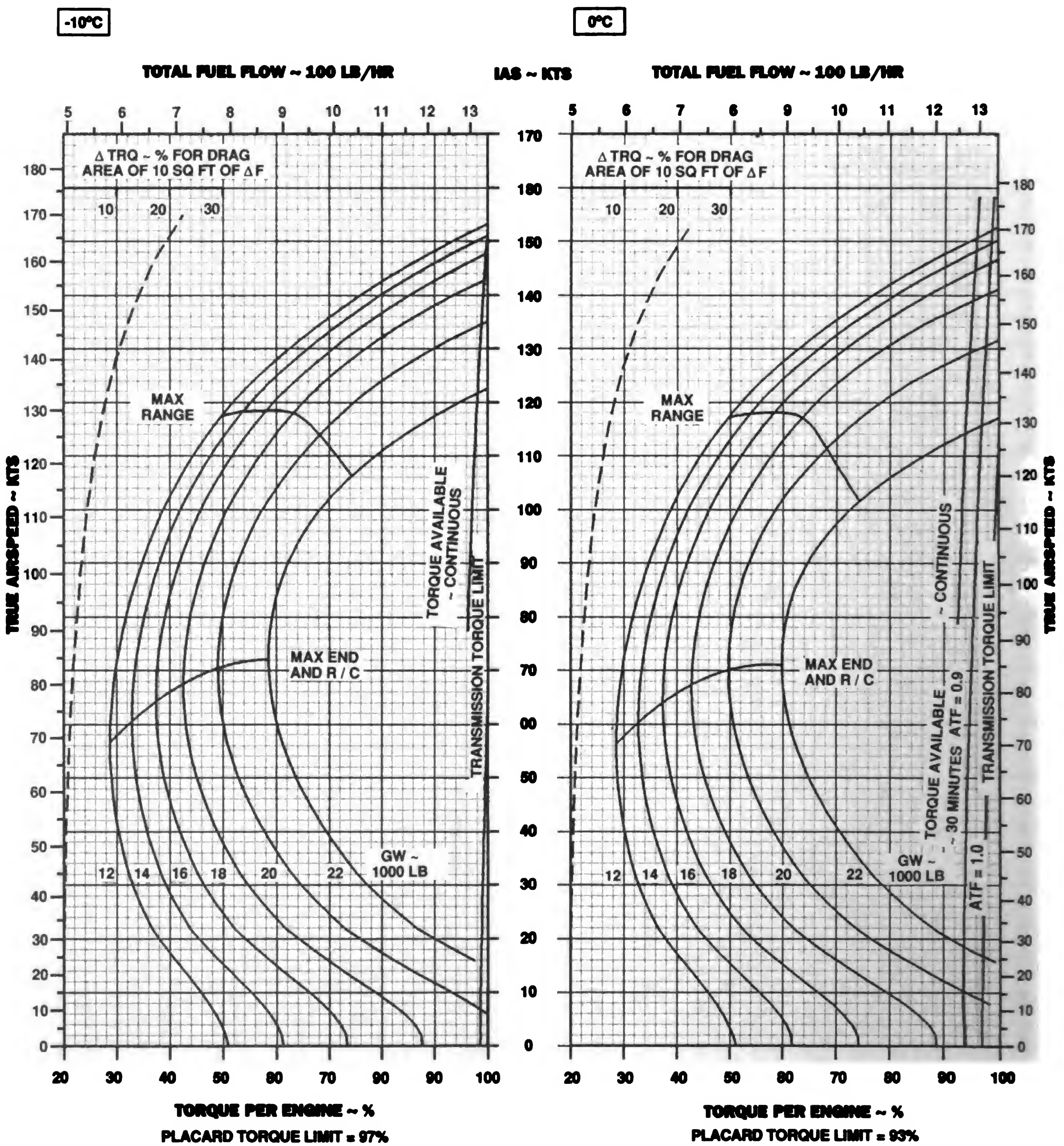
UH60A-156470.2 (C7)

Figure 7.1-13. Cruise - Pressure Altitude 8,000 Feet (Sheet 2 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8,000 FT

CRUISE
8,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

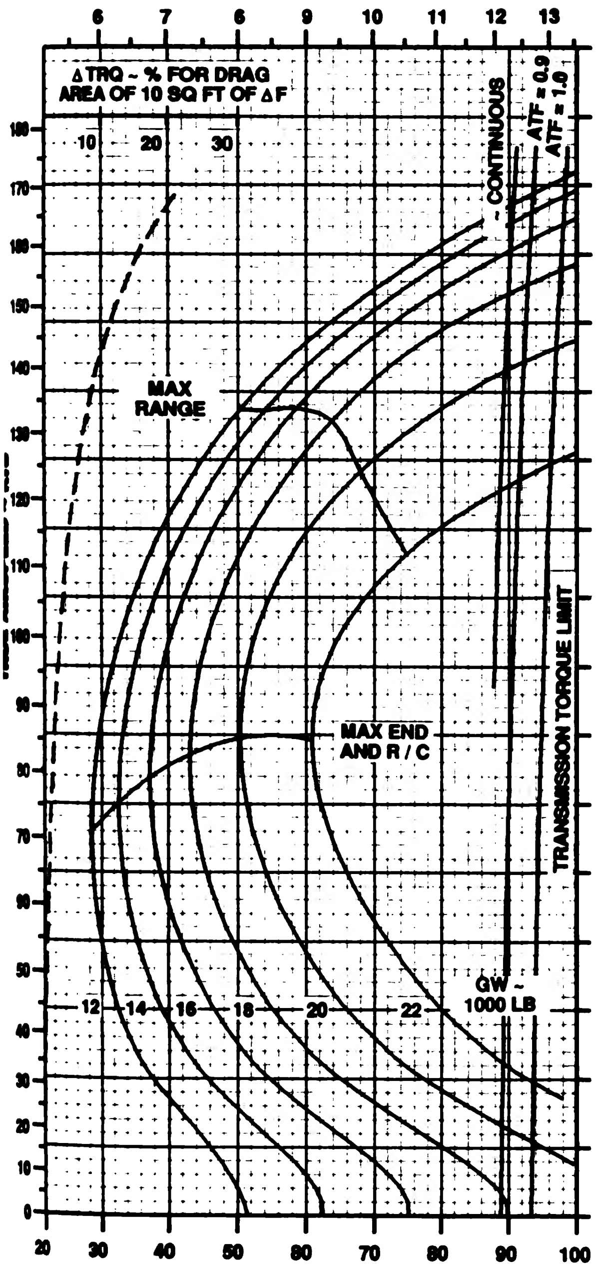
UH60A-156470.3 (C7)

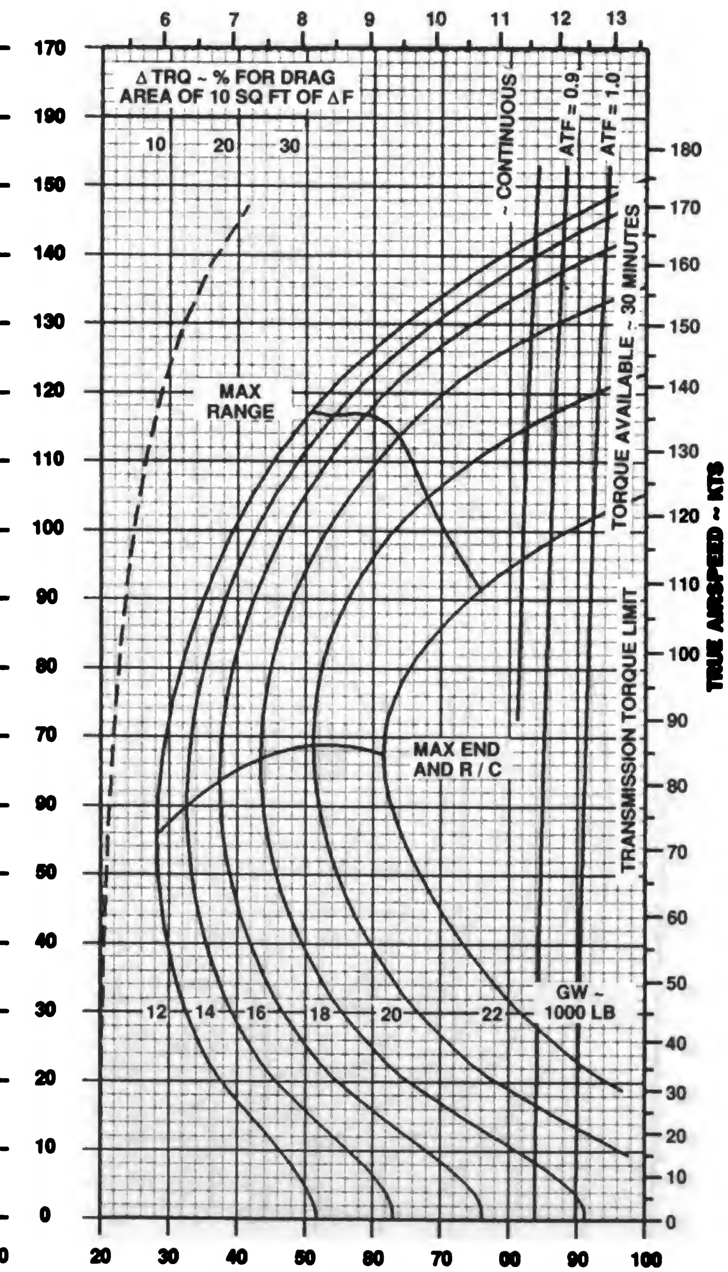
Figure 7.1-13. Cruise - Pressure Altitude 8,000 Feet (Sheet 3 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8,000 FT

CRUISE
8,000 FT
T701C (2)





DATA BASE: FLIGHT TEST

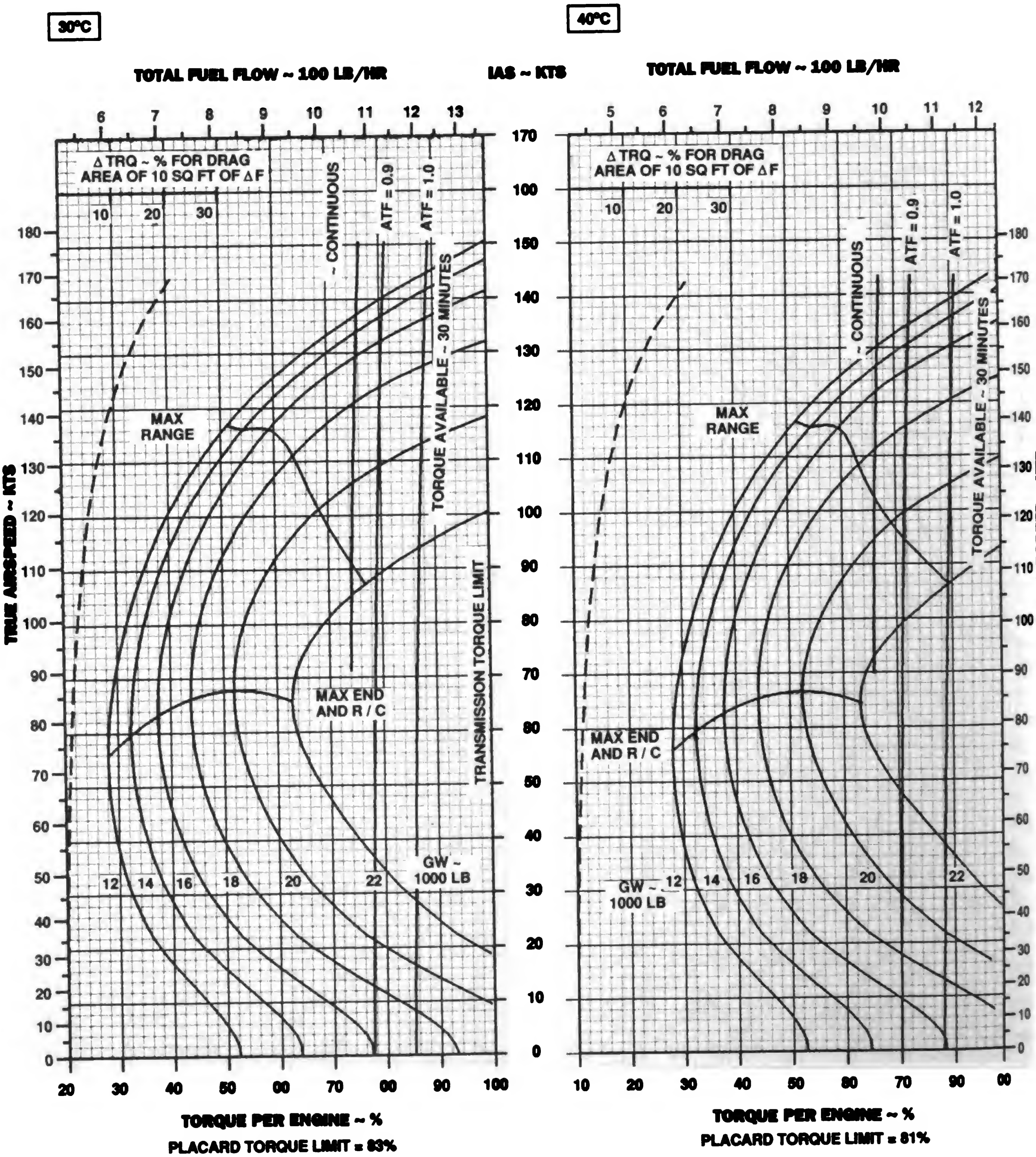
UH60A -158470.4 (C7)

Figure 7.1-13. Cruise - Pressure Altitude 8,000 Feet (Sheet 4 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8,000 FT

CRUISE
8,000 FT
T701C (2)



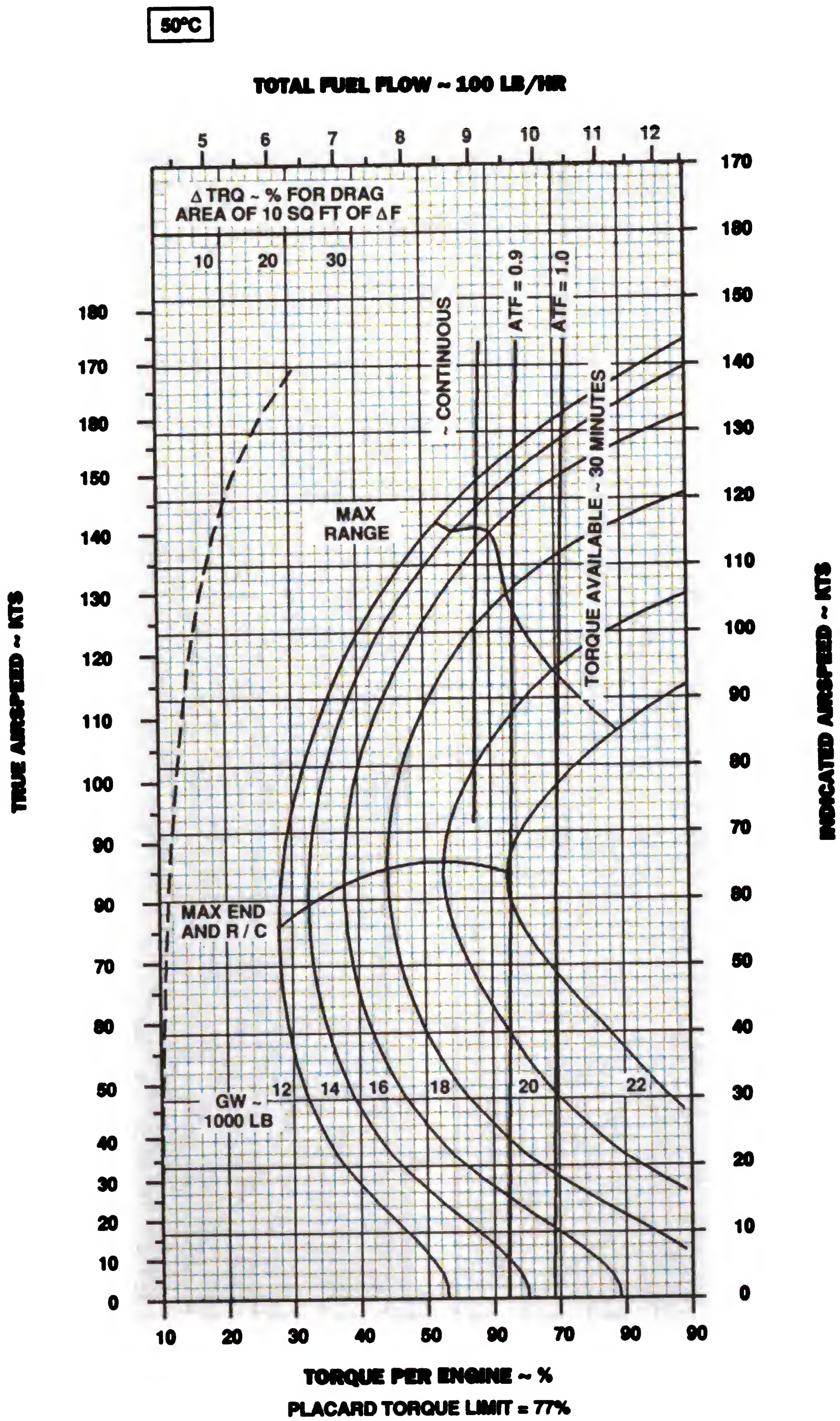
DATA BASE: FLIGHT TEST

UH60A-158470.5 (C7)

Figure 7.1-13. Cruise - Pressure Altitude 8,000 Feet (Sheet 5 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 8,000 FT



DATA BASE: FLIGHT TEST

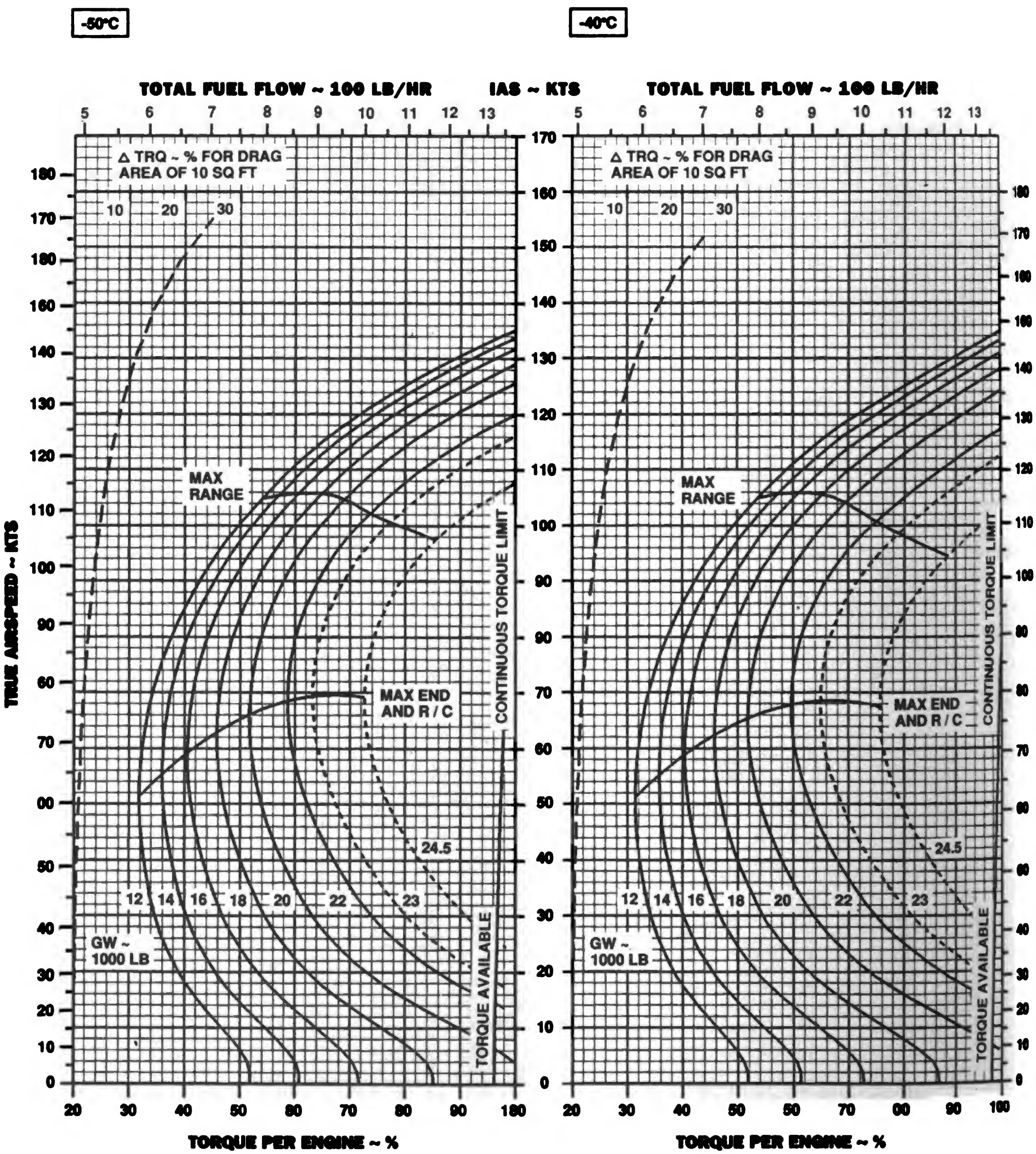
UH60A-158470.6 (C7)

Figure 7.1-13. Cruise - Pressure Altitude 8,000 Feet (Sheet 6 of 6)

CRUISE

CRUISE
8000 FT
T701C (2)

PRESS ALT: 8000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

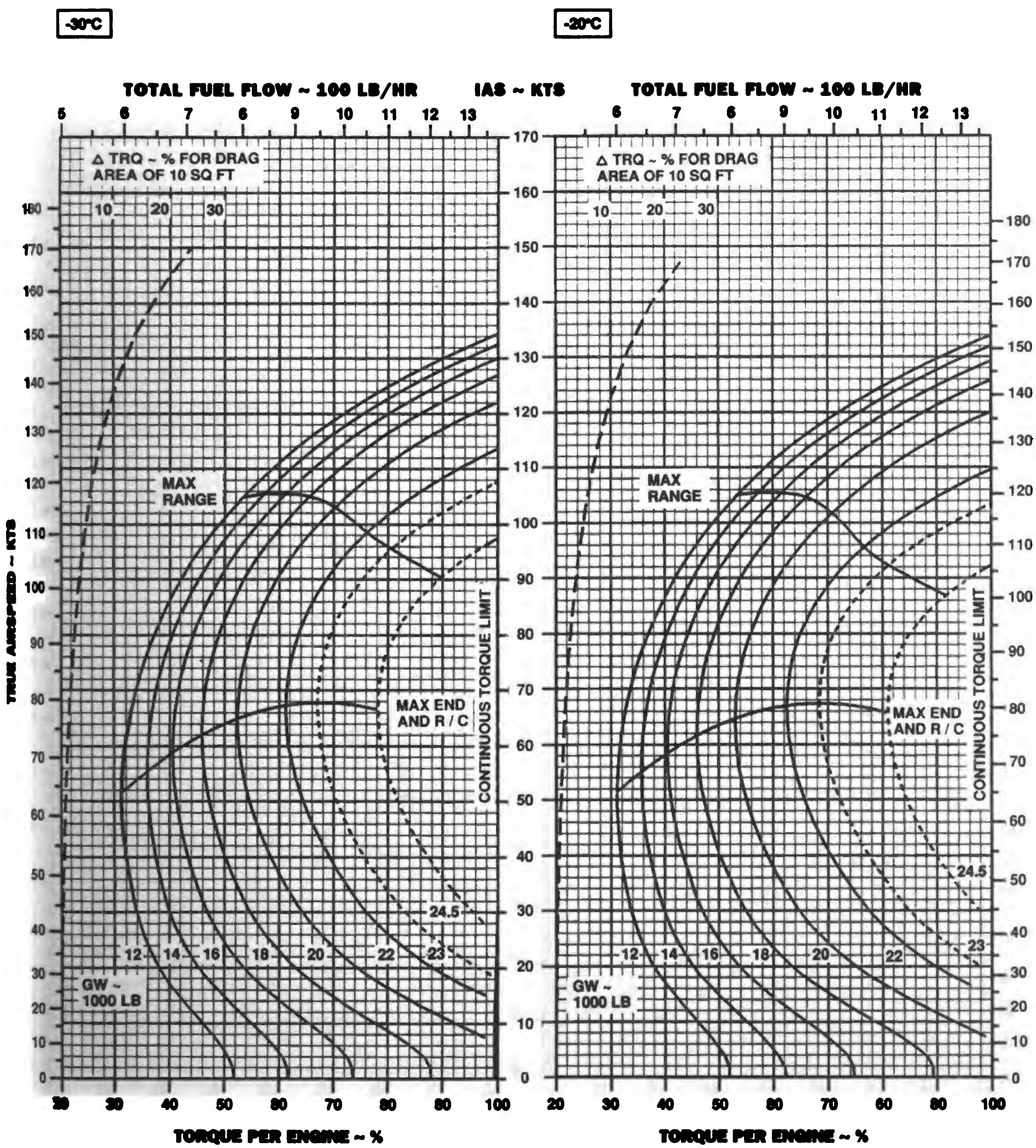
DATA BASE: FLIGHT TEST

UH60A_167897_1 (R1C13)

Figure 7.1-13.1. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 1 of 6)

CRUISE

PRESS ALT: 8000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

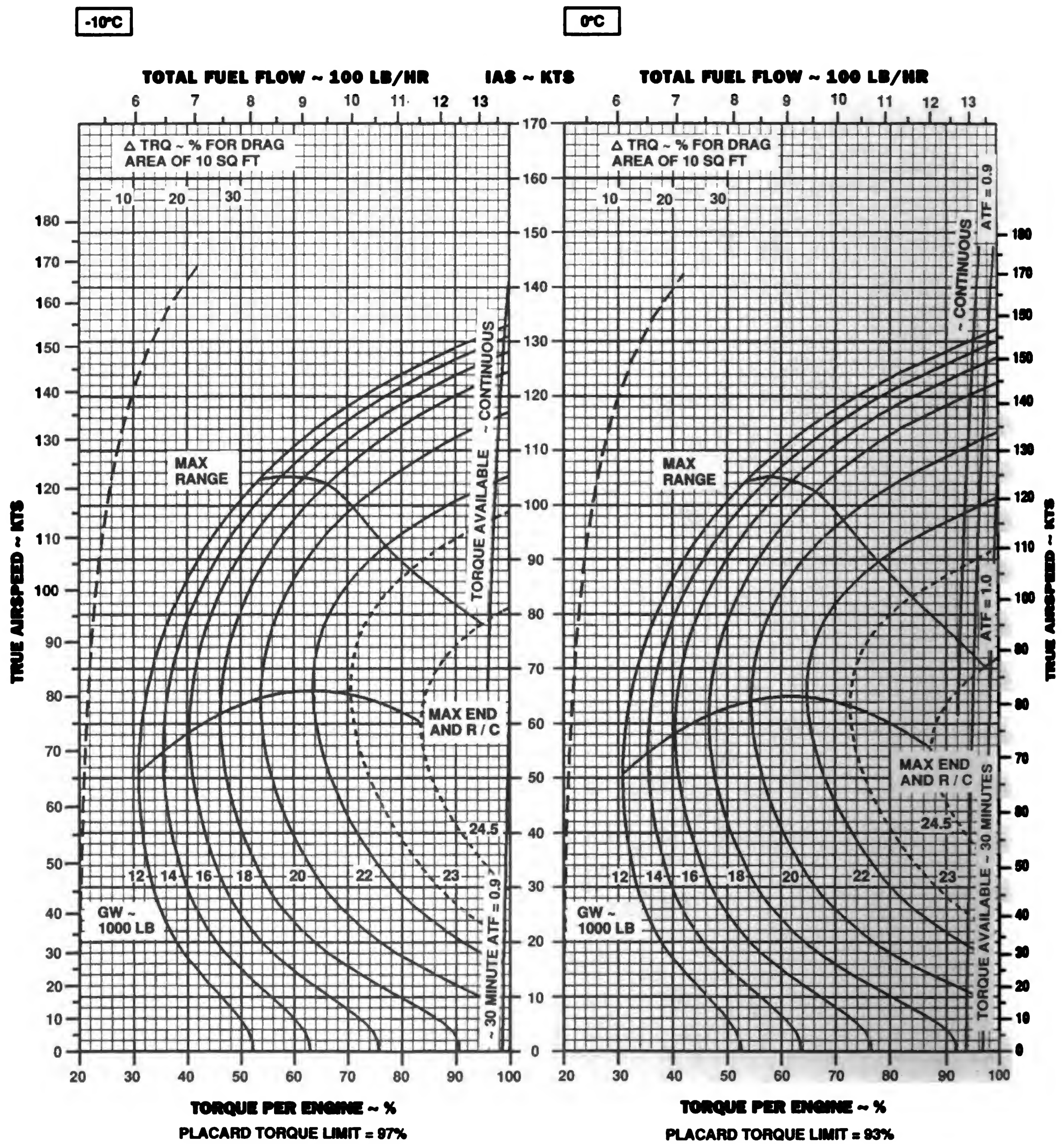
UH60A_167597_2 (R1C13)

Figure 7.1-13.1. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 2 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE
8000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

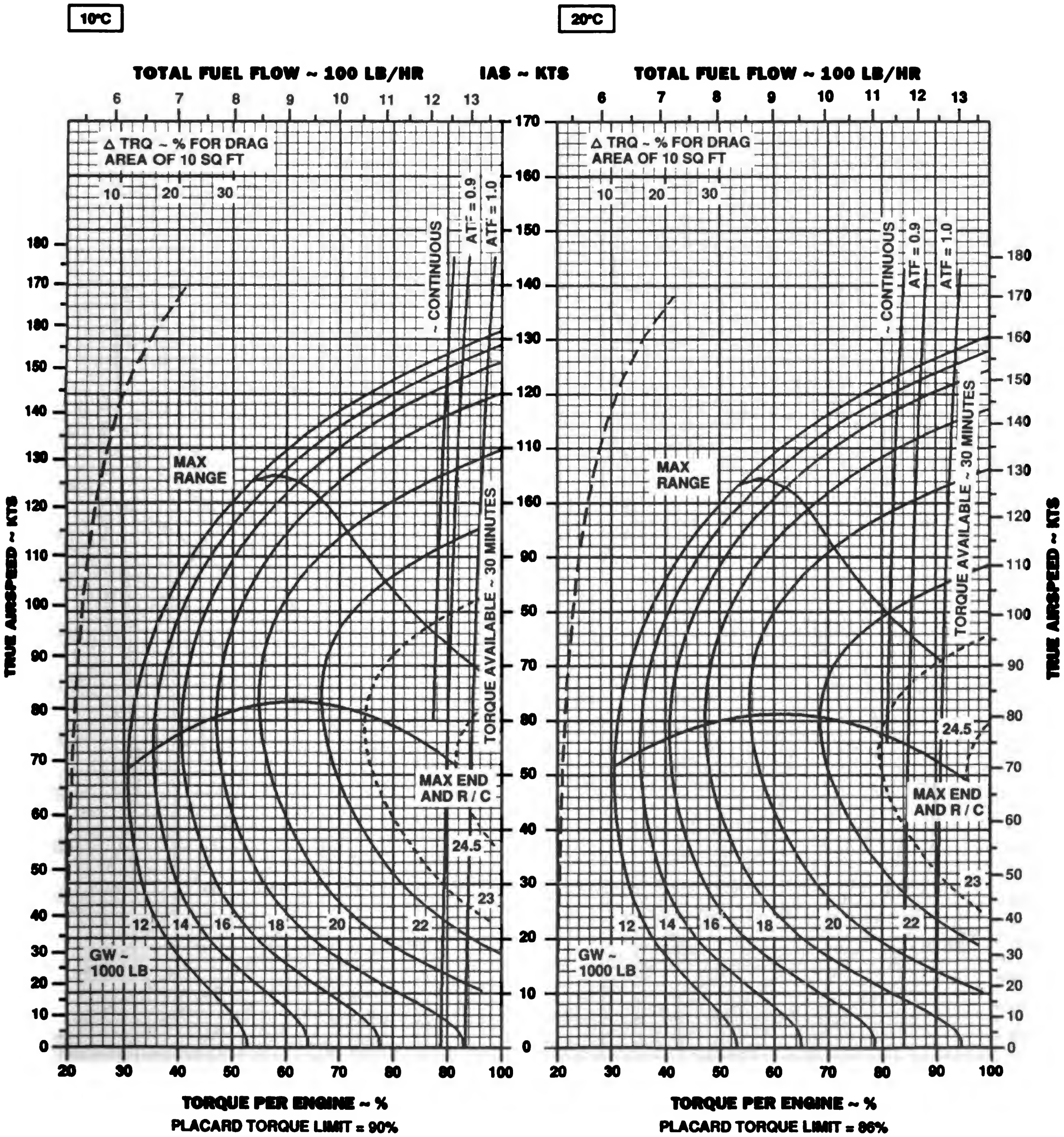
UH60A_167597_3 (R1C13)

Figure 7.1-13.1. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 3 of 6)

CRUISE

PRESS ALT: 8000 FT

CRUISE
8000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

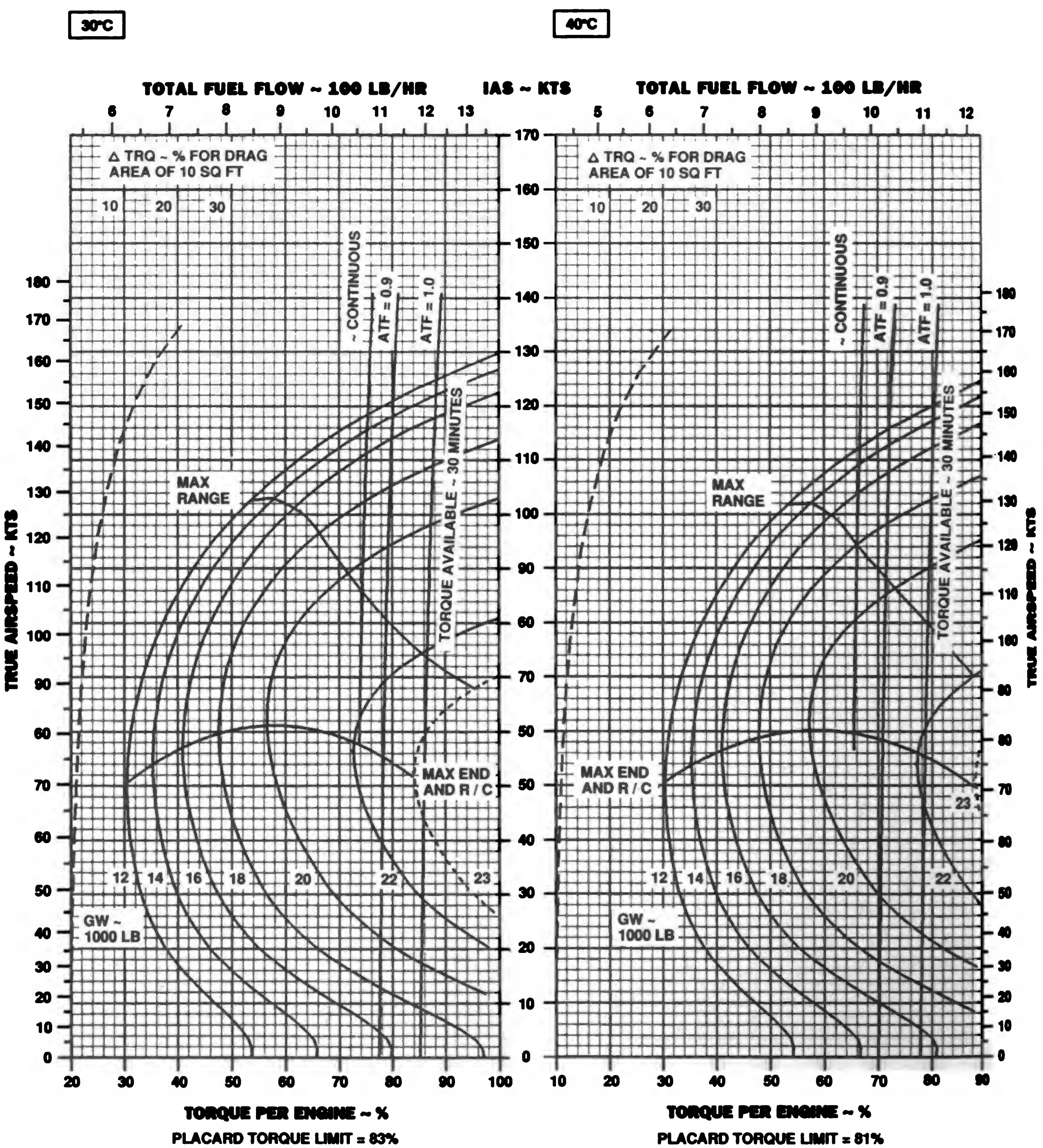
UH60A_167597_4 (R1C13)

Figure 7.1-13.1. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 4 of 6)

CRUISE

CRUISE
8000 FT
T701C (2)

PRESS ALT: 8000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

UH60A_167597_5 (R1C13)

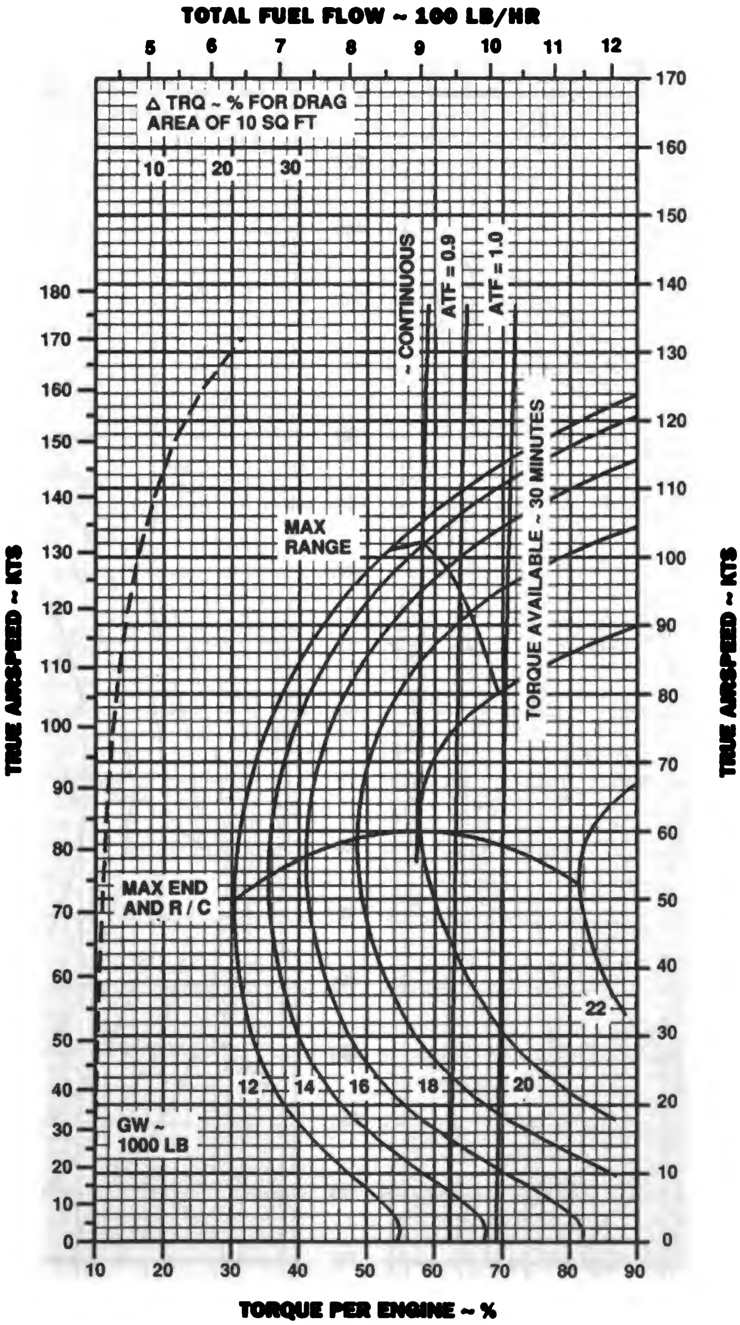
Figure 7.1-13.1. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 5 of 6)

CRUISE

CRUISE
8000 FT
T701C (2)

PRESS ALT: 8000 FT

50°C



PLACARD TORQUE LIMIT = 77%

NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

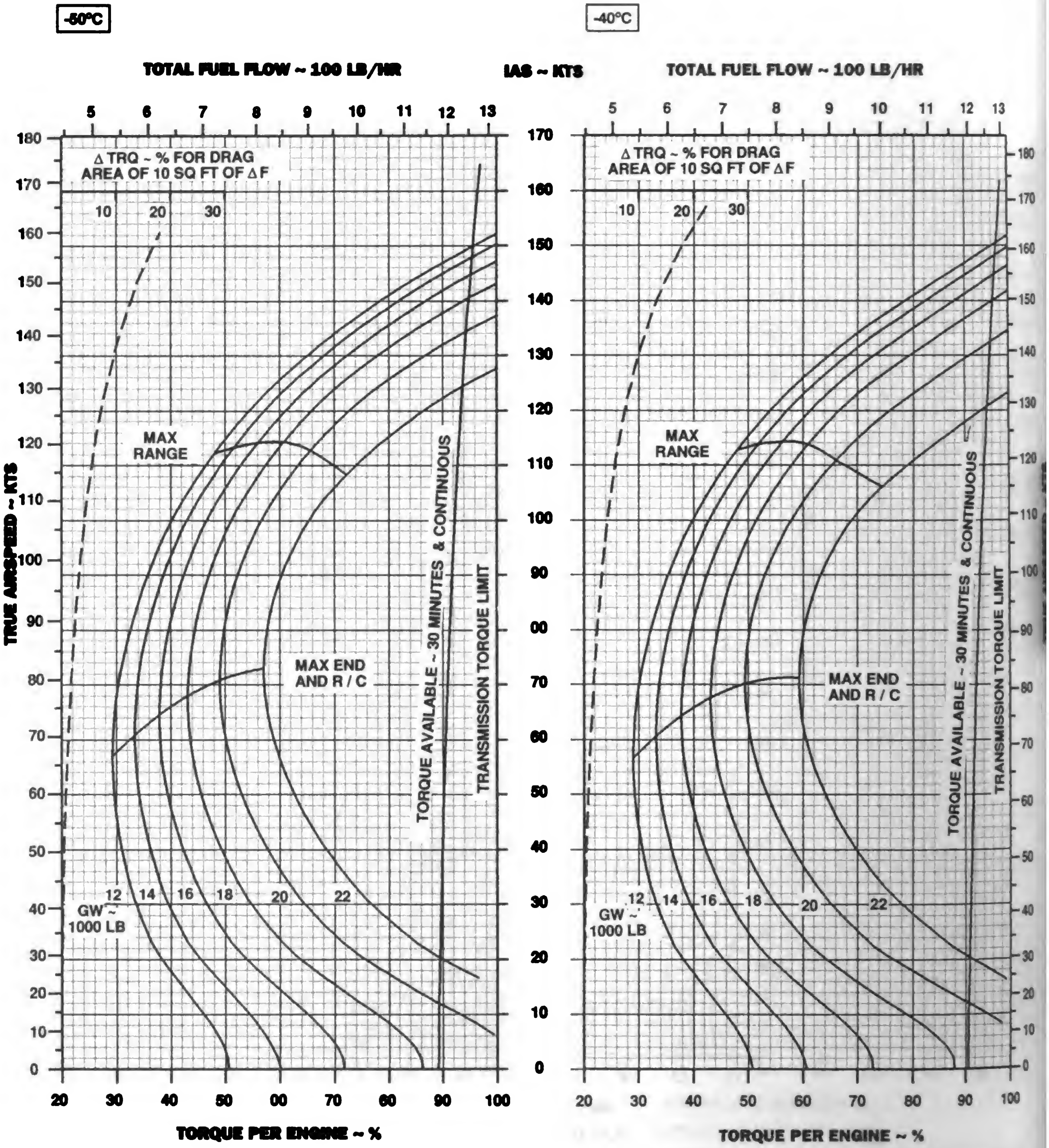
UH60A_167597_6 (R1C13)

Figure 7.1-13.1. Cruise High Drag - Pressure Altitude 8,000 Feet (Sheet 6 of 6)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 10,000 FT

CRUISE 10,000 FT T701C (2)



DATA BASE: FLIGHT TEST

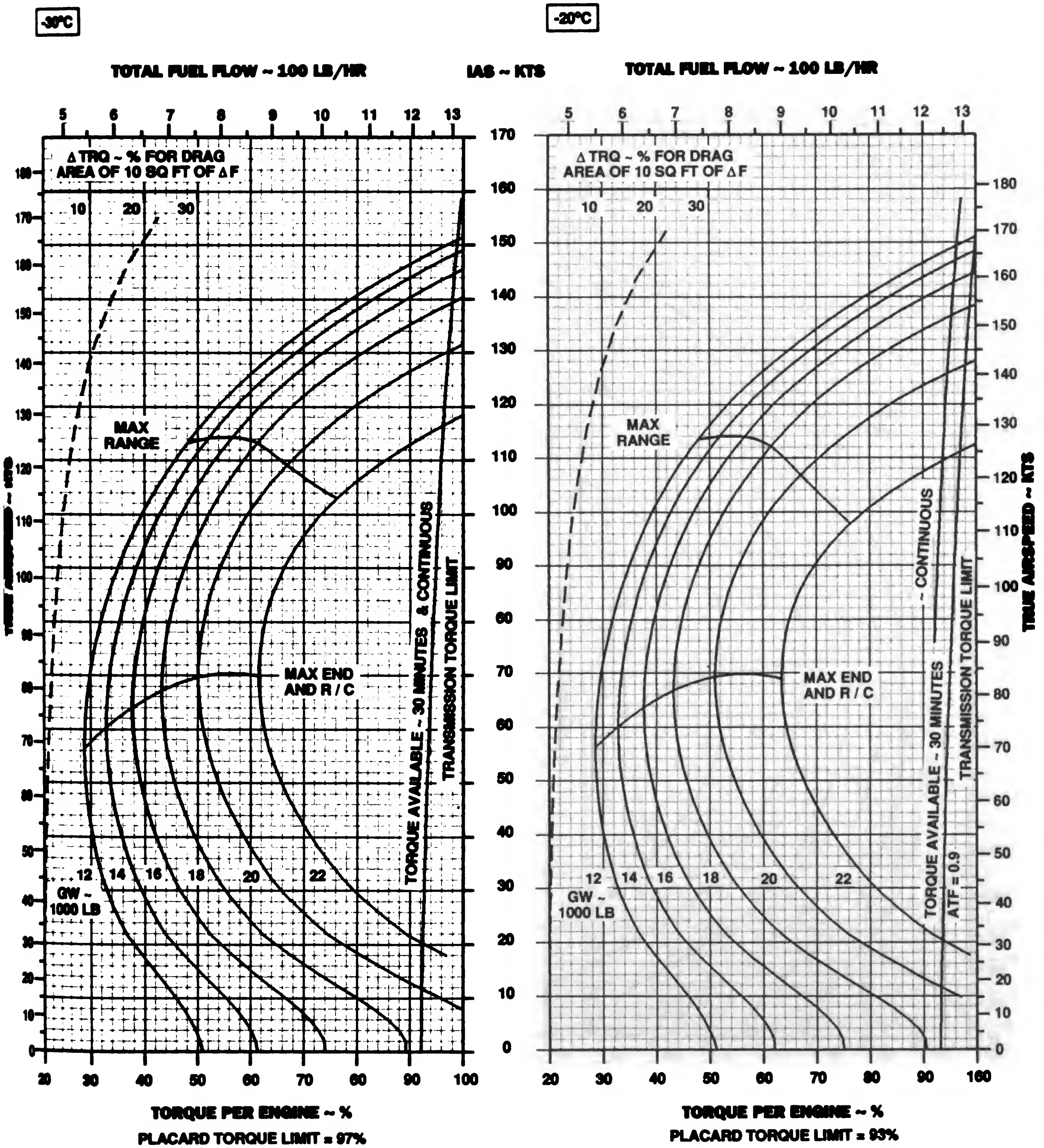
UH60A-156471.1 (C7)

Figure 7.1-14. Cruise - Pressure Altitude 10,000 Feet (Sheet 1 of 5)

CRUISE

CRUISE
10,000 FT
T701C (2)

CLEAN CONFIGURATION
PRESS ALT: 10,000 FT



DATA BASE: FLIGHT TEST

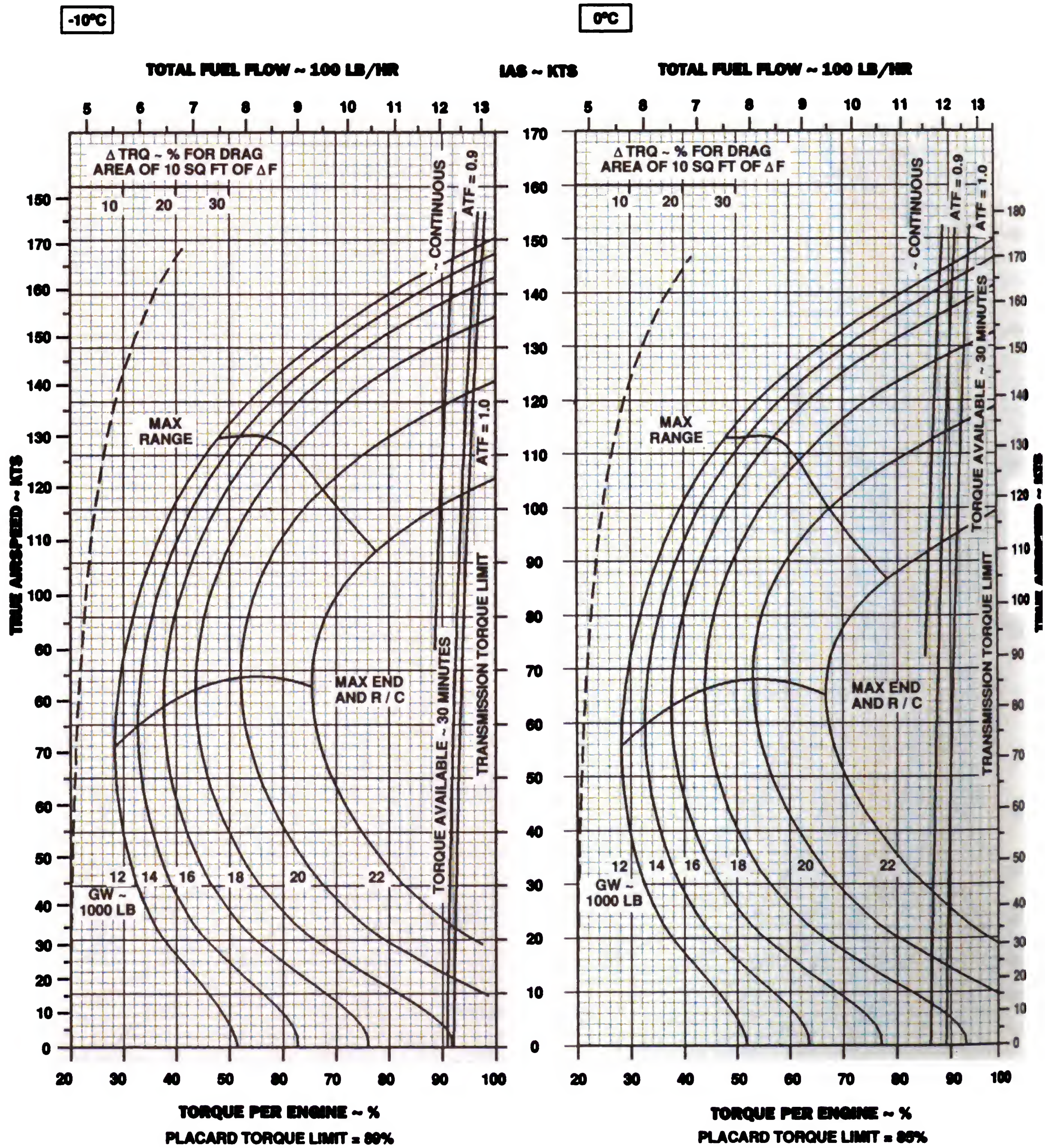
UH60A-156471.2 (C7)

Figure 7.1-14. Cruise - Pressure Altitude 10,000 Feet (Sheet 2 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 10,000 FT

CRUISE
10,000 FT
T7FT1C (2)



DATA BASE: FLIGHT TEST

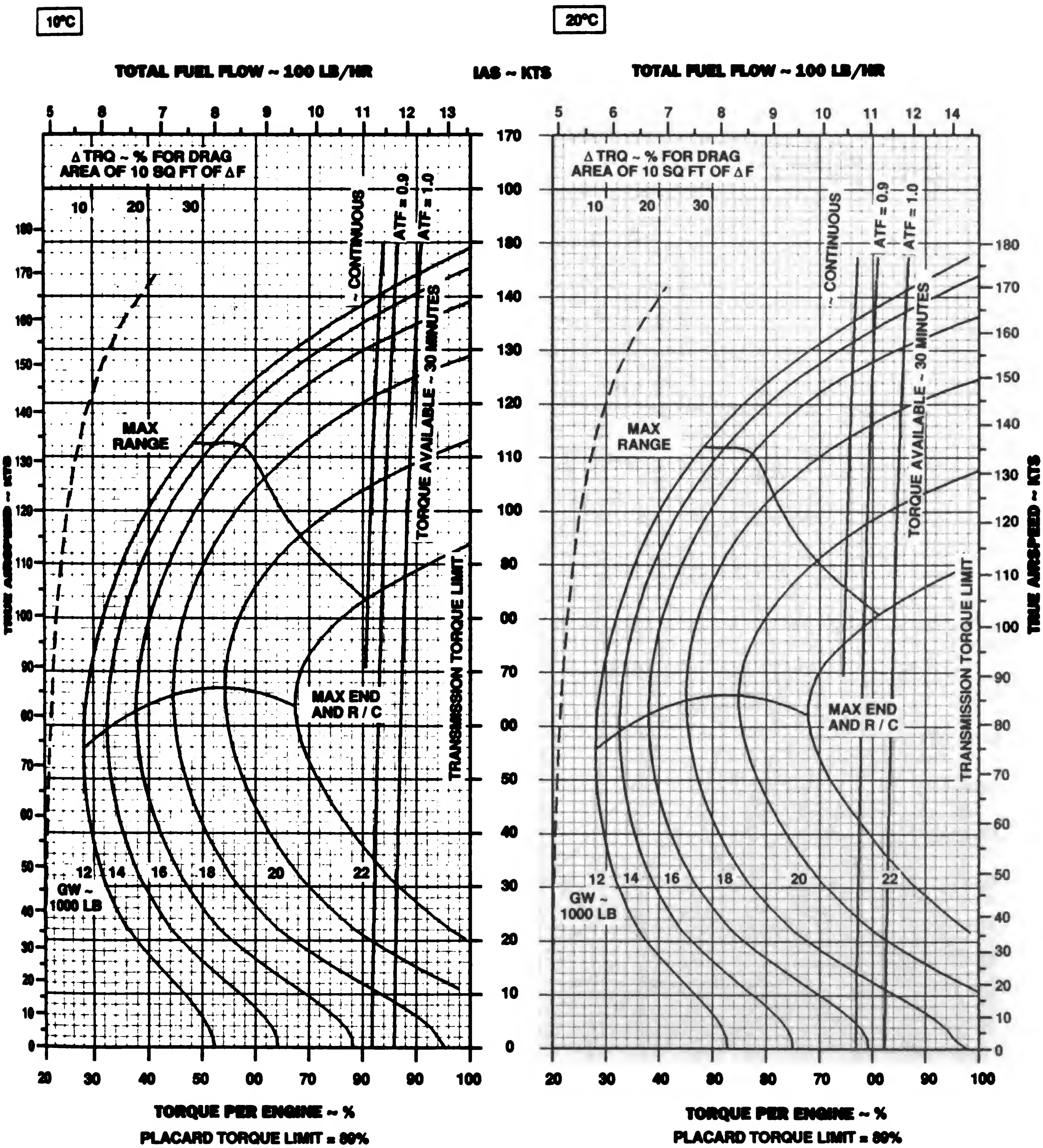
UH60A-188471.3 (C7)

Figure 7.1-14. Cruise - Pressure Altitude 10,000 Feet (Sheet 3 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 10,000 FT

CRUISE
10,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

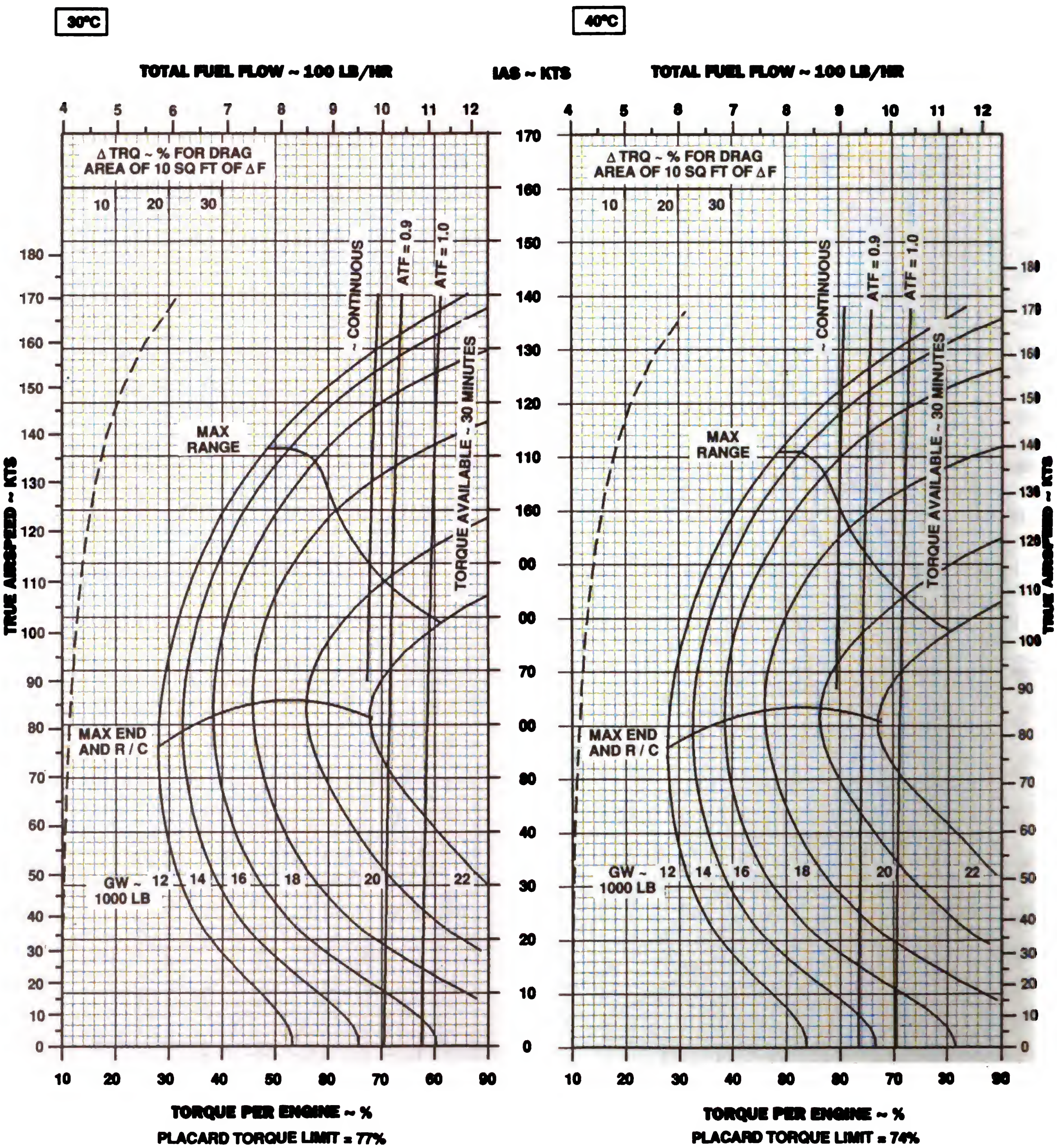
UH60A-156471.4 (C7)

Figure 7.1-14. Cruise - Pressure Altitude 10,000 Feet (Sheet 4 of 5)

CRUISE
10,000 FT
T701C (2)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 10,000 FT



DATA BASE: FLIGHT TEST

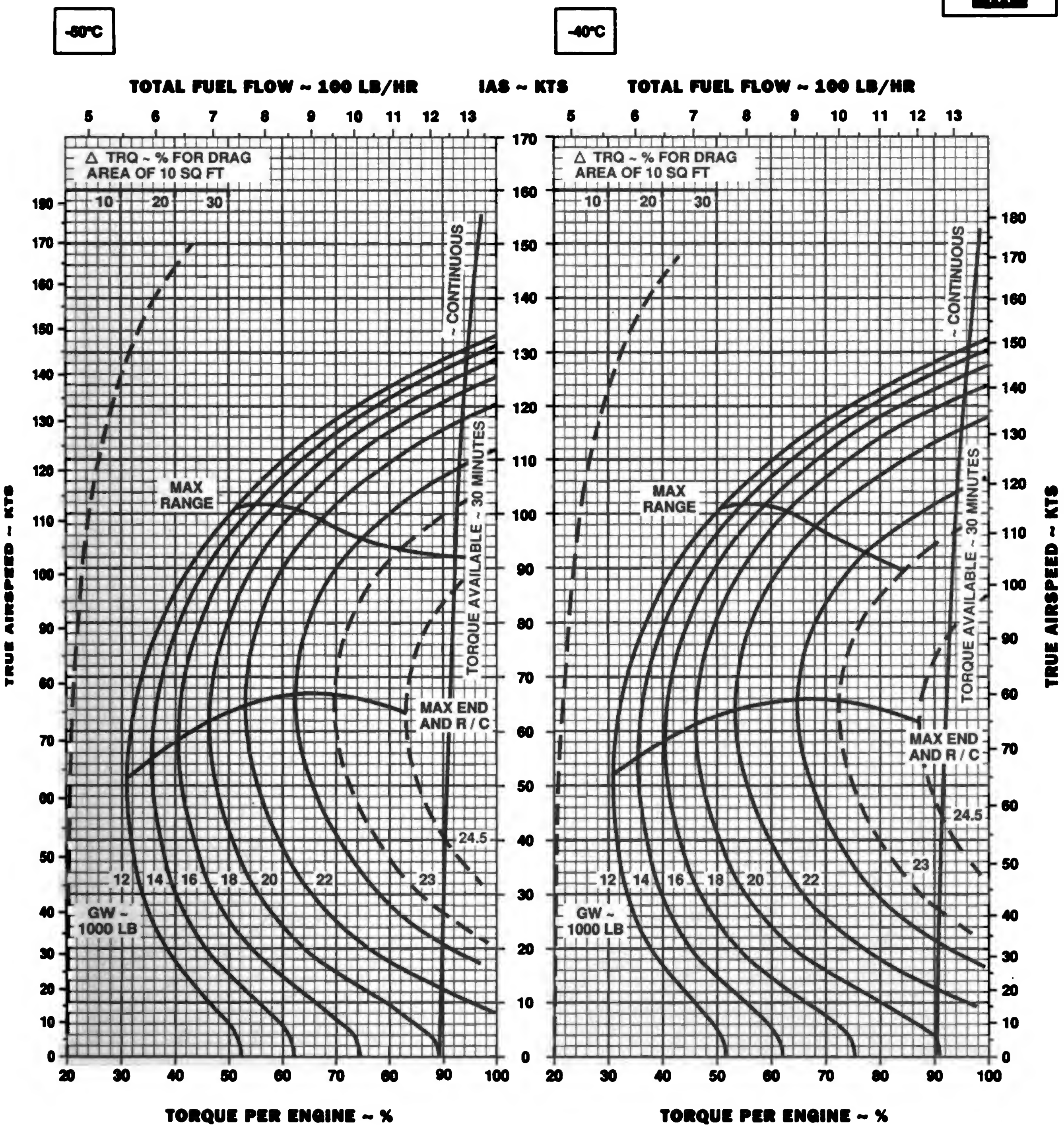
UH60A-158471.5 (C7)

Figure 7.1-14. Cruise - Pressure Altitude 10,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

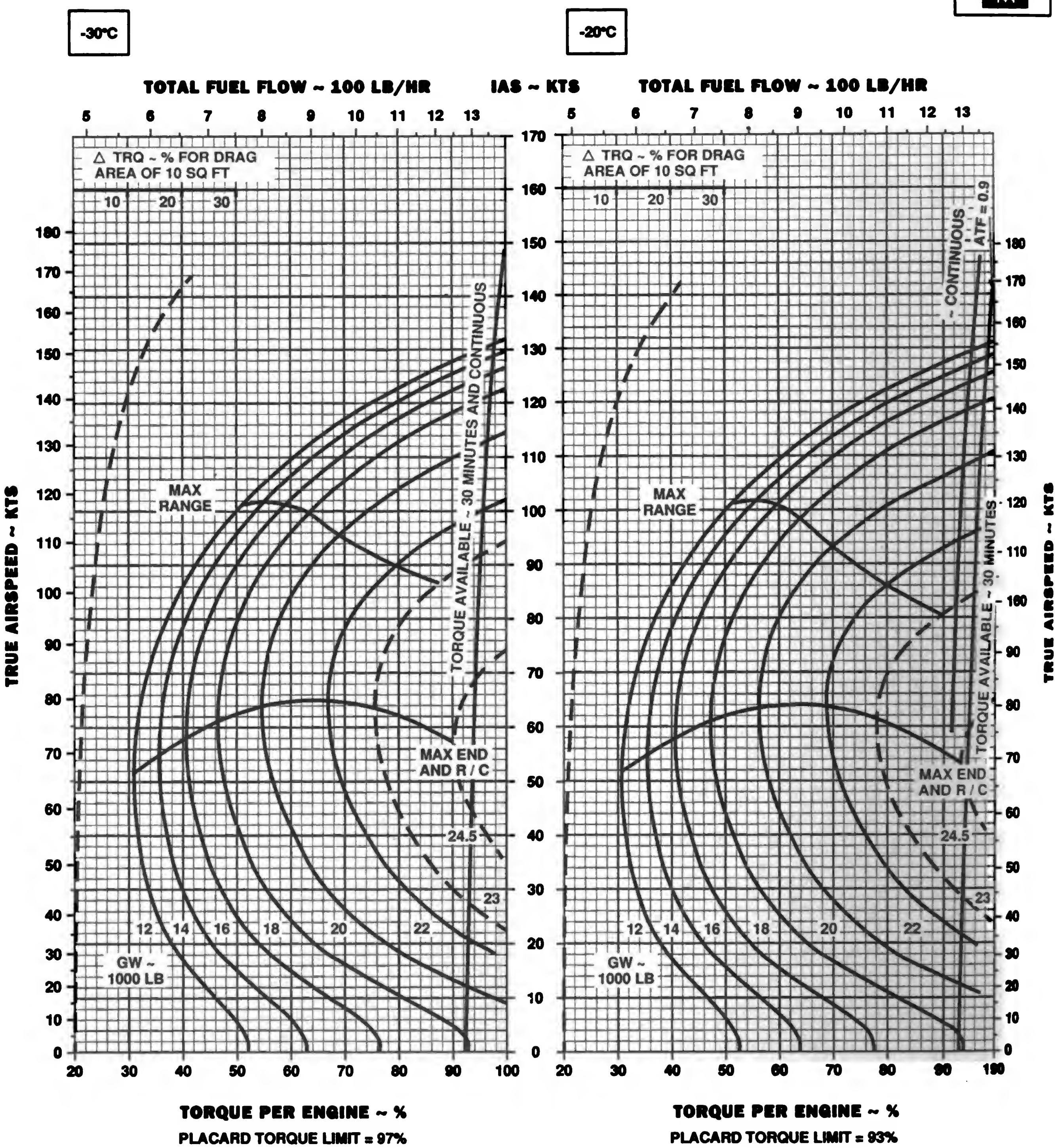
AA1014_1

Figure 7.1-14.1. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 1 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

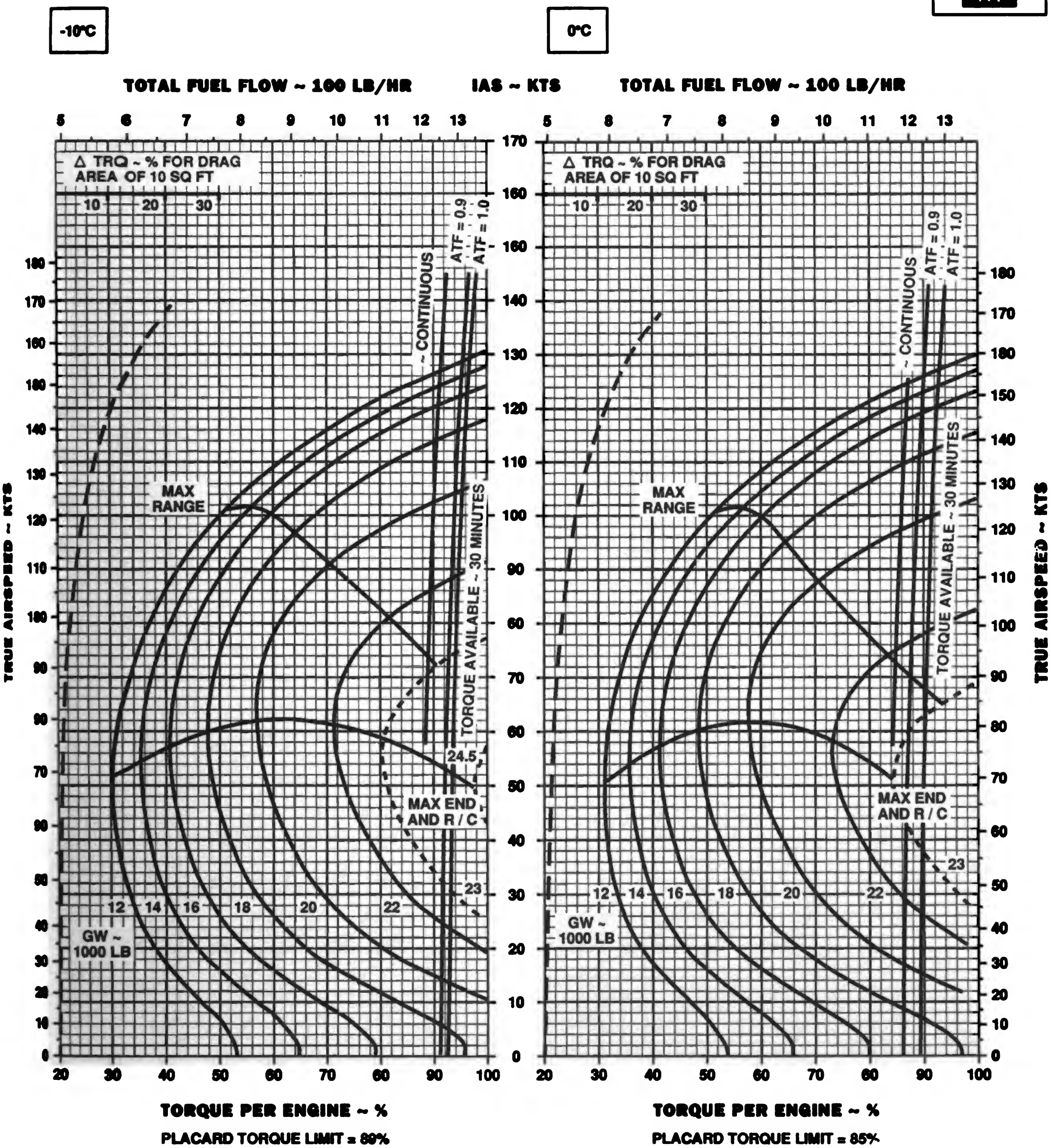
AA1014_2

Figure 7.1-14.1. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 2 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

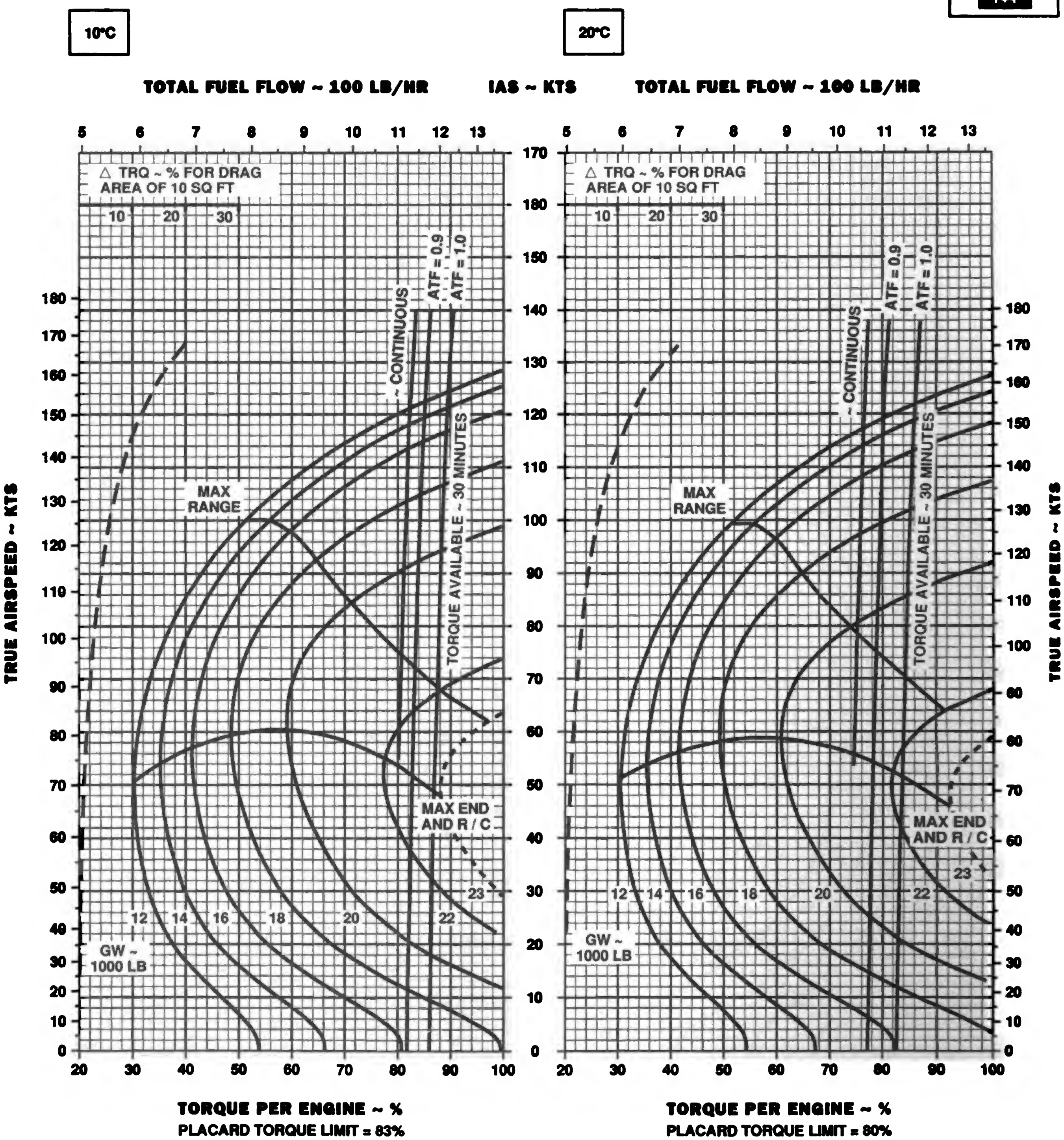
AA1014_3

Figure 7.1-14.1. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 3 of 5)

CRUISE

PRESS ALT: 10000 FT

CRUISE
10000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

AA1014_4

Figure 7.1-14.1. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 4 of 5)

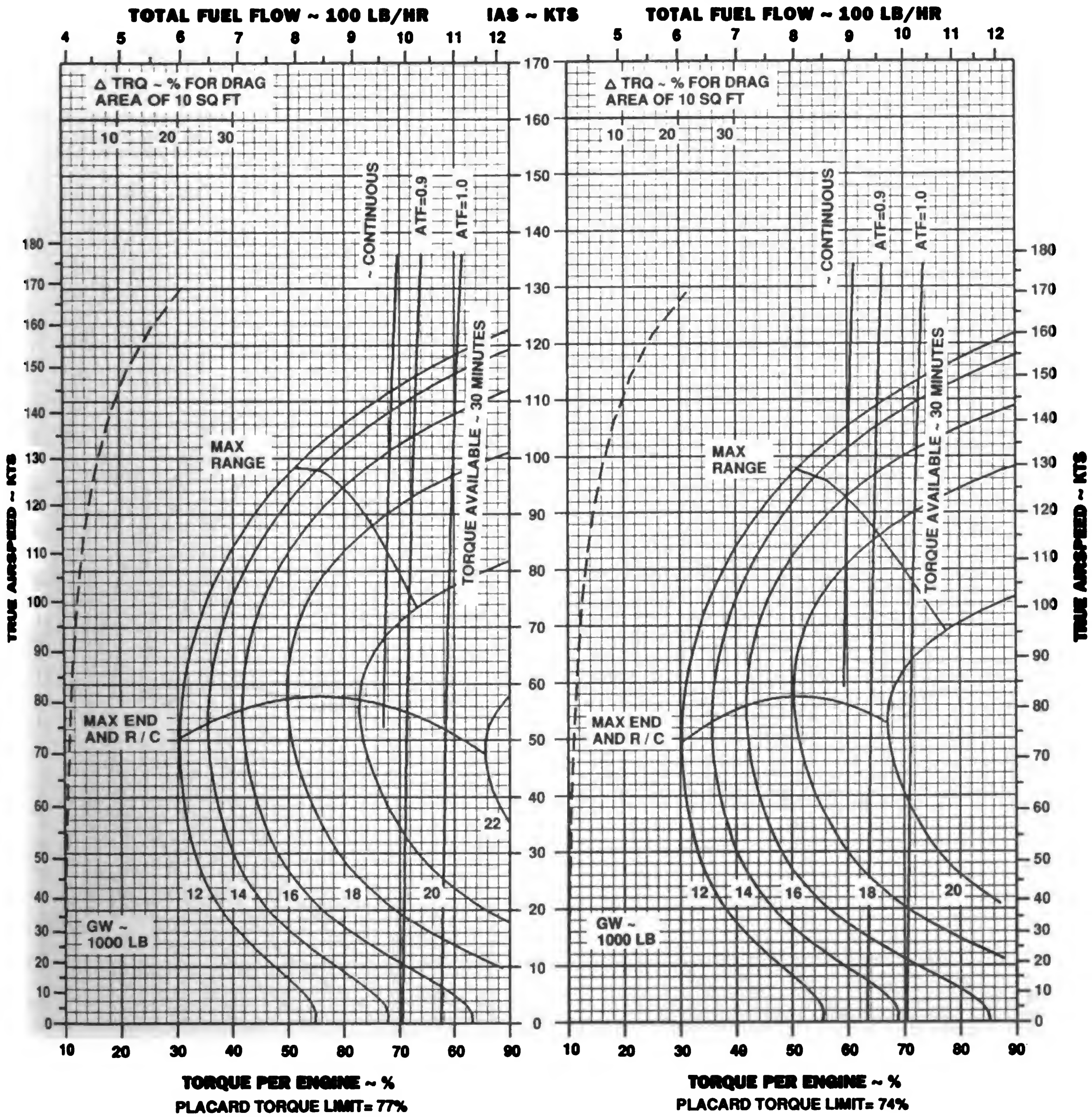
CRUISE

CRUISE
10000 FT
T701C (2)

PRESS ALT: 10000 FT

30 °C

40 °C



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

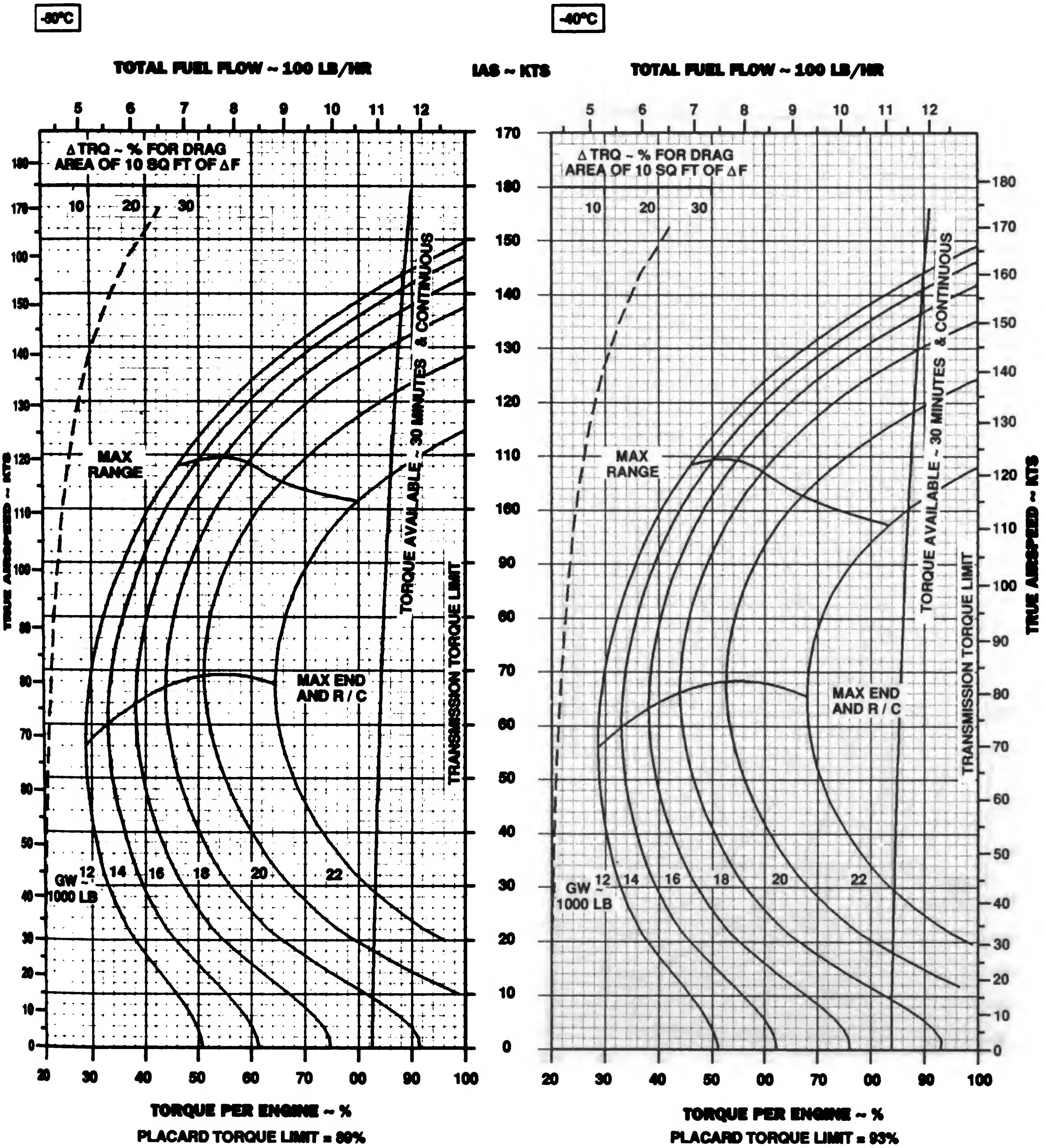
UH60A_167598_5 (R1C13)

Figure 7.1-14.1. Cruise High Drag - Pressure Altitude 10,000 Feet (Sheet 5 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 12,000 FT

CRUISE
12,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

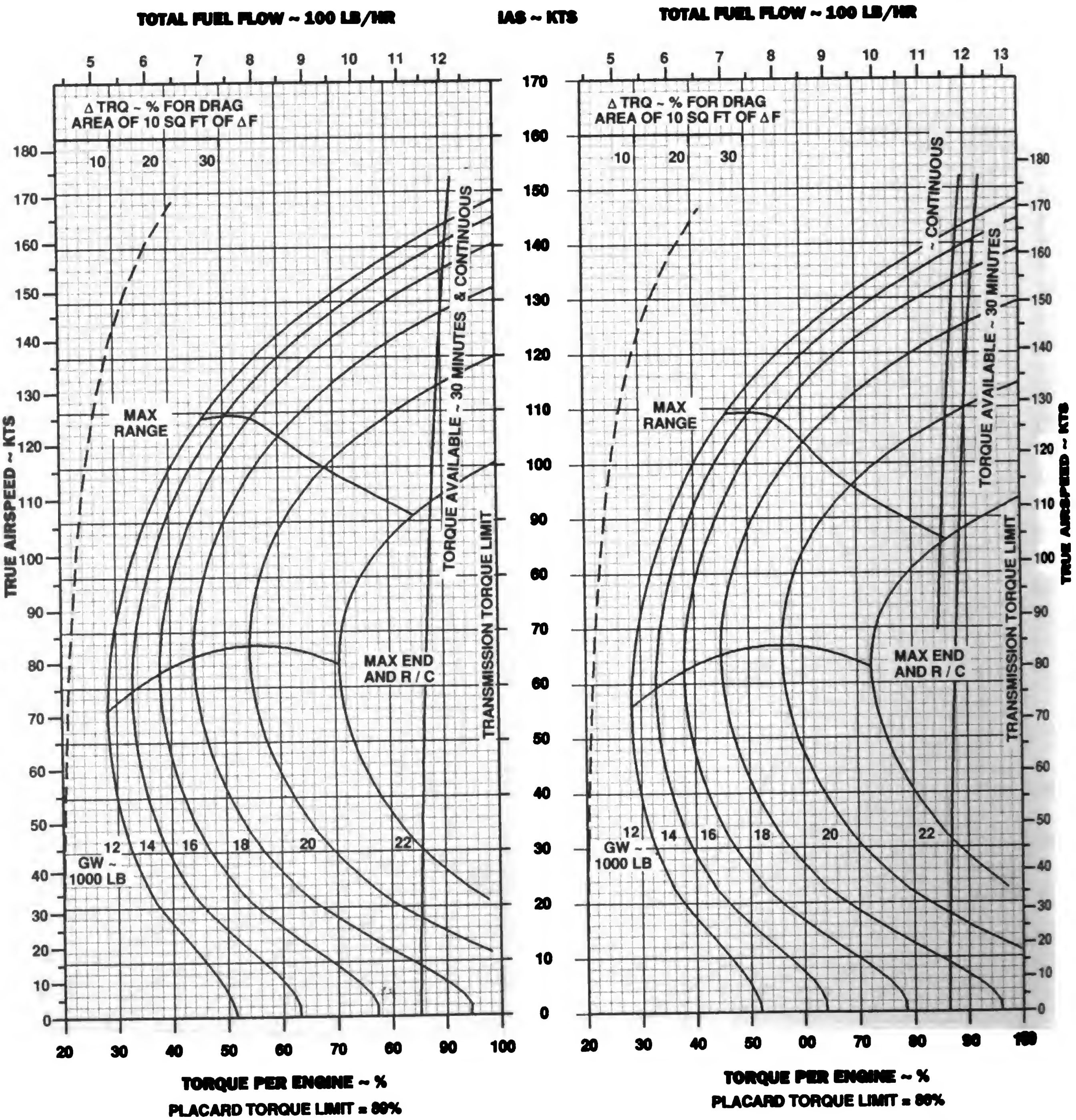
UH60A-156472.1 (C7)

Figure 7.1-15. Cruise - Pressure Altitude 12,000 Feet (Sheet 1 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 12,000 FT

CRUISE 12,000 FT T701C (2)



DATA BASE: FLIGHT TEST

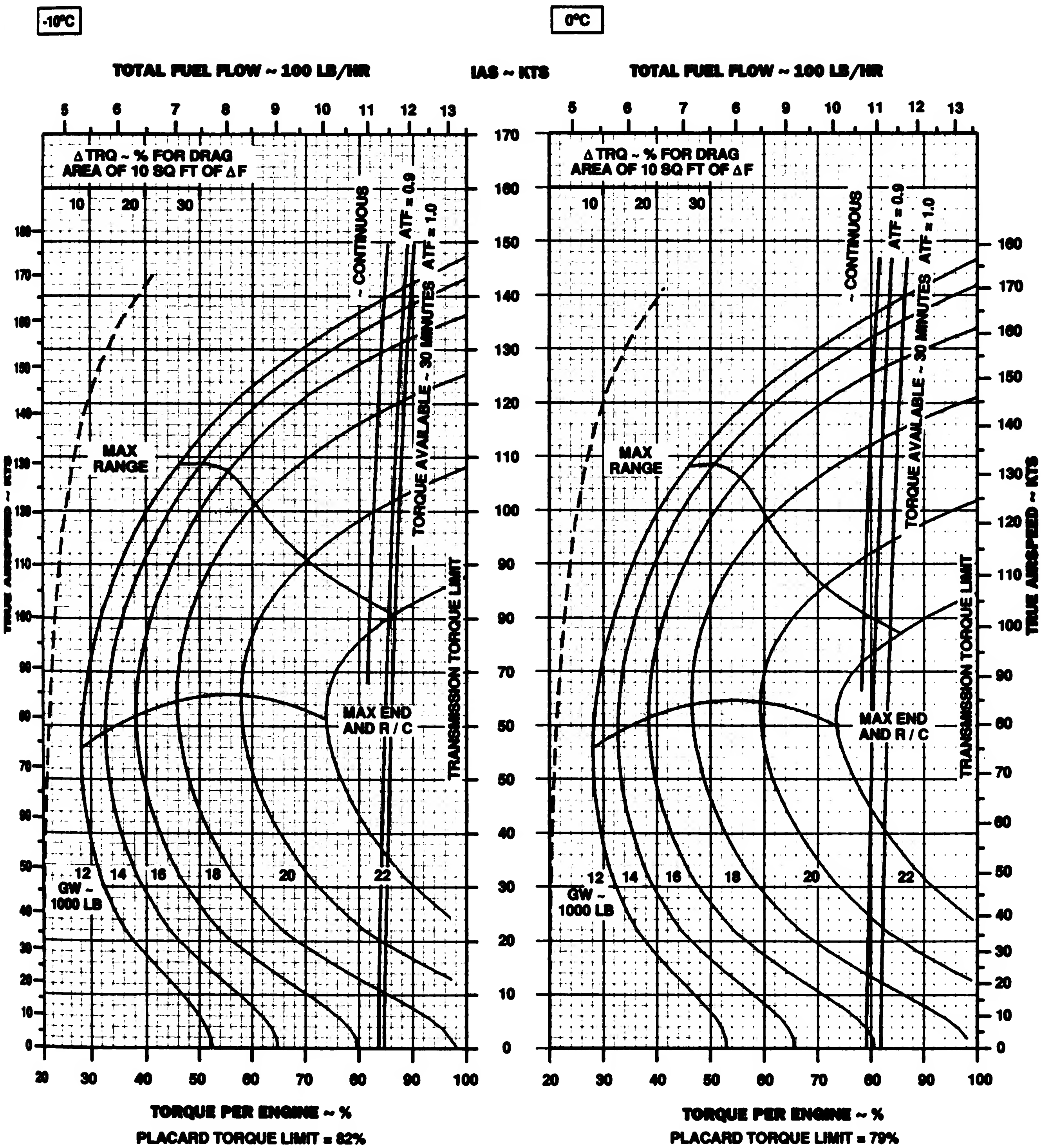
UH60A-156472.2 (C7)

Figure 7.1-15. Cruise - Pressure Altitude 12,000 Feet (Sheet 2 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 12,000 FT

CRUISE
12,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

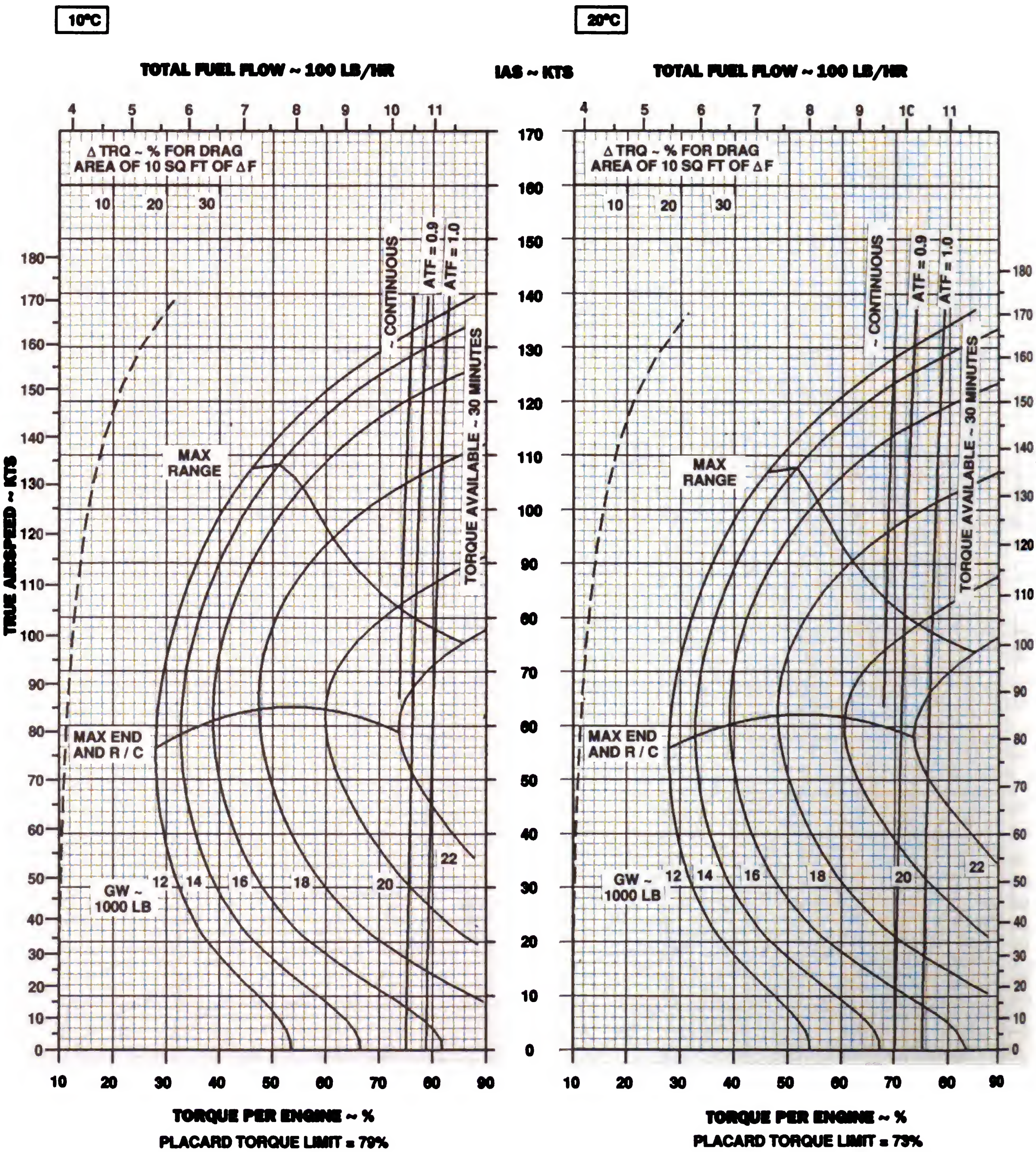
UH60A-156472.3 (C7)

Figure 7.1-15. Cruise - Pressure Altitude 12,000 Feet (Sheet 3 of 5)

CRUISE

CRUISE
12,000 FT
T701C (2)

CLEAN CONFIGURATION
PRESS ALT: 12,000 FT



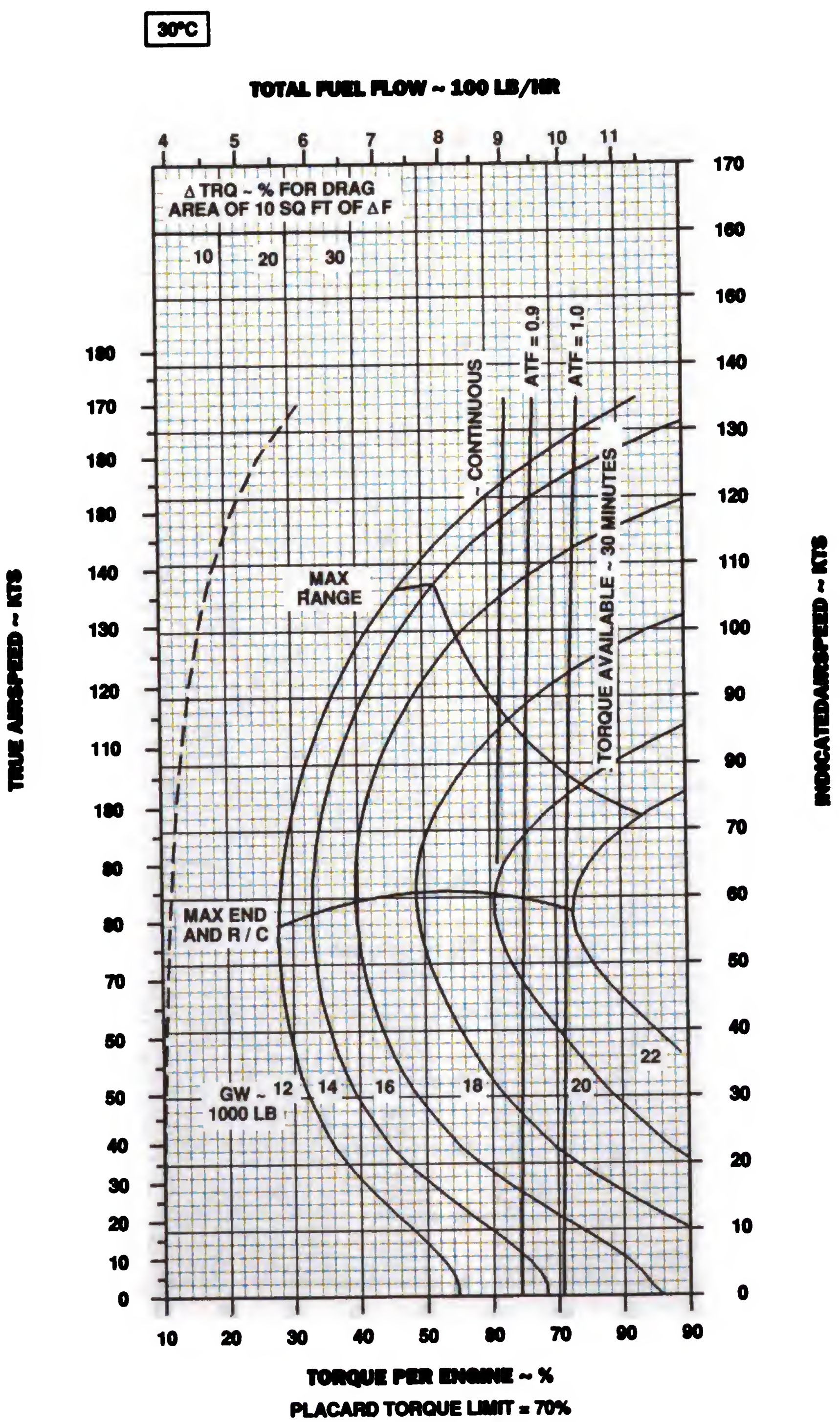
DATA BASE: FLIGHT TEST

UH60A-186472.4 (C7)

Figure 7.1-15. Cruise - Pressure Altitude 12,000 Feet (Sheet 4 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 12,000 FT

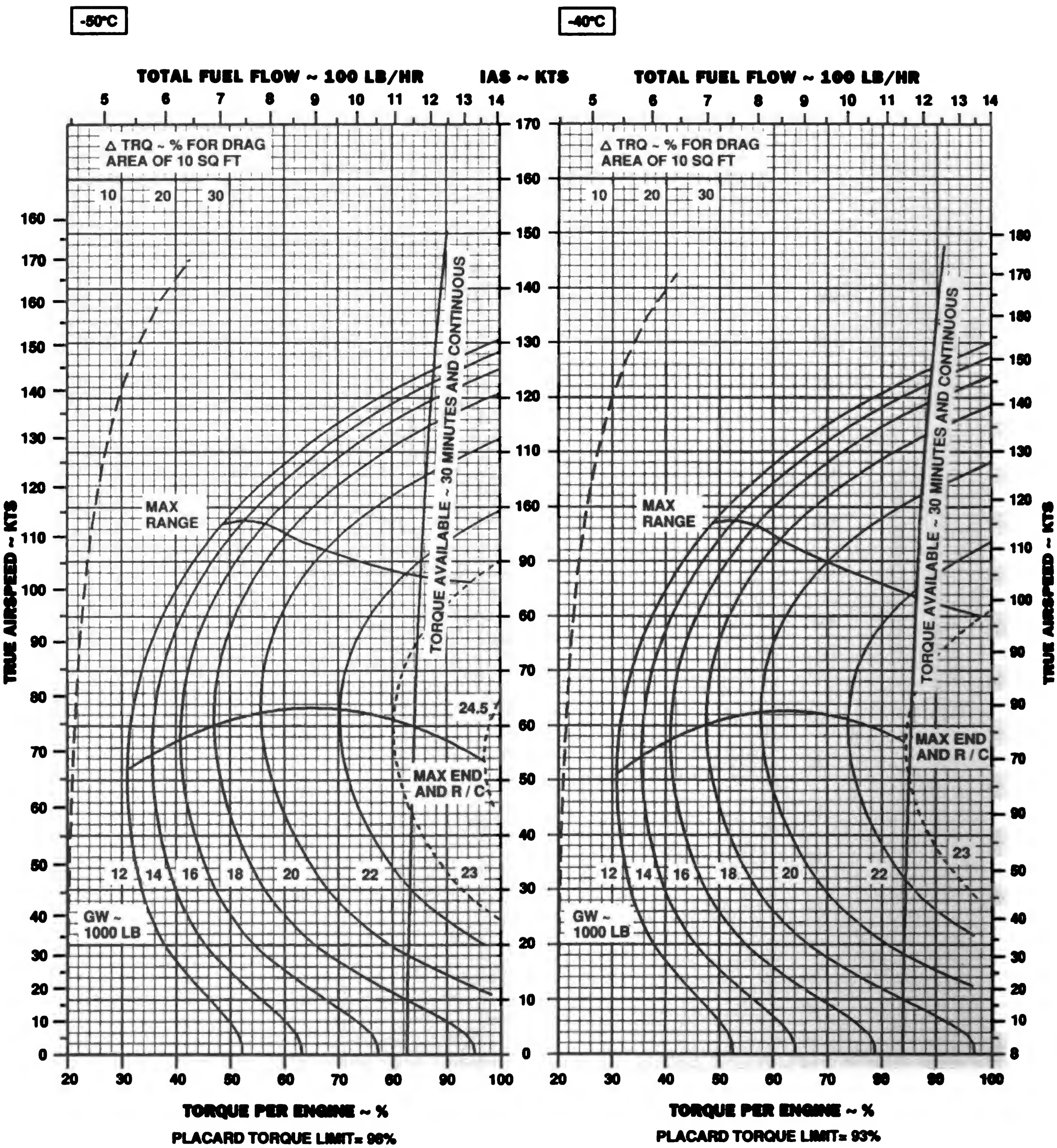


DATA BASE: FLIGHT TEST

Figure 7.1-15. Cruise - Pressure Altitude 12,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 12000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

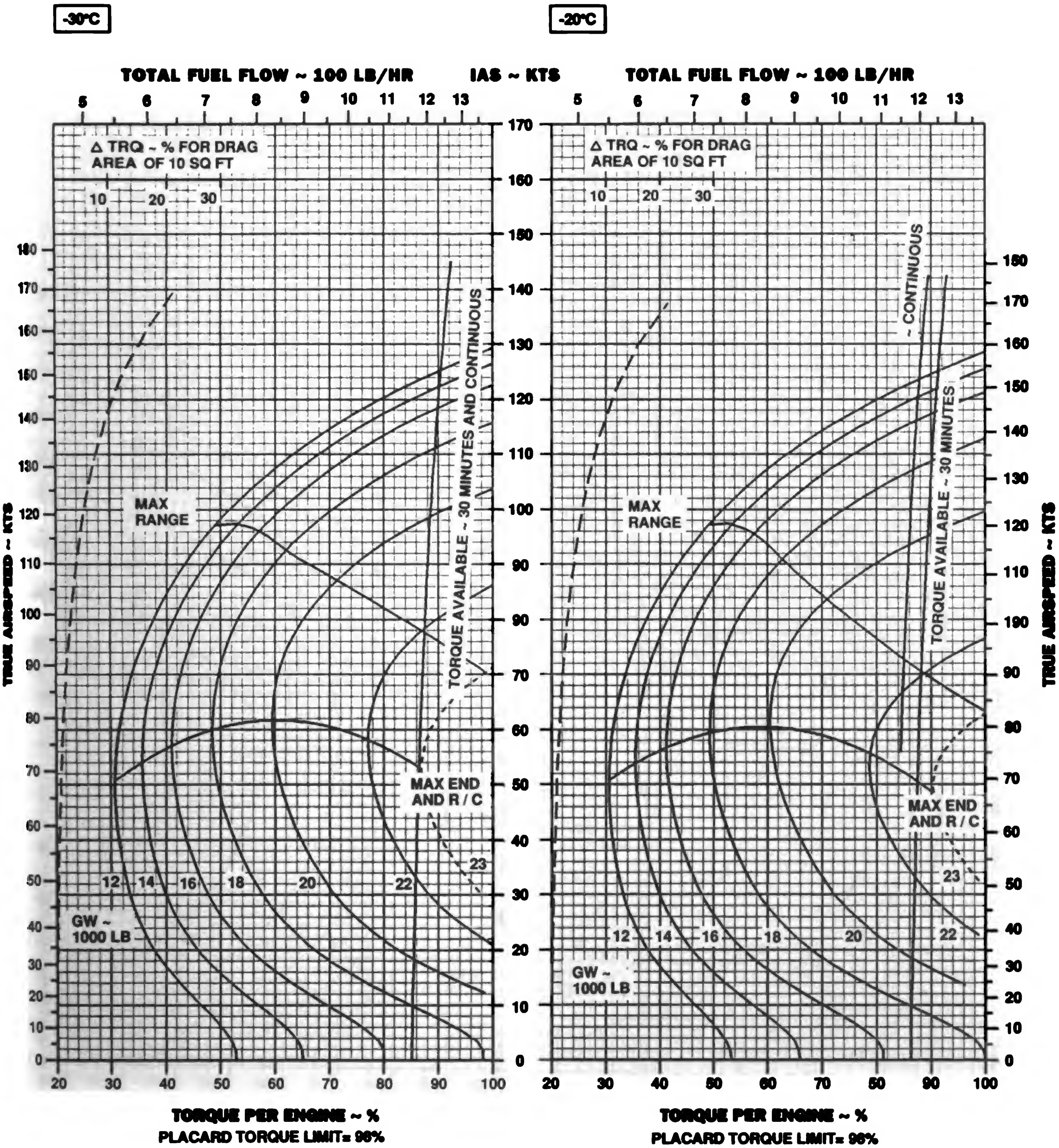
UH60A_167580_1 (R1C13)

Figure 7.1-15.1. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 1 of 5)

CRUISE

CRUISE
12000 FT
T701C (2)

PRESS ALT: 12000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

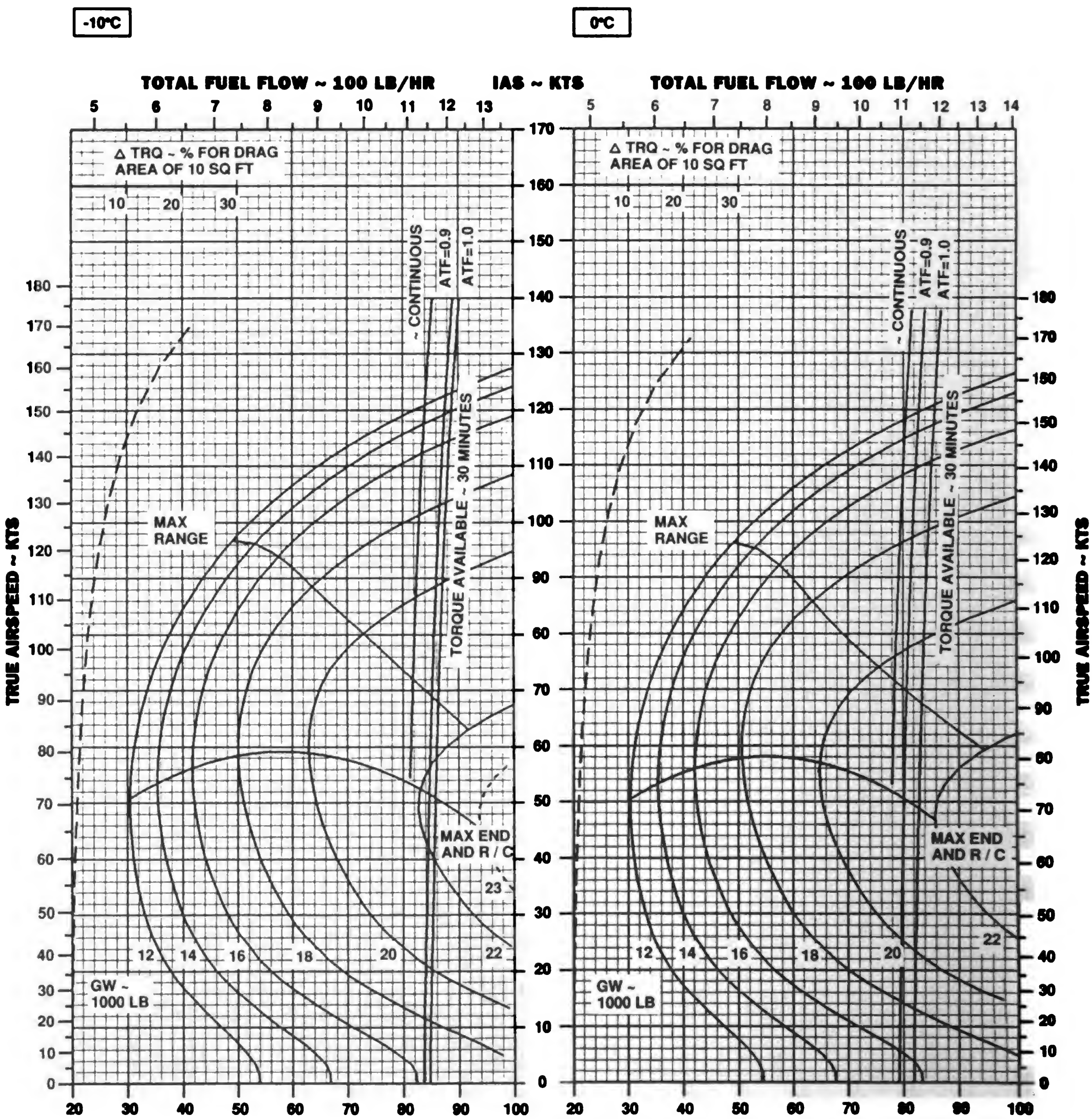
UH60A_167599_2 (R1C13)

Figure 7.1-15.1. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 2 of 5)

CRUISE

PRESS ALT: 12000 FT

CRUISE
12000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

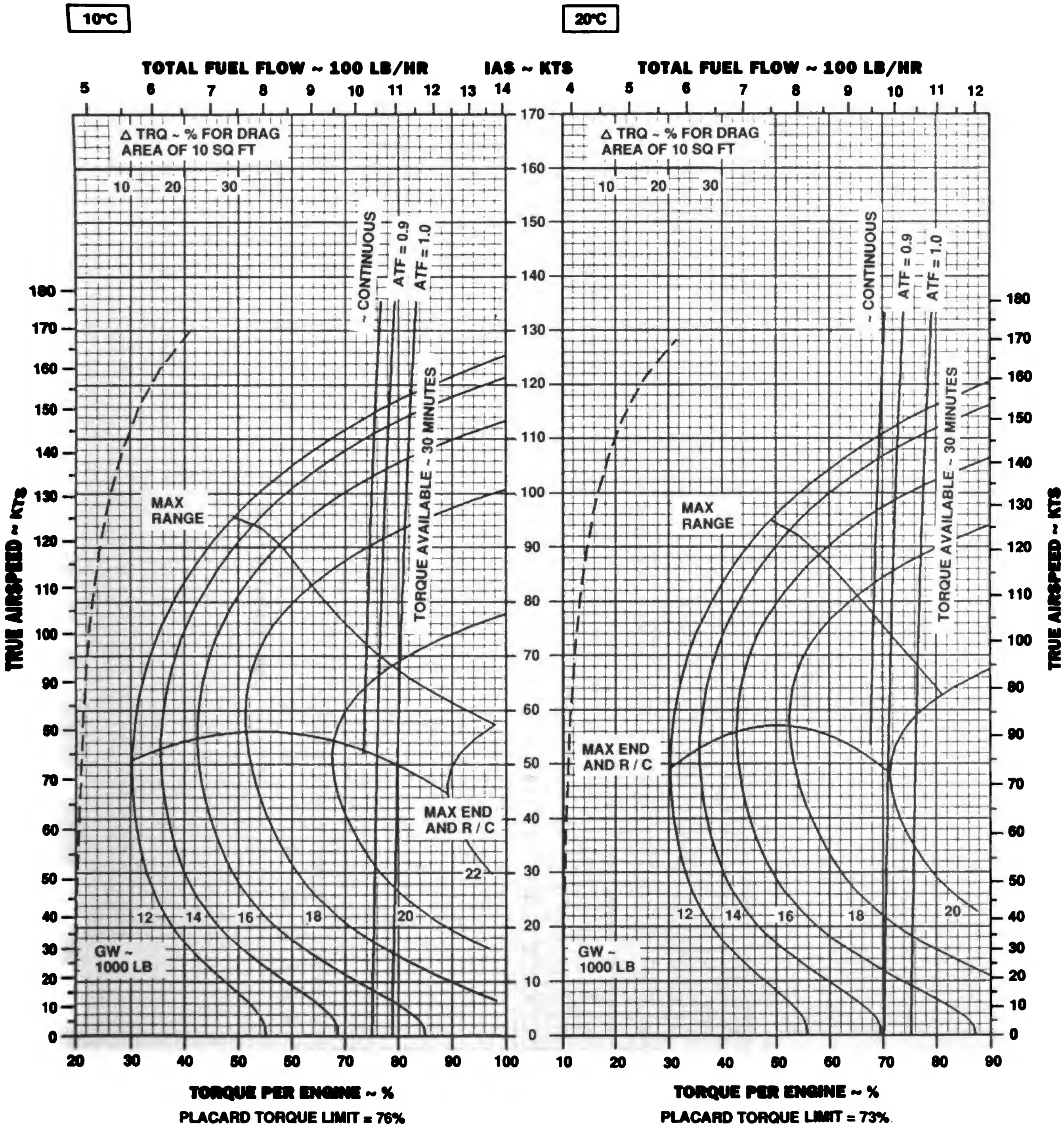
UH60A_167599_3 (R1C13)

Figure 7.1-15.1. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 3 of 5)

CRUISE

PRESS ALT: 12000 FT

CRUISE
12000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

UH60A_167599_4 (R1C13)

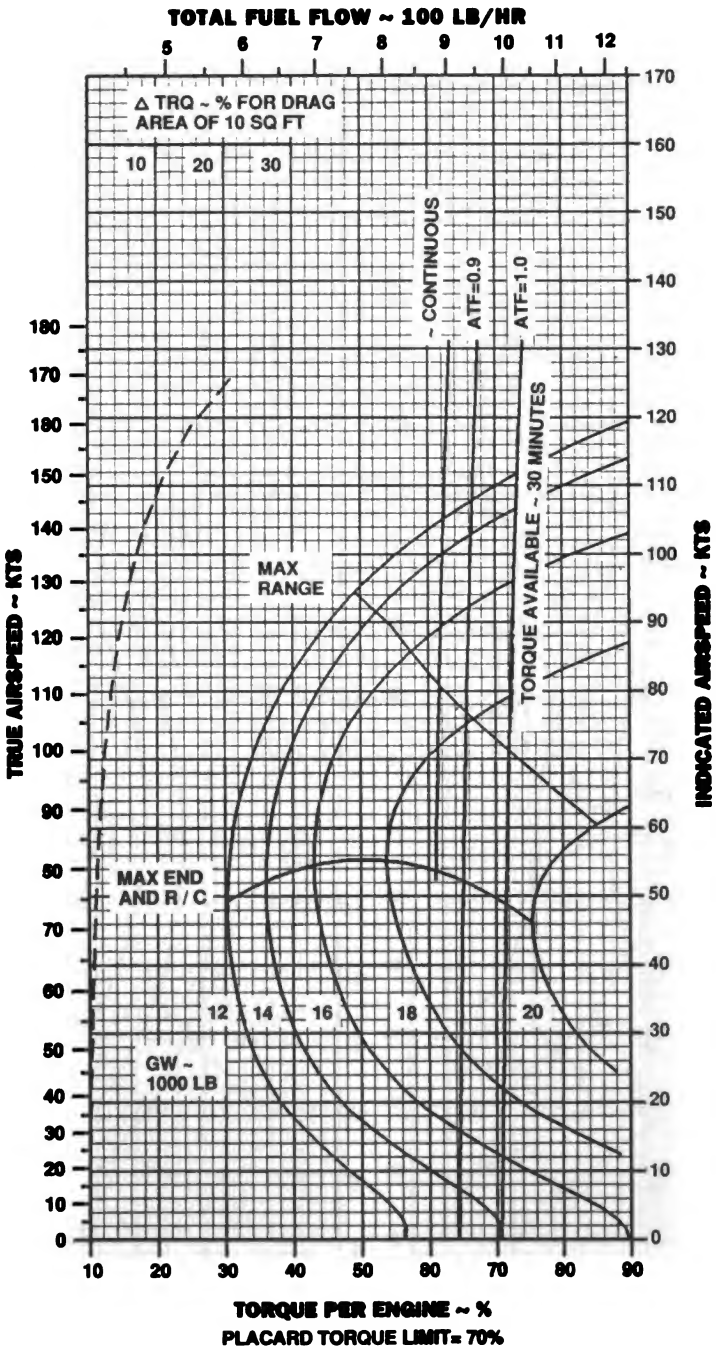
Figure 7.1-15.1. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 4 of 5)

CRUISE

CRUISE
12000 FT
T701C (2)

PRESS ALT: 12000 FT

30°C



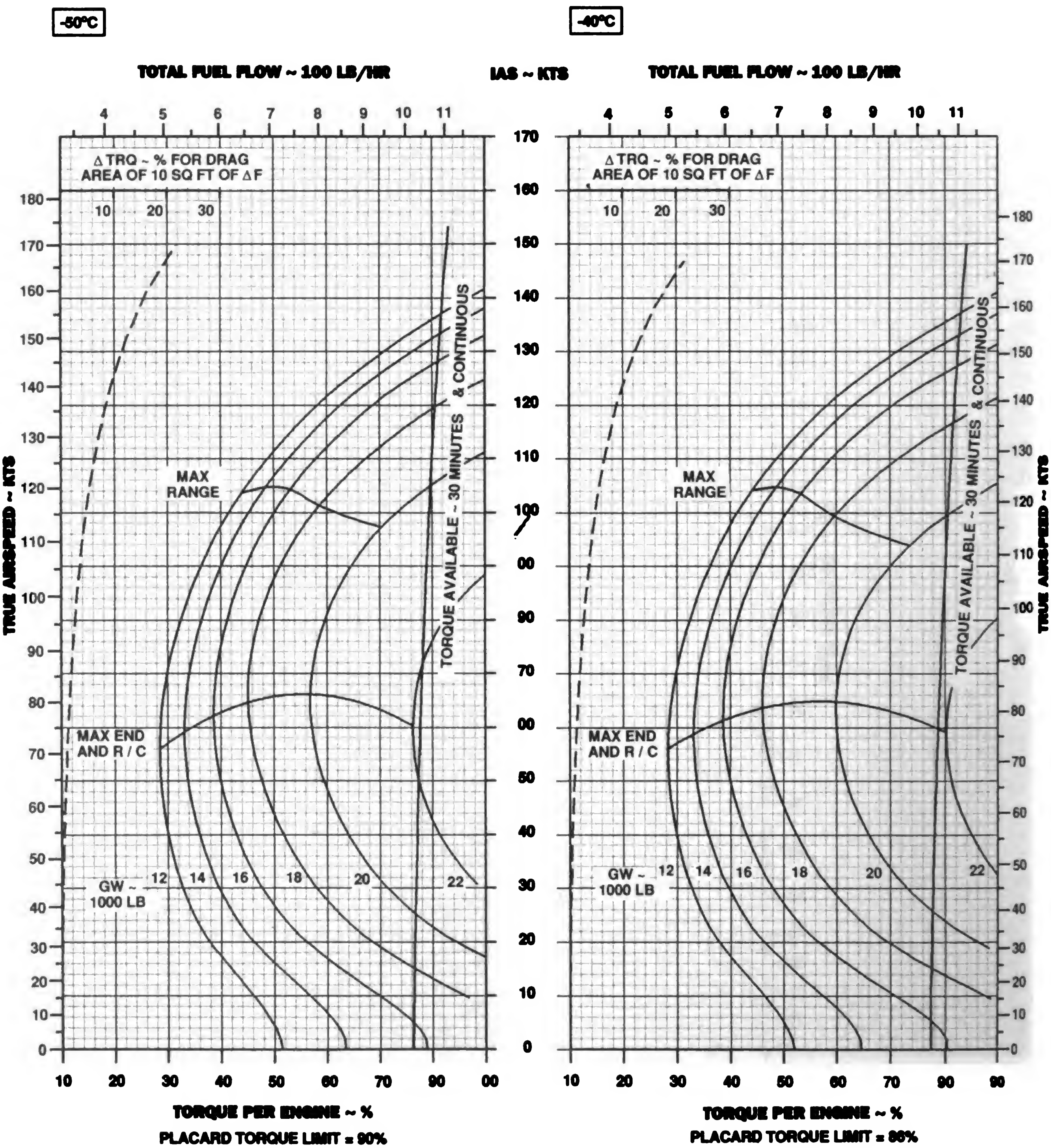
NOTE: SHORT DASH LINES: FERRY MISSION ONLY
DATA BASE: FLIGHT TEST

UH60A_167599_5 (R1C13)

Figure 7.1-15.1. Cruise High Drag - Pressure Altitude 12,000 Feet (Sheet 5 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 14,000 FT



DATA BASE: FLIGHT TEST

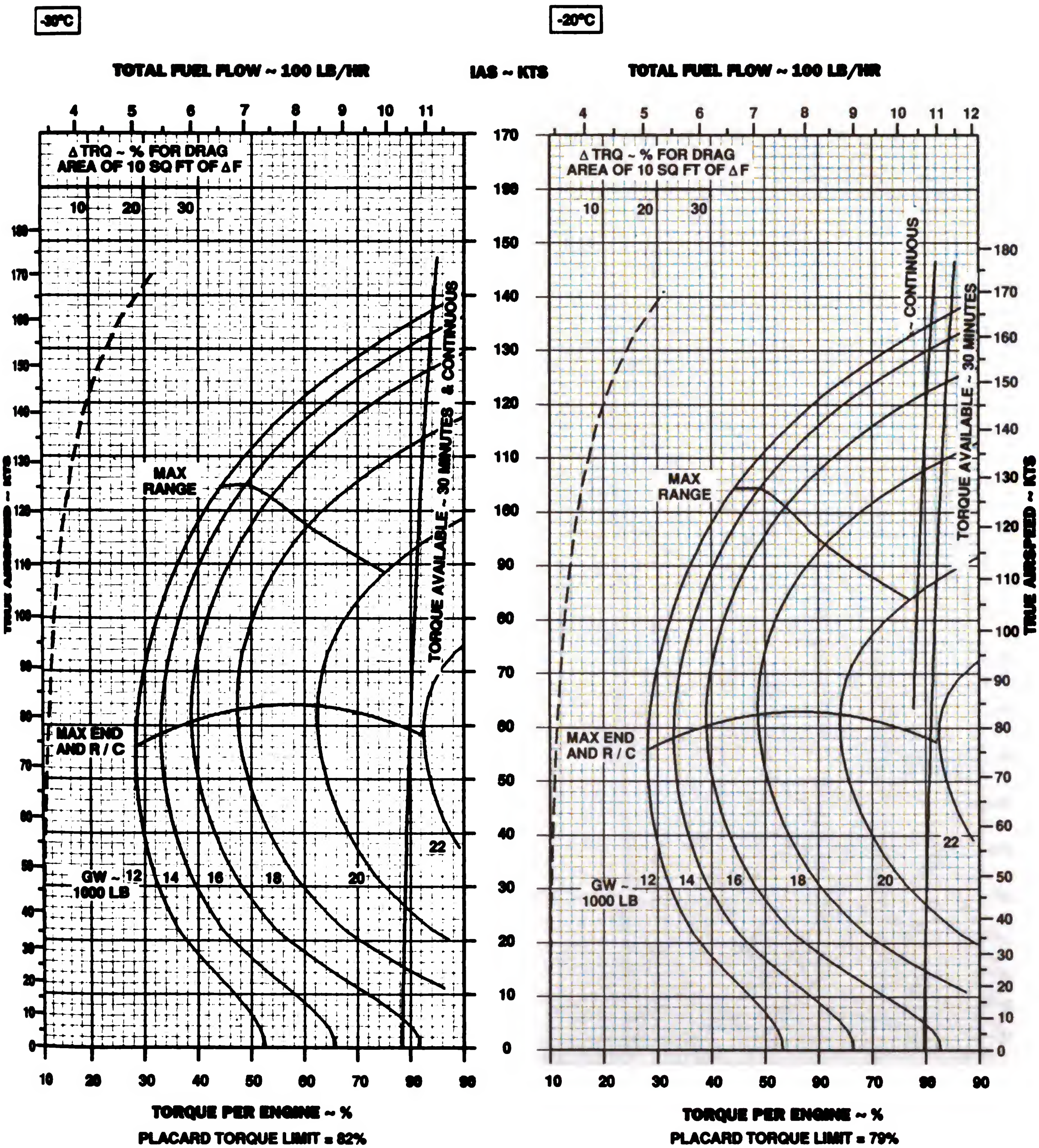
UH60A-156473.1 (C7)

Figure 7.1-16. Cruise - Pressure Altitude 14,000 Feet (Sheet 1 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 14,000 FT

CRUISE
14,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

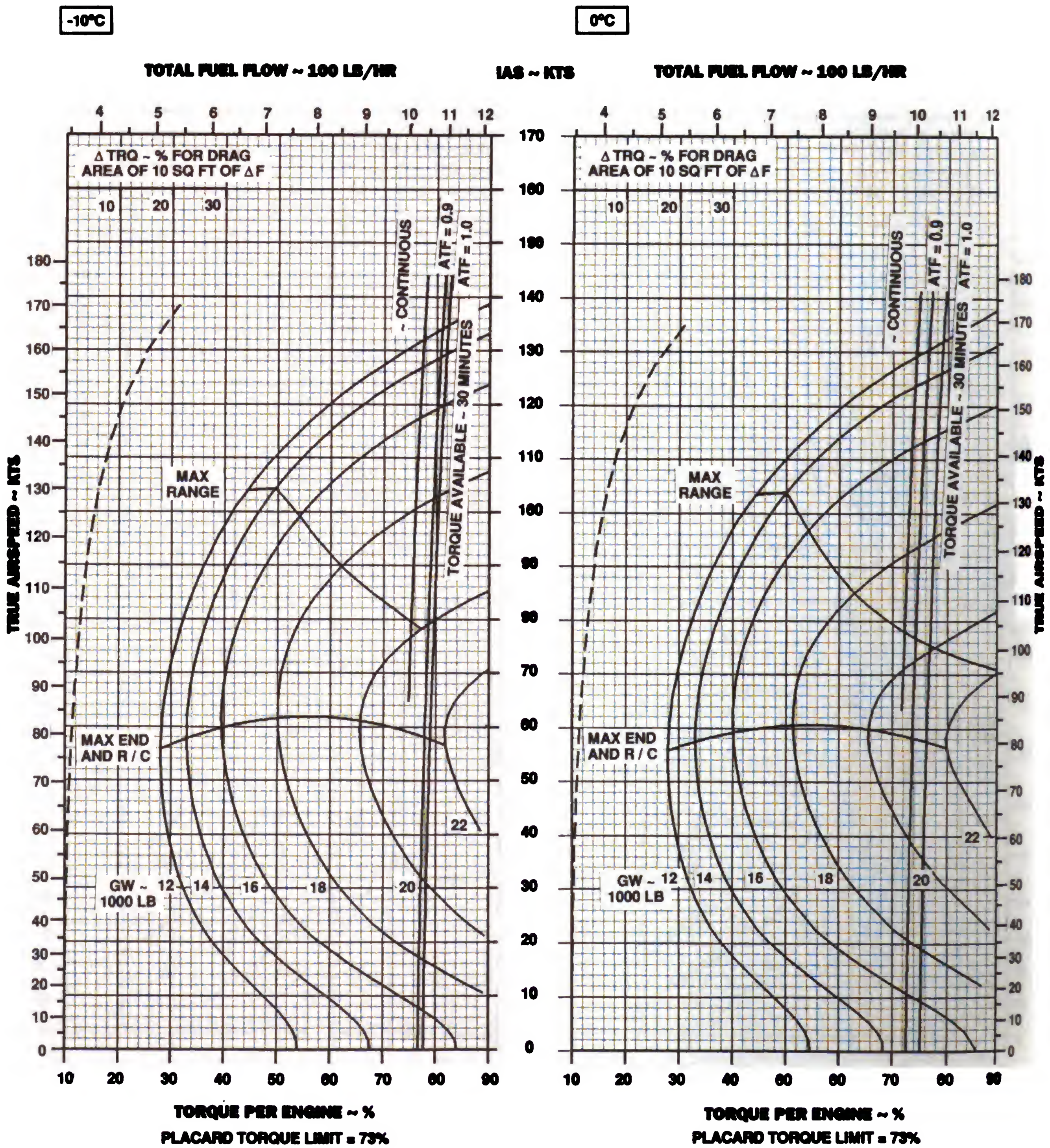
UH60A-158473.2 (C7)

Figure 7.1-16. Cruise - Pressure Altitude 14,000 Feet (Sheet 2 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 14,000 FT

CRUISE
14,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

UH60A-159473.3 (C7)

Figure 7.1-16. Cruise - Pressure Altitude 14,000 Feet (Sheet 3 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 14,000 FT

CRUISE
14,000 FT
T701C (2)

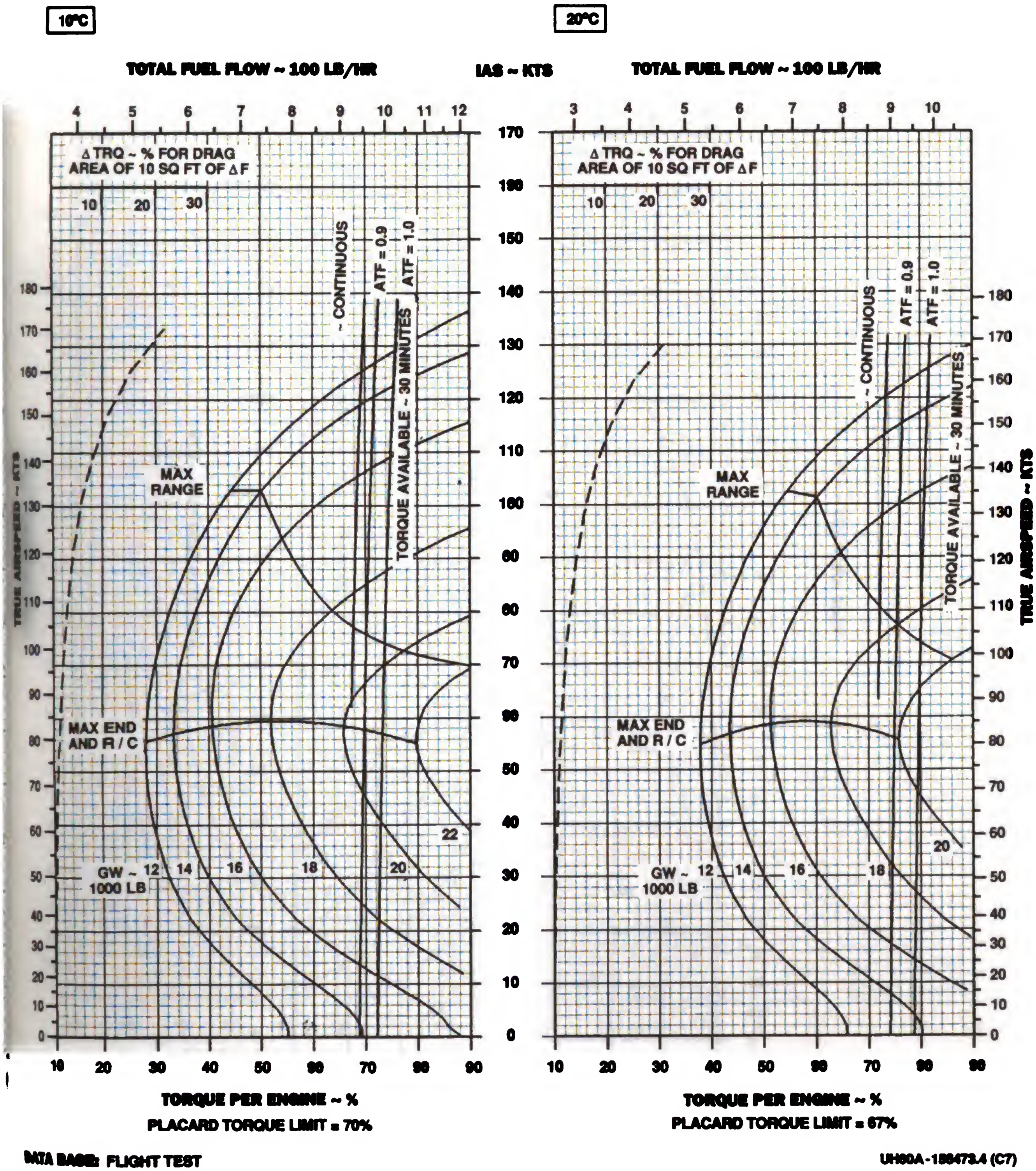
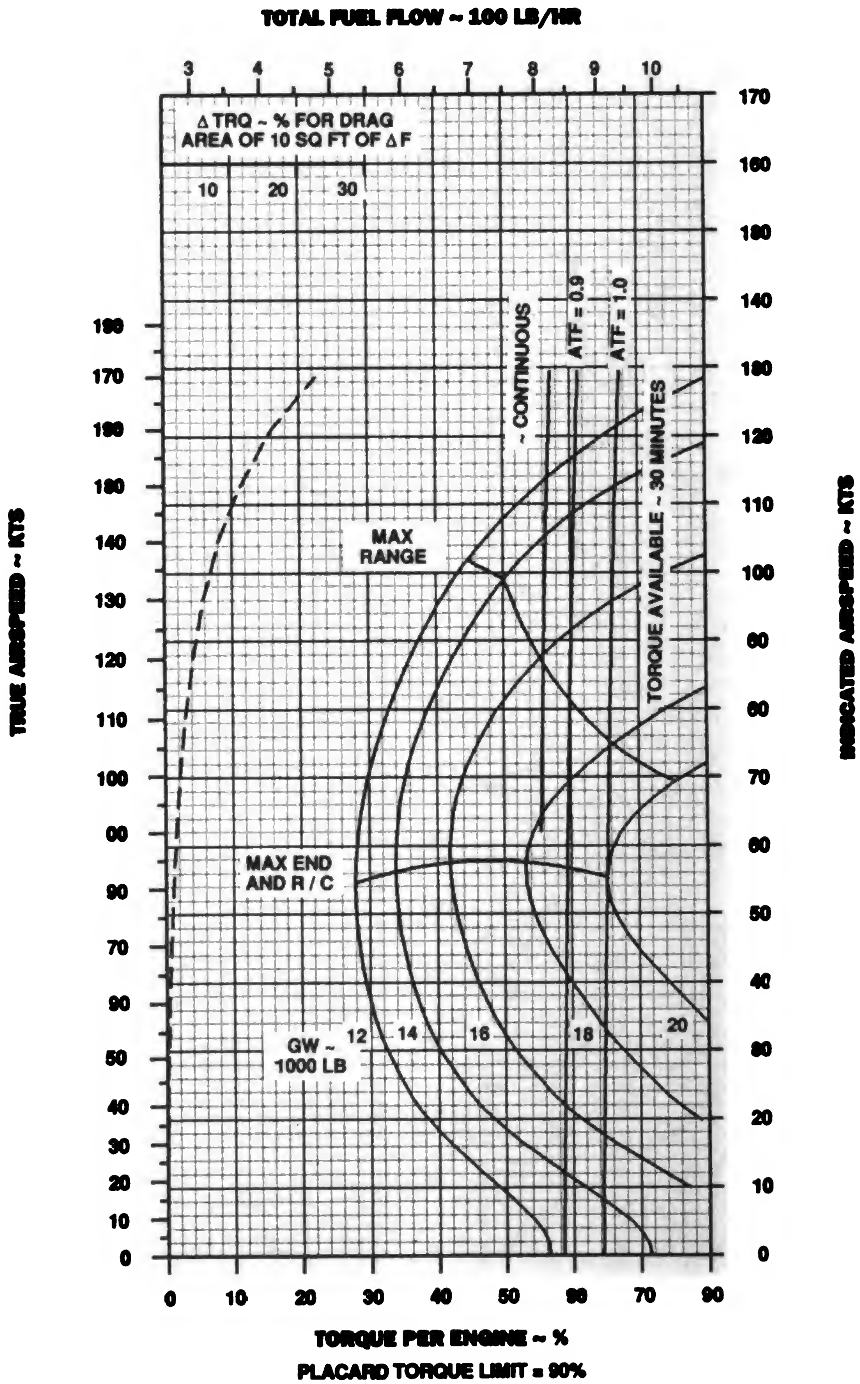


Figure 7.1-16. Cruise - Pressure Altitude 14,000 Feet (Sheet 4 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 14,000 FT

30°C



DATA BASE: FLIGHT TEST

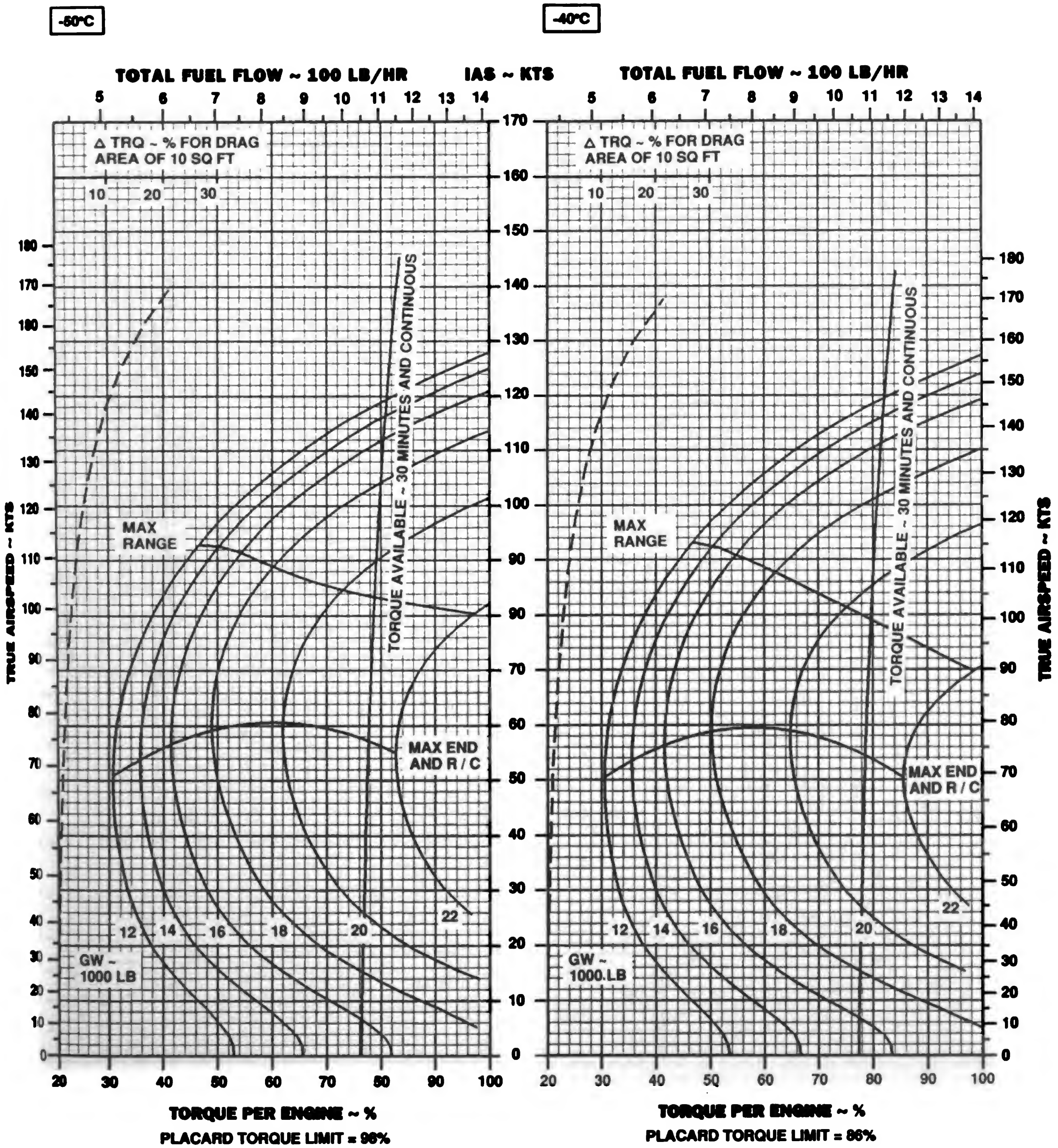
UH60A-180473.5 (C7)

Figure 7.1-16. Cruise - Pressure Altitude 14,000 Feet (Sheet 5 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

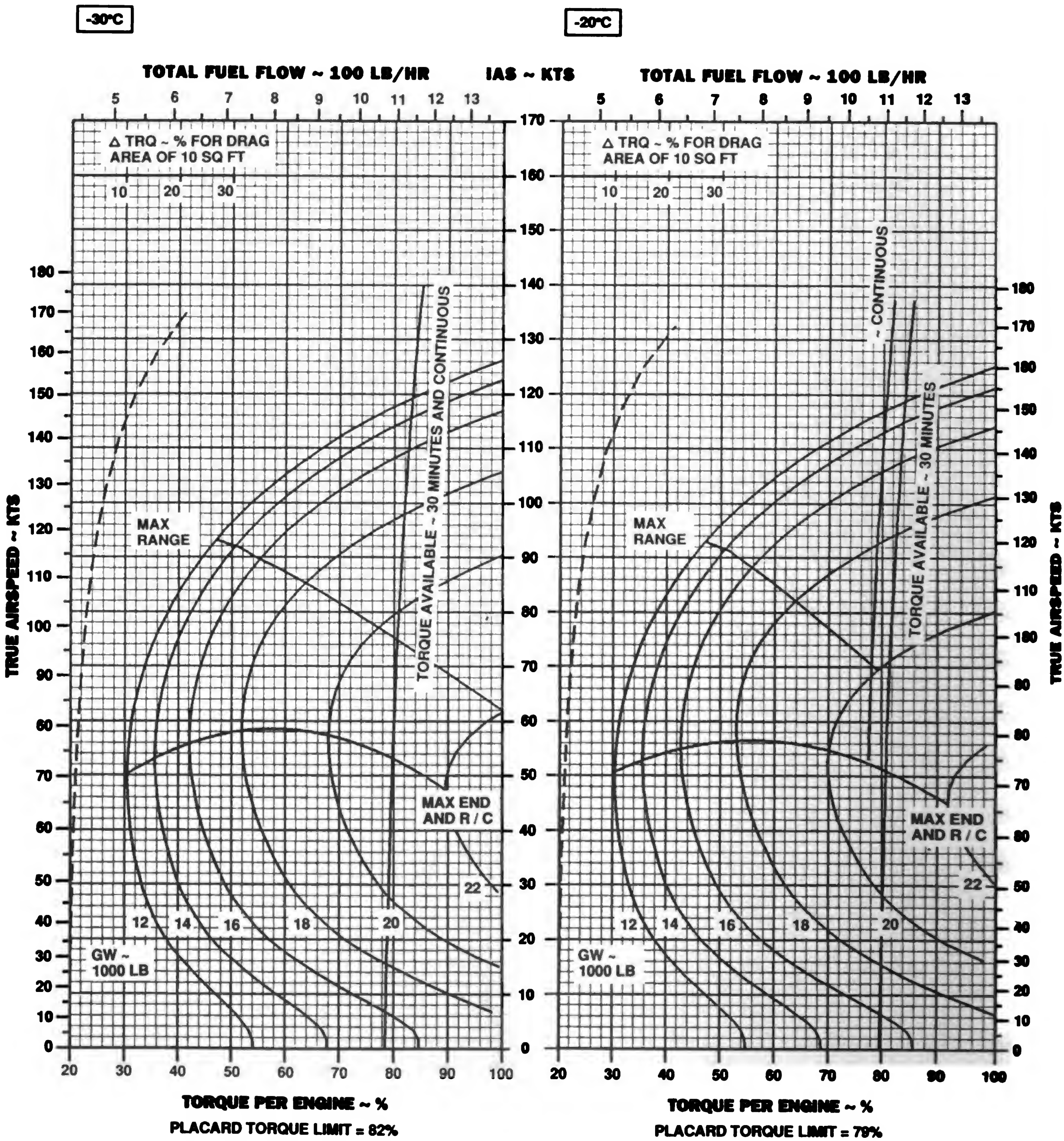
UH60A_167600_1 (R1C13)

Figure 7.1-16.1. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 1 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

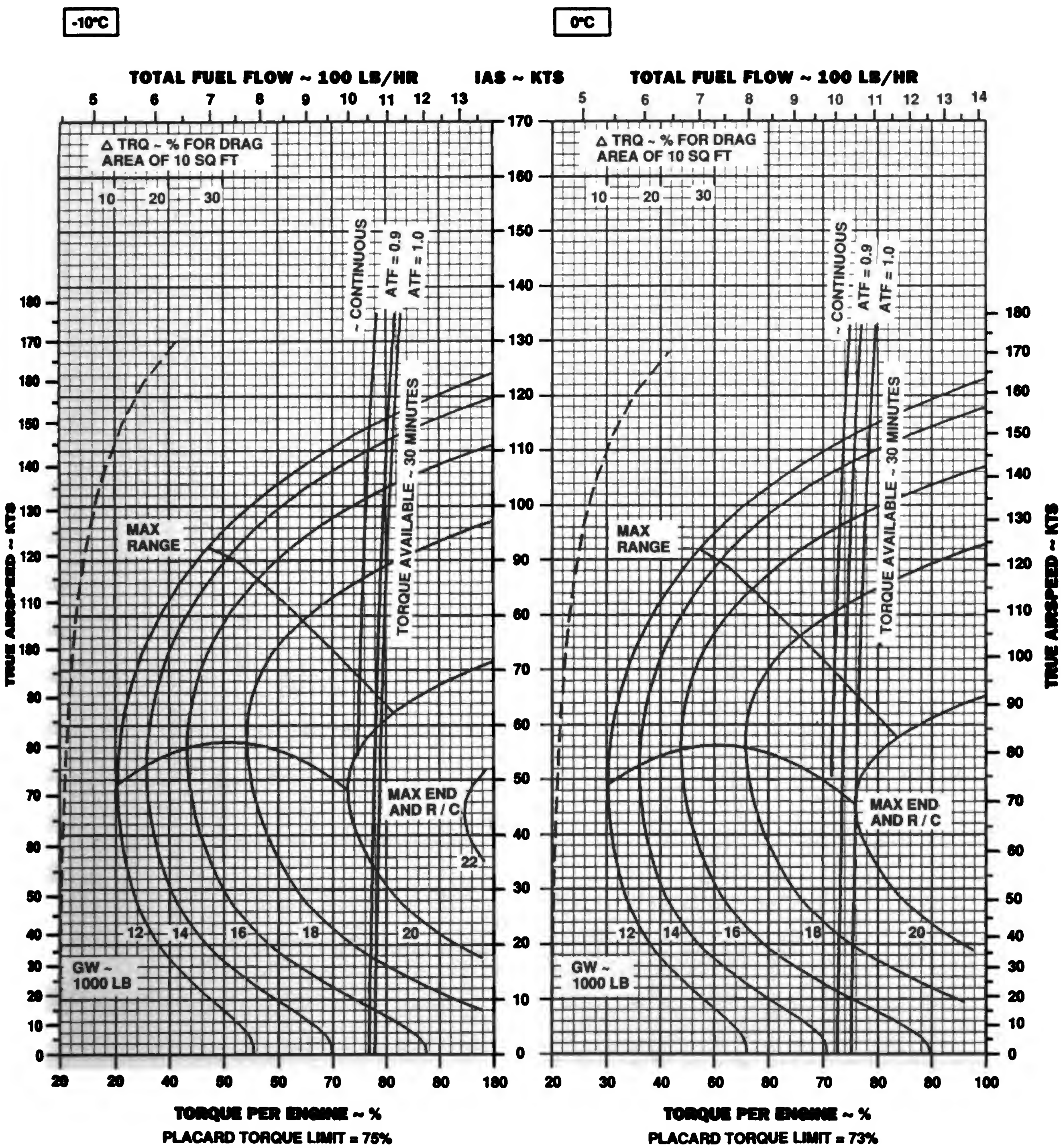
UH60A_167600_2 (R1C13)

Figure 7.1-16.1. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 2 of 5)

CRUISE

PRESS ALT: 14000 FT

CRUISE
14000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

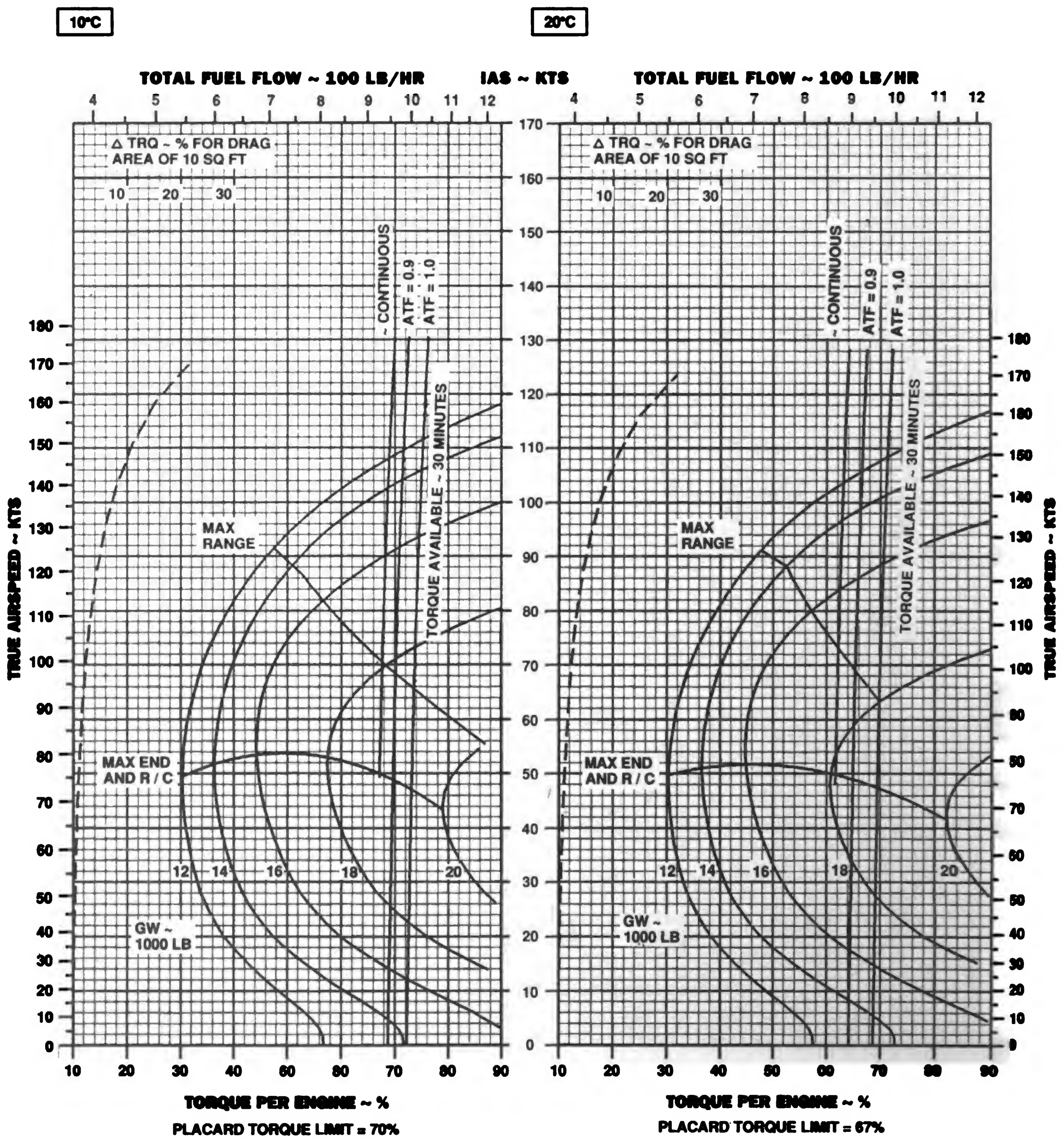
UH60A_167800_3 (R1C13)

Figure 7.1-16.1. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 3 of 5)

CRUISE

CRUISE
14000 FT
T701C (2)

PRESS ALT: 14000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

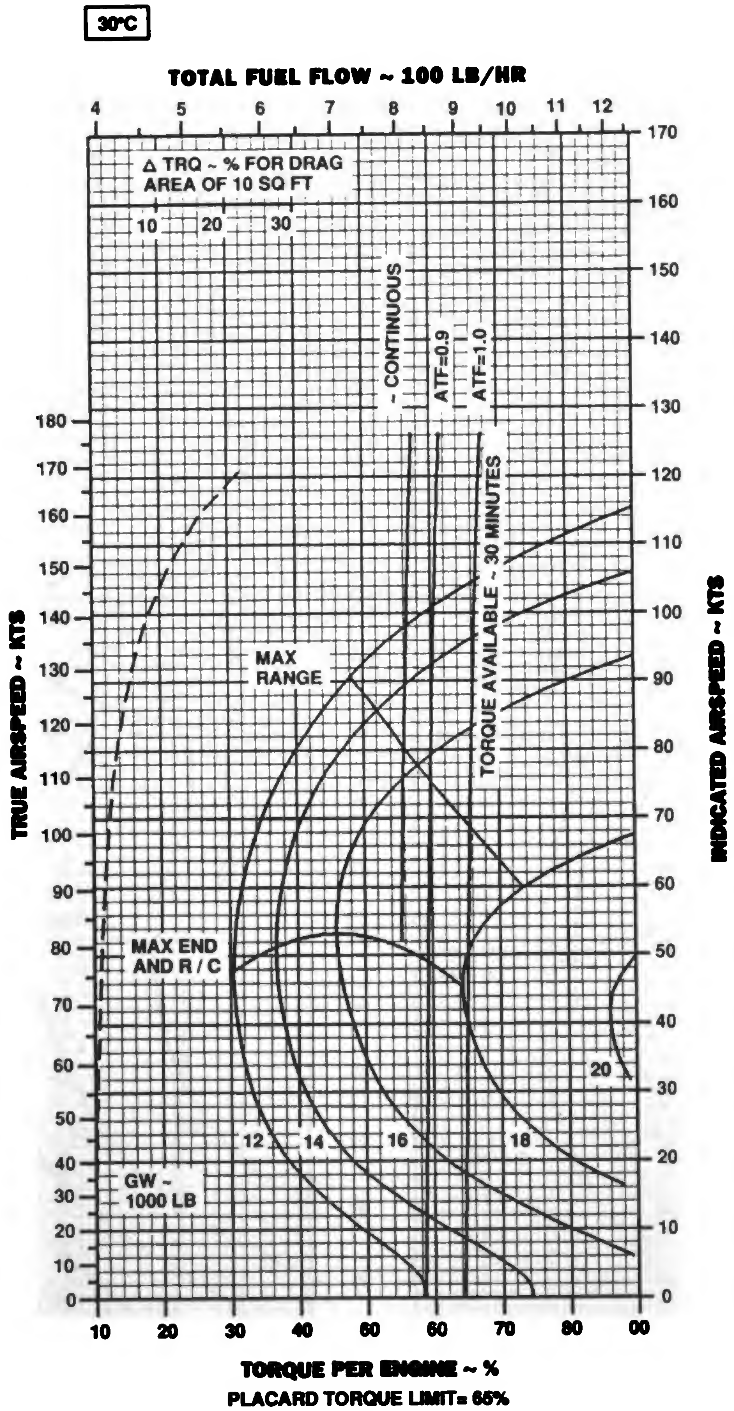
DATA BASE: FLIGHT TEST

UH60A_167600_4 (R1C13)

Figure 7.1-16.1. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 4 of 5)

CRUISE

PRESS ALT: 14000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

UH60A_167600_5 (R1C13)

Figure 7.1-16.1. Cruise High Drag - Pressure Altitude 14,000 Feet (Sheet 5 of 5)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16,000 FT

CRUISE
16,000 FT
T701C (2)

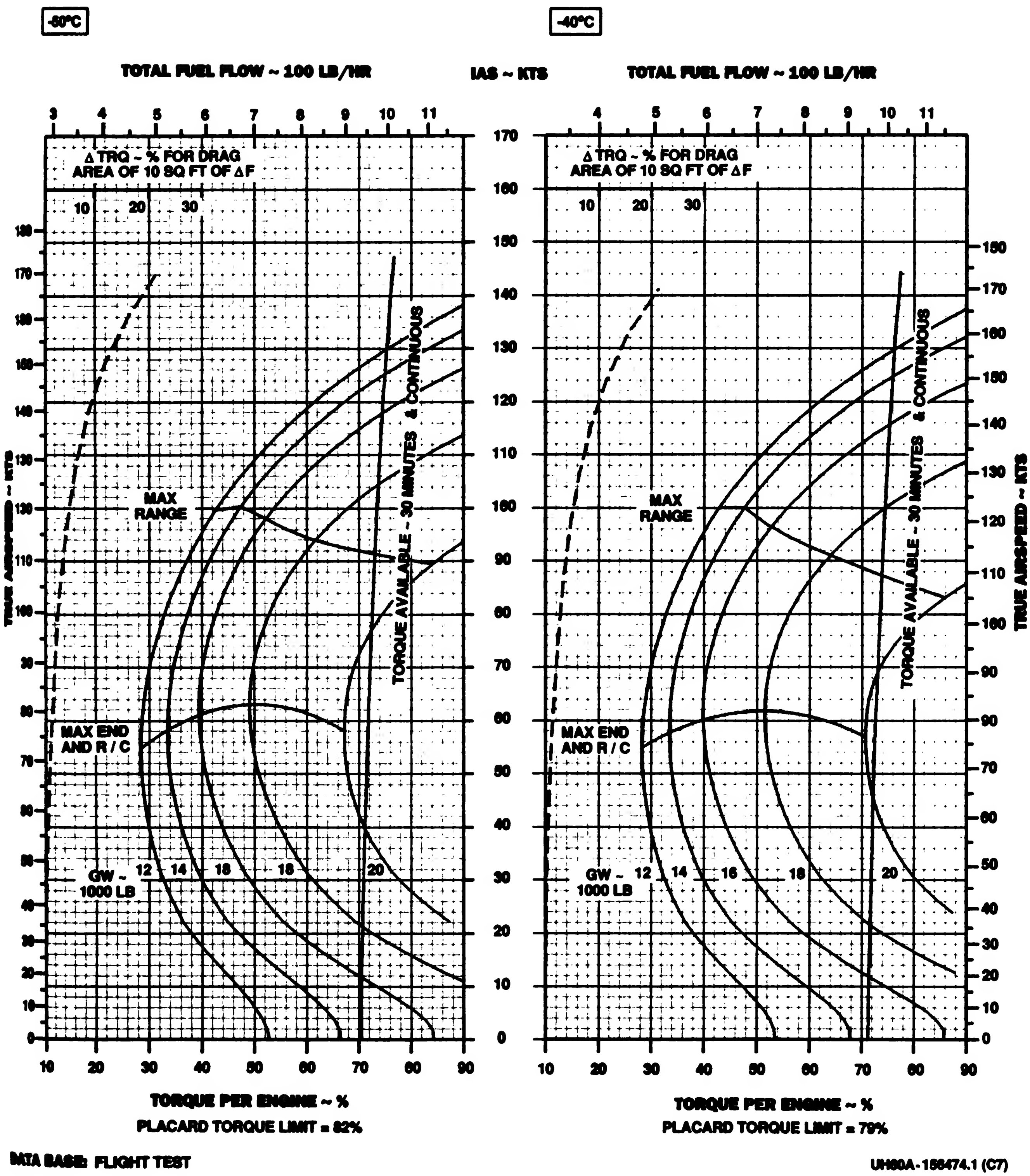
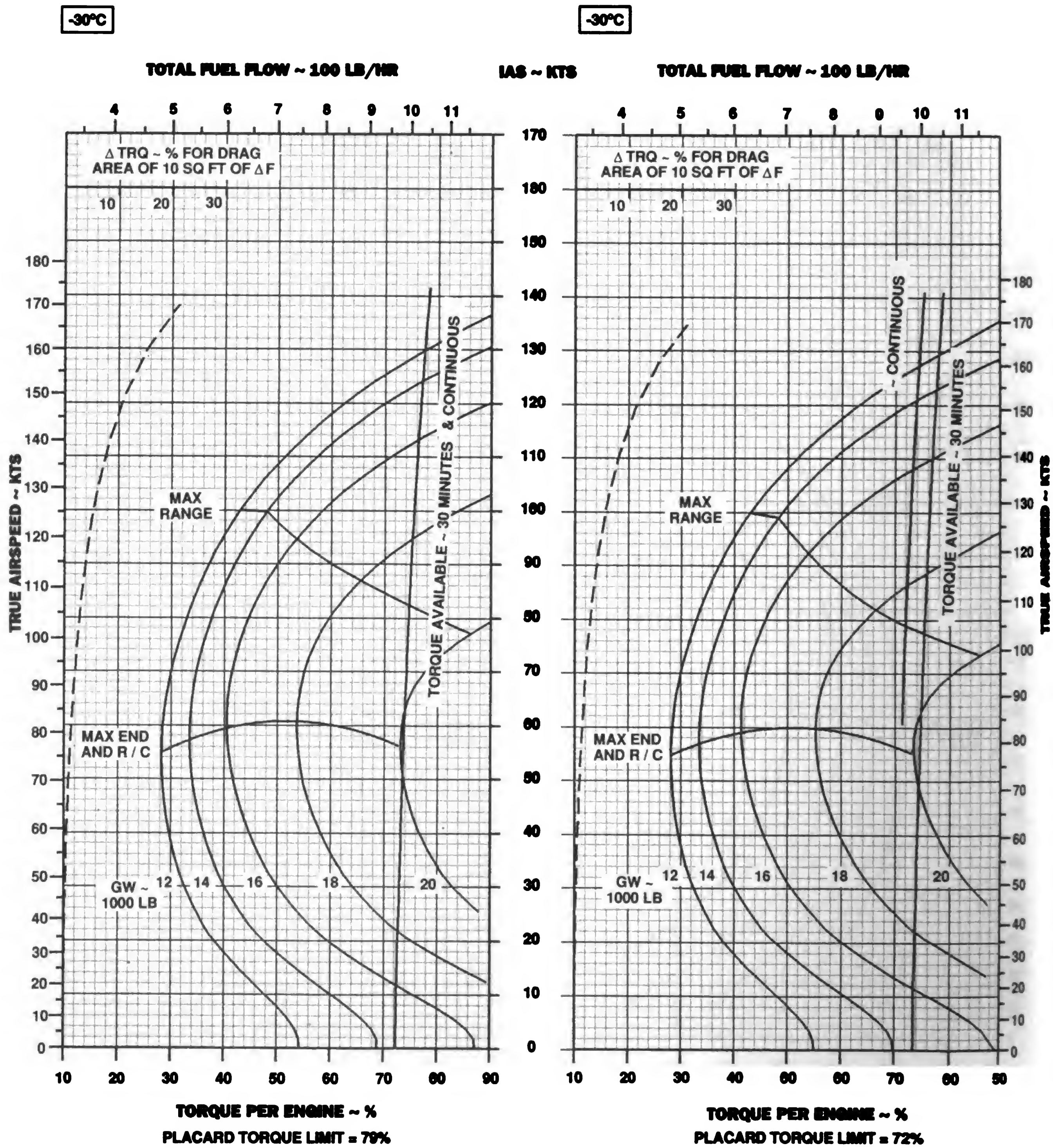


Figure 7.1-17. Cruise - Pressure Altitude 16,000 Feet (Sheet 1 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16,000 FT

CRUISE
16,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

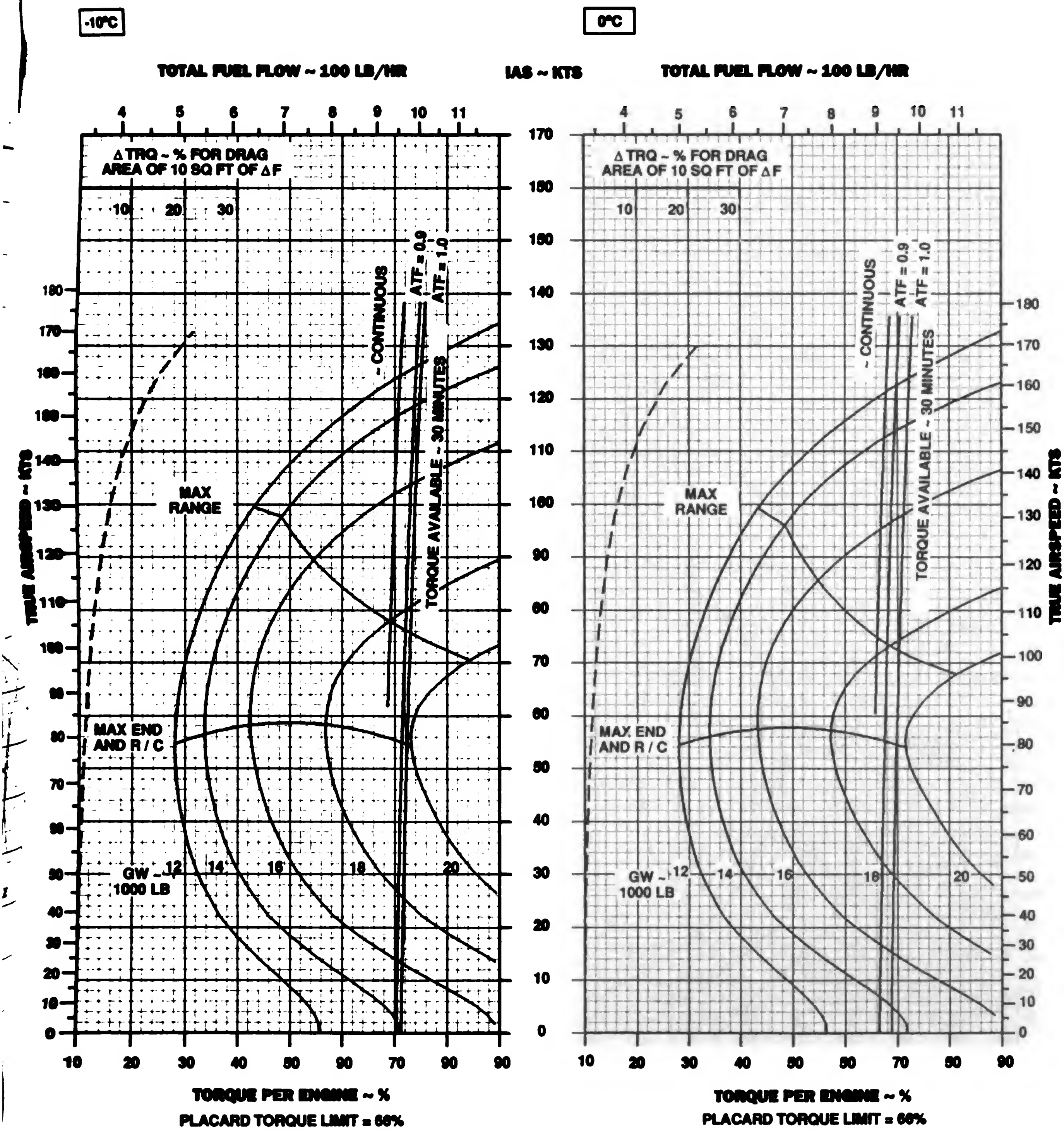
UH60A-158474.2 (C7)

Figure 7.1-17. Cruise - Pressure Altitude 16,000 Feet (Sheet 2 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16,000 FT

CRUISE
16,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

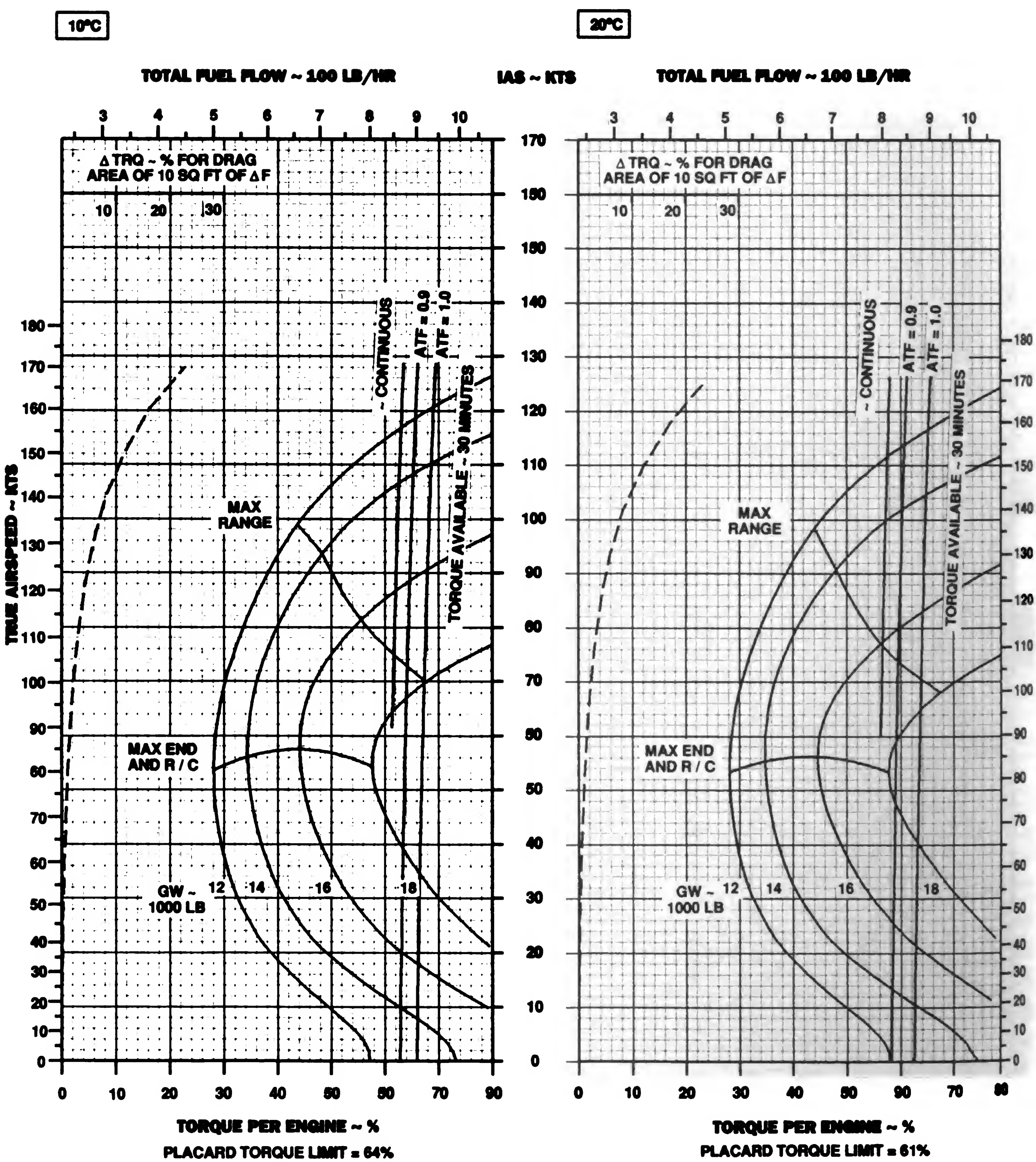
UH60A 156474.3 (C7)

Figure 7.1-17. Cruise - Pressure Altitude 16,000 Feet (Sheet 3 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16,000 FT

CRUISE
16,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

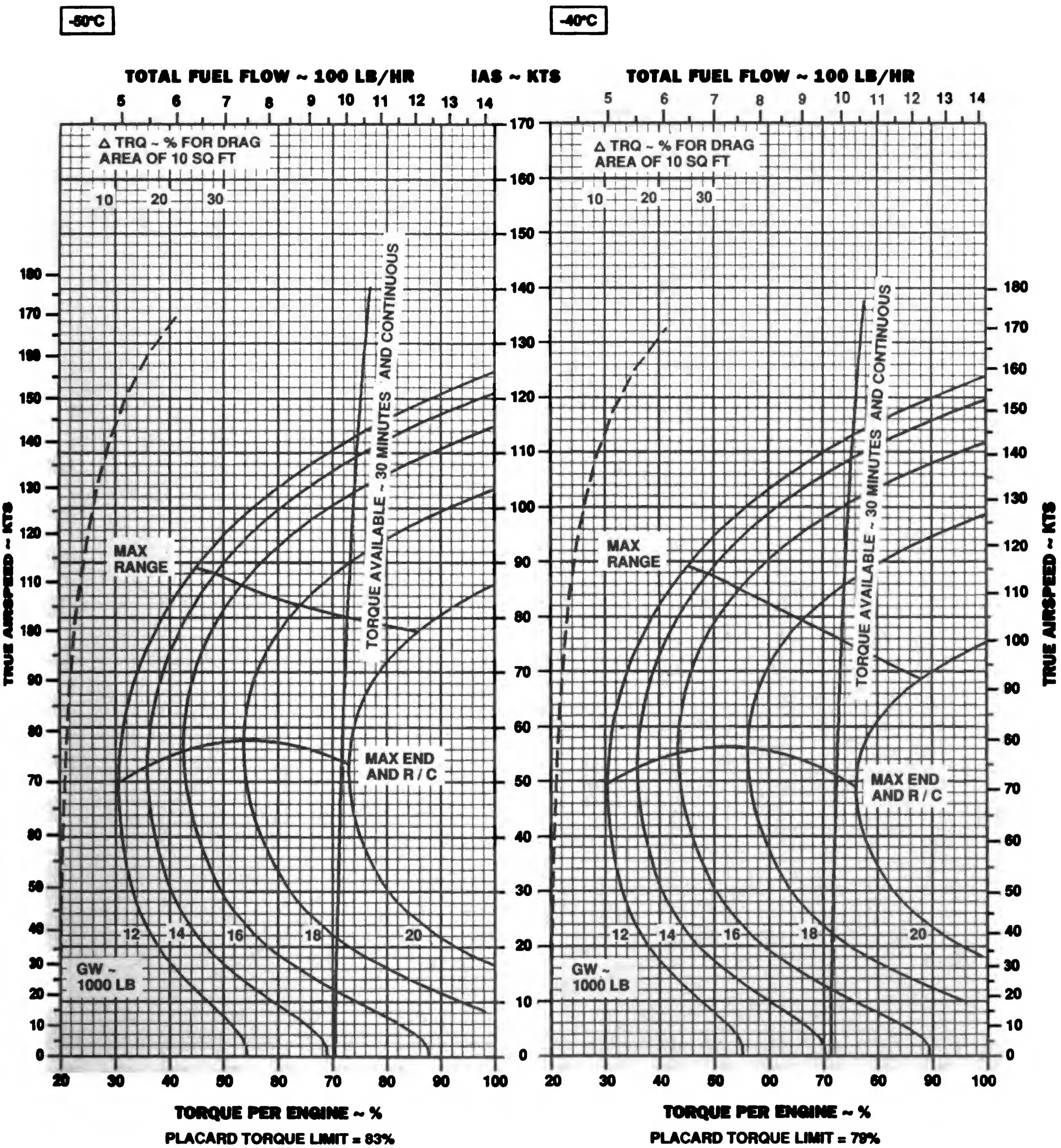
UH60A-159474.4 (C7)

Figure 7.1-17. Cruise - Pressure Altitude 16,000 Feet (Sheet 4 of 4)

CRUISE

PRESS ALT: 16000 FT

CRUISE
16000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

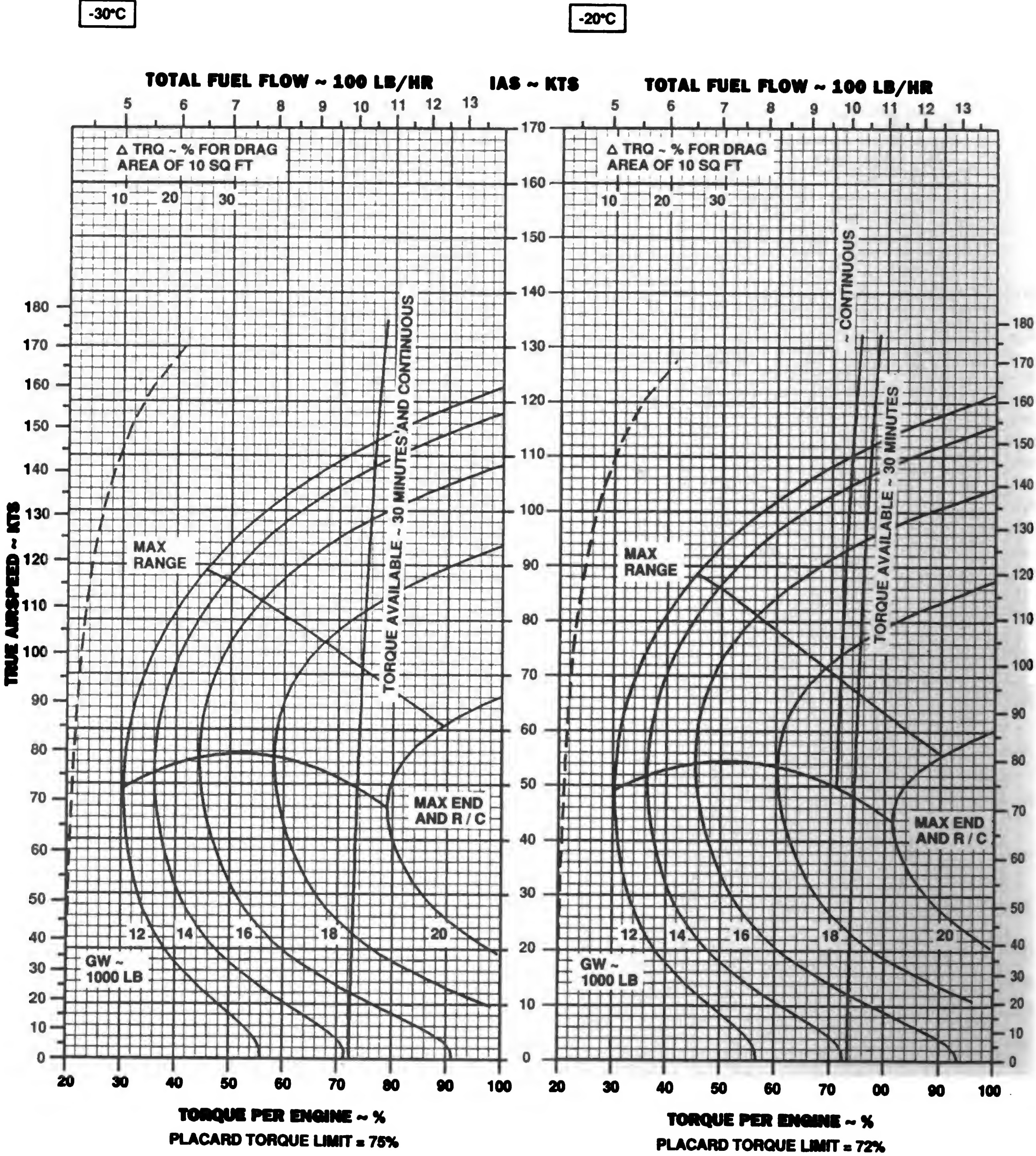
UH60A_167601_1 (R1C13)

Figure 7.1-17.1. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 1 of 4)

CRUISE

PRESS ALT: 16000 FT

CRUISE
16000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

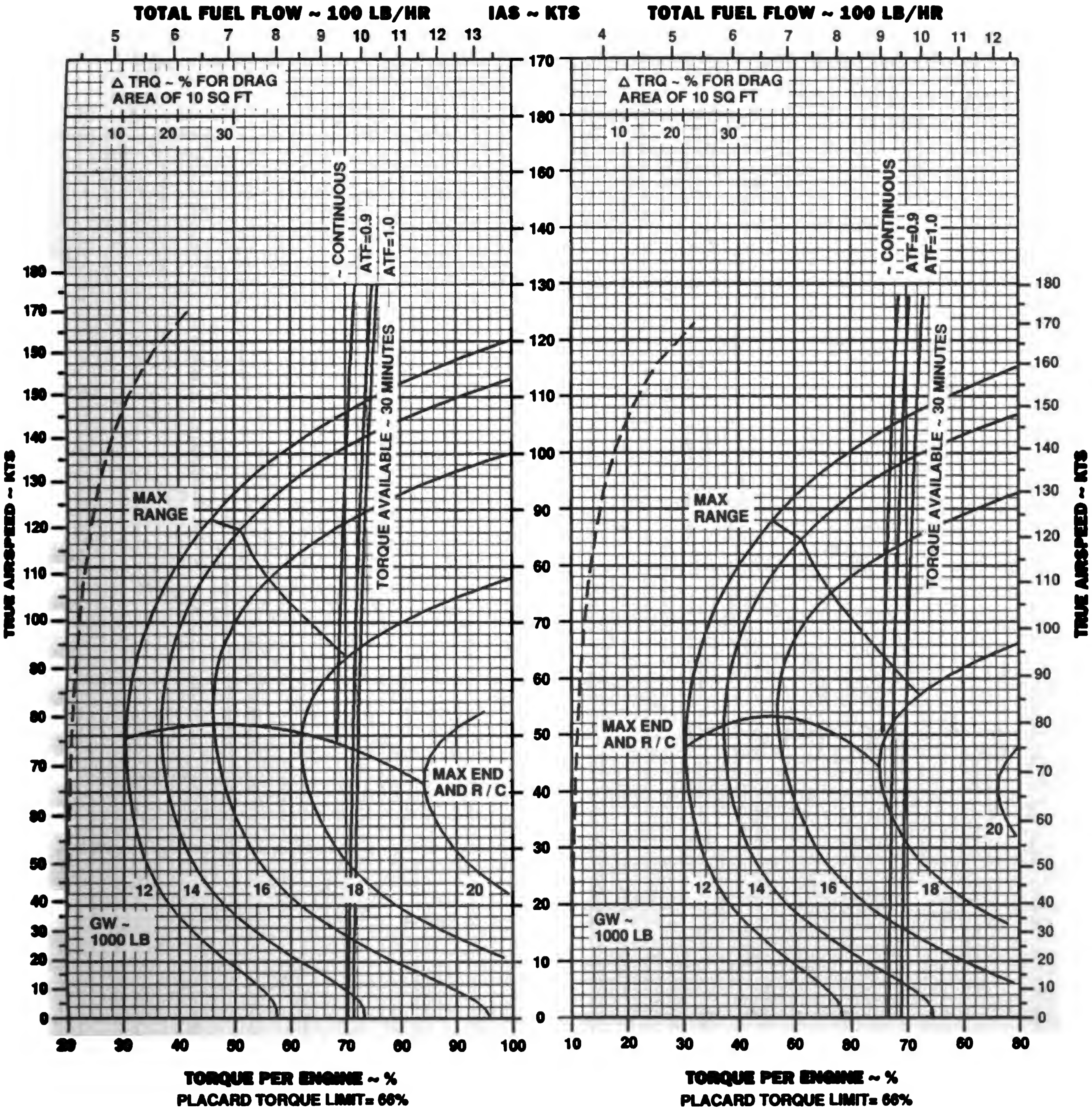
DATA BASE: FLIGHT TEST

UH60A_167601_2 (R1C13)

Figure 7.1-17.1. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 2 of 4)

CRUISE

PRESS ALT: 16000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

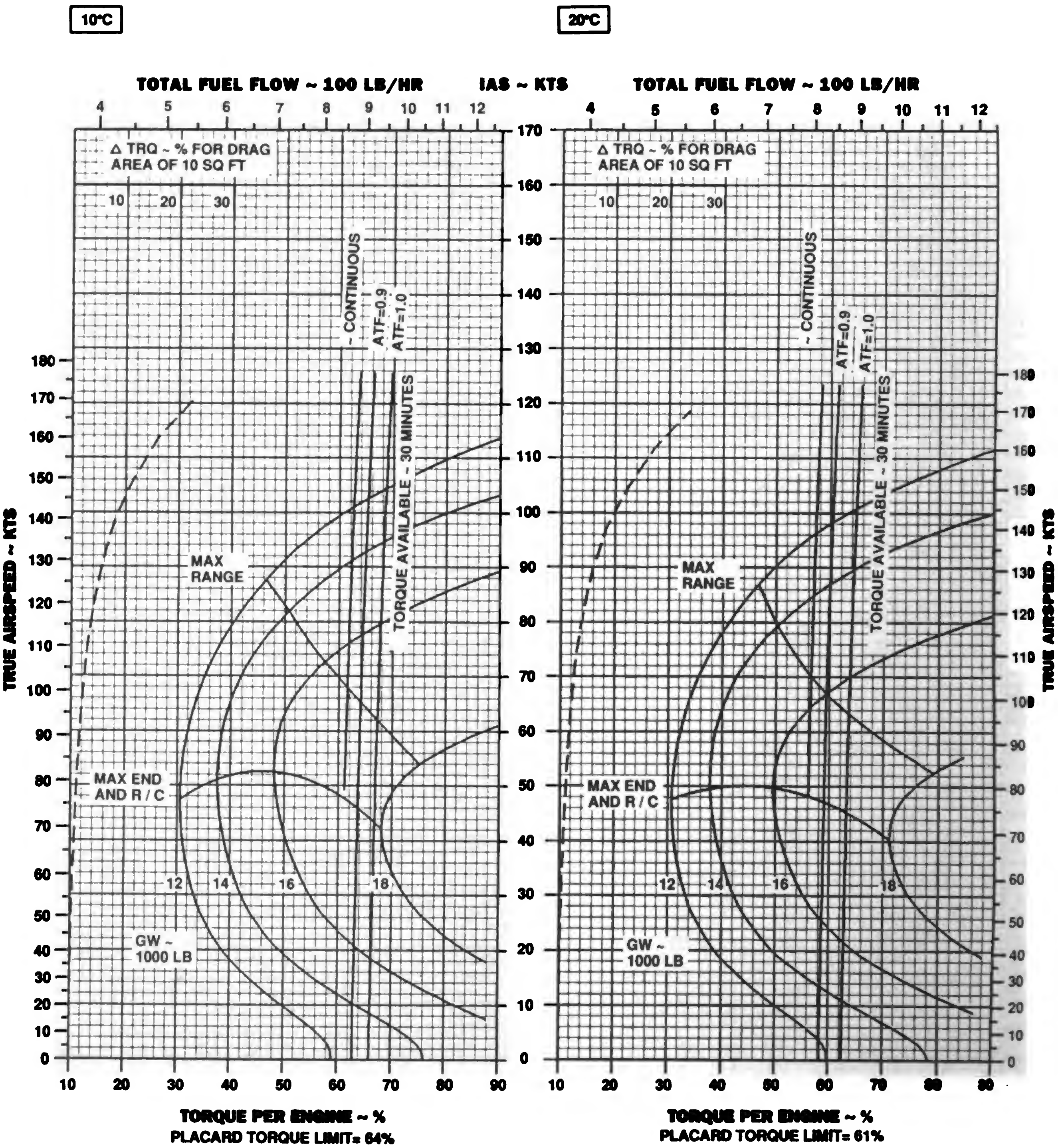
UH60A_167601_3 (R1C13)

Figure 7.1-17.1. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 3 of 4)

CRUISE

PRESS ALT: 16000 FT

CRUISE
16000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

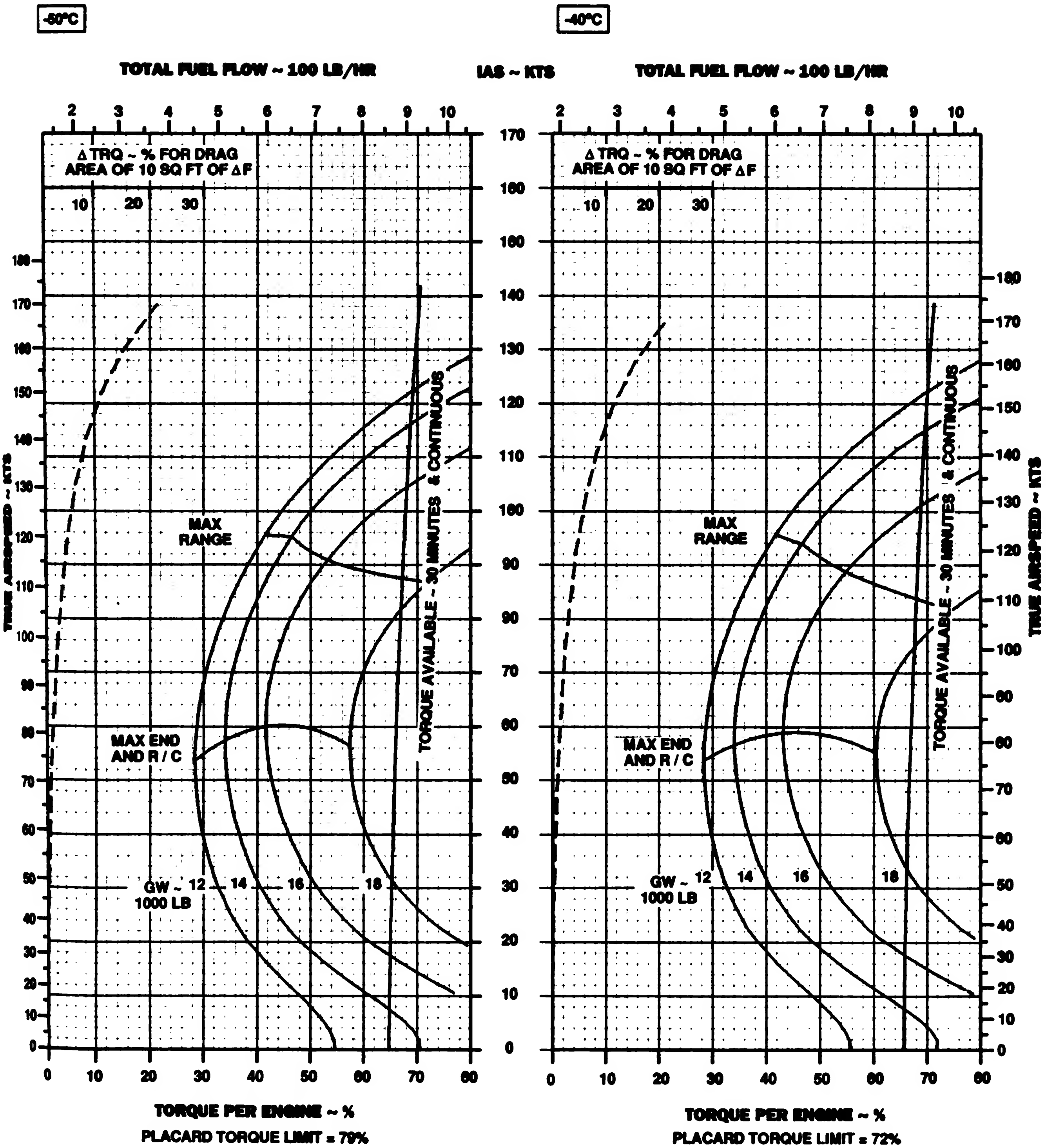
UH60A_167601_4 (R1C13)

Figure 7.1-17.1. Cruise High Drag - Pressure Altitude 16,000 Feet (Sheet 4 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 16,000 FT

CRUISE
16,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

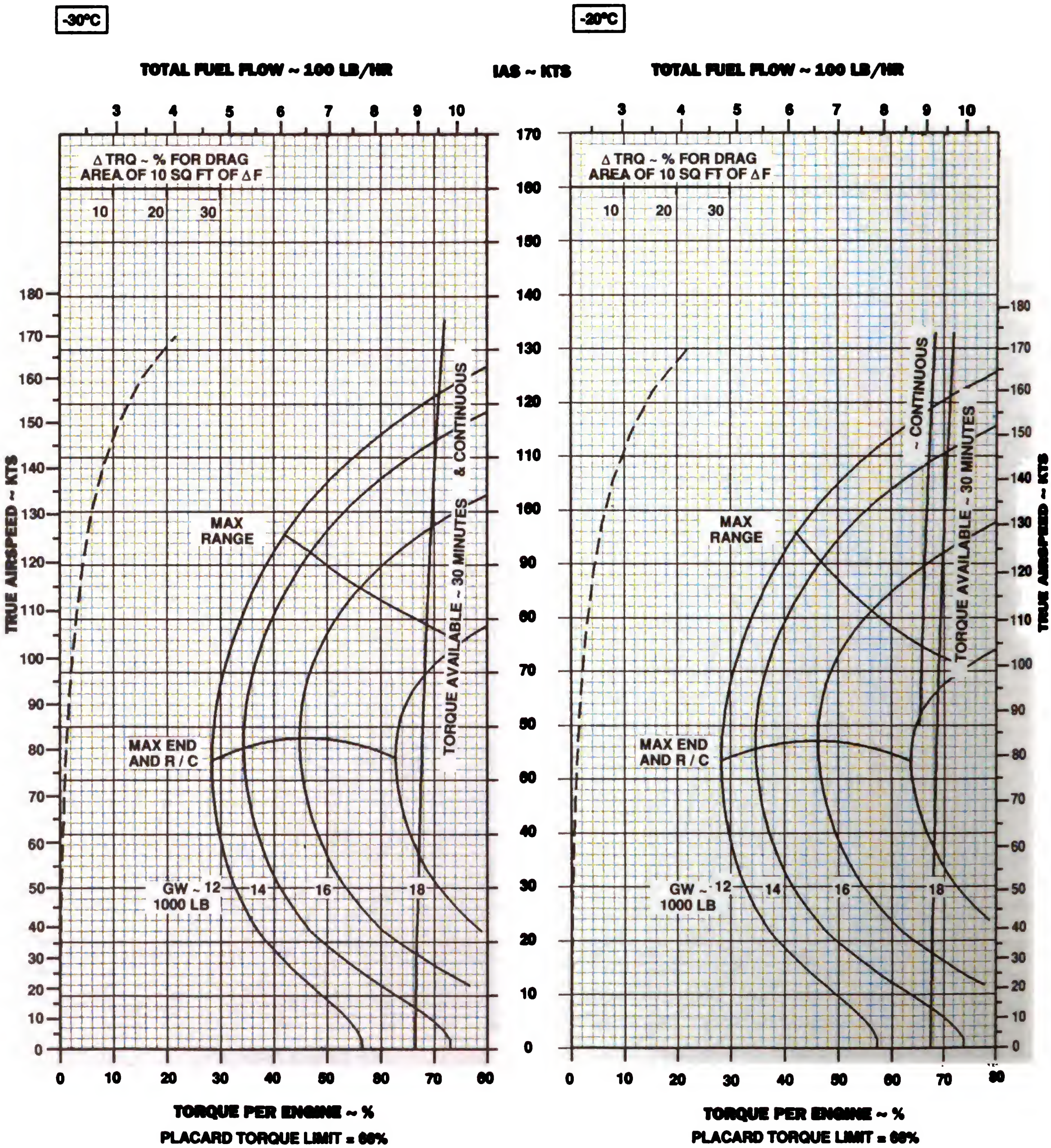
UH60A-156475.1 (C7)

Figure 7.1-18. Cruise - Pressure Altitude 18,000 Feet (Sheet 1 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 18,000 FT

CRUISE
18,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

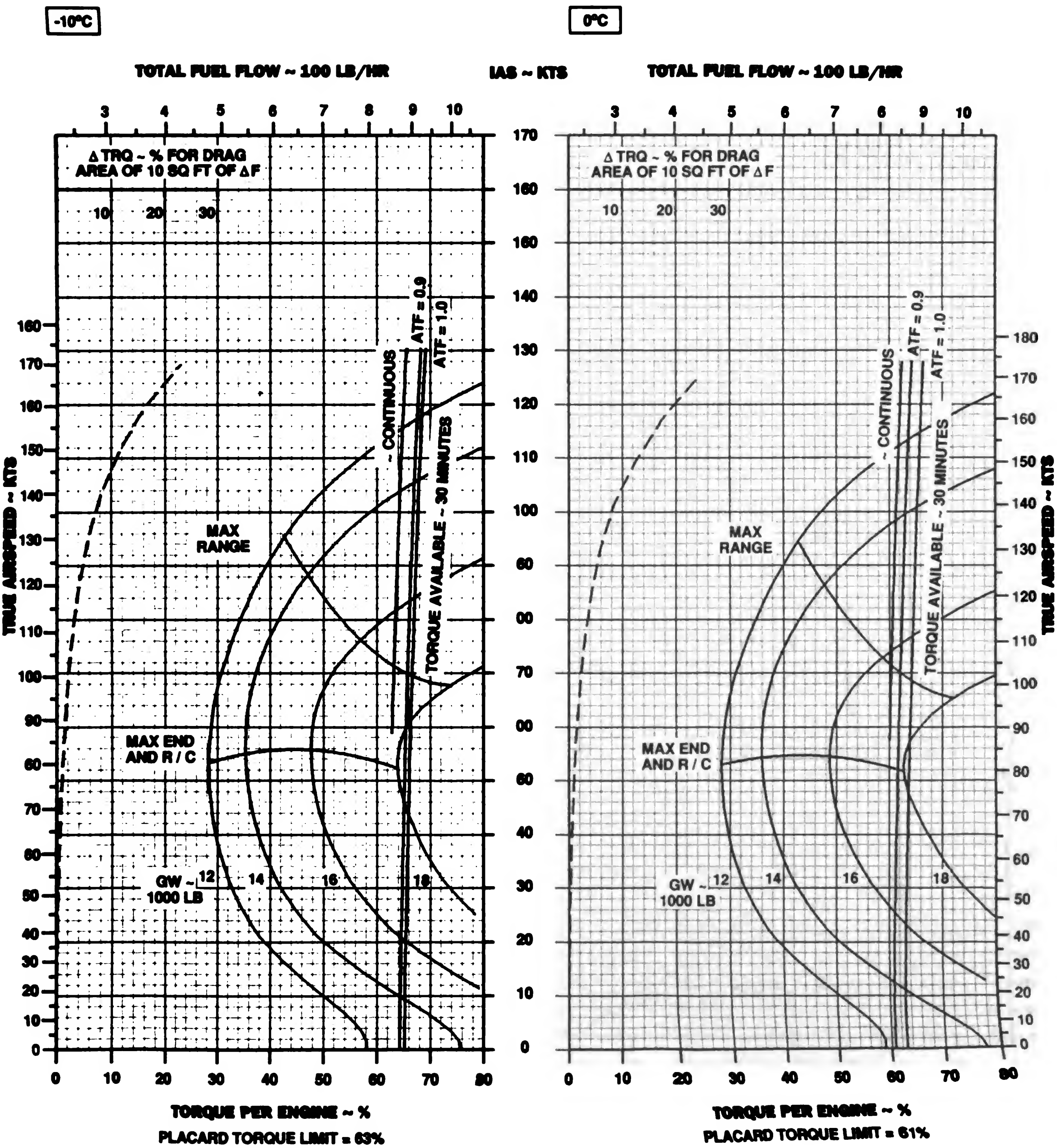
UH60A-1504752 (C7)

Figure 7.1-18. Cruise - Pressure Altitude 18,000 Feet (Sheet 2 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 18,000 FT

CRUISE
18,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

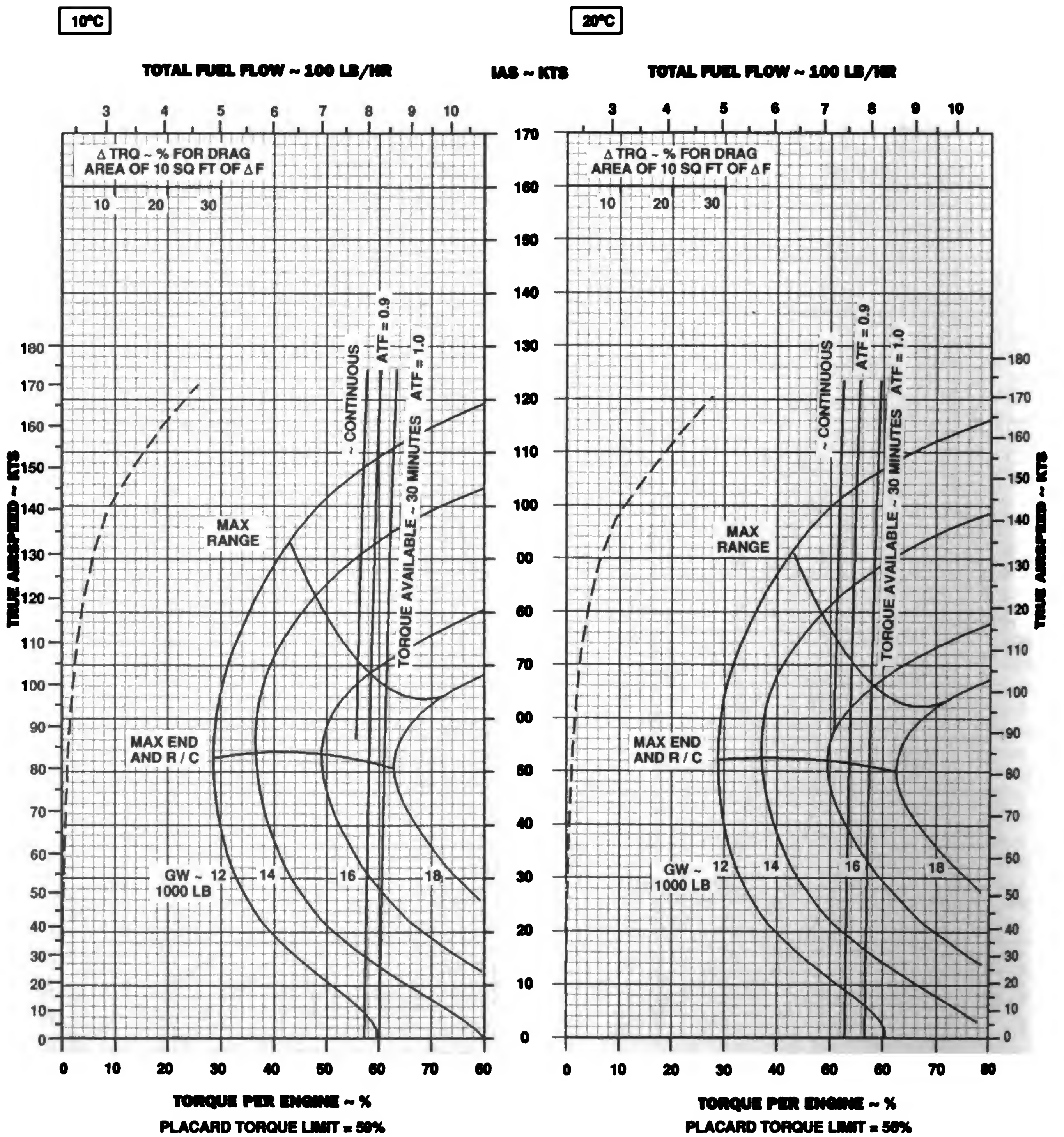
UH60A-158475.3 (CT)

Figure 7.1-18. Cruise - Pressure Altitude 18,000 Feet (Sheet 3 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 18,000 FT

CRUISE
18,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

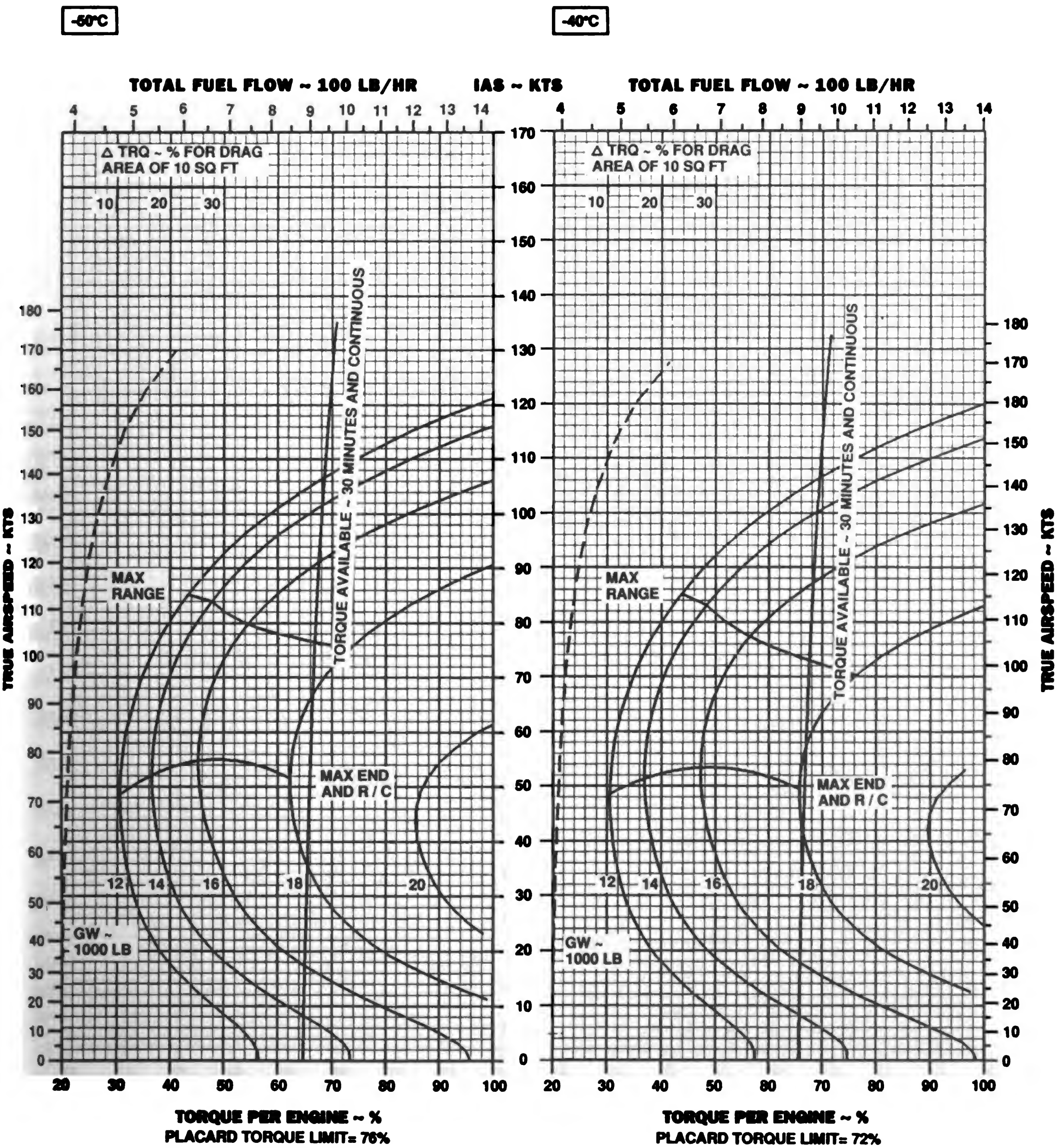
UH60A-155475.4 (C7)

Figure 7.1-18. Cruise - Pressure Altitude 18,000 Feet (Sheet 4 of 4)

CRUISE

CRUISE
18000 FT
T701C (2)

PRESS ALT: 18000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY.

DATA BASE: FLIGHT TEST

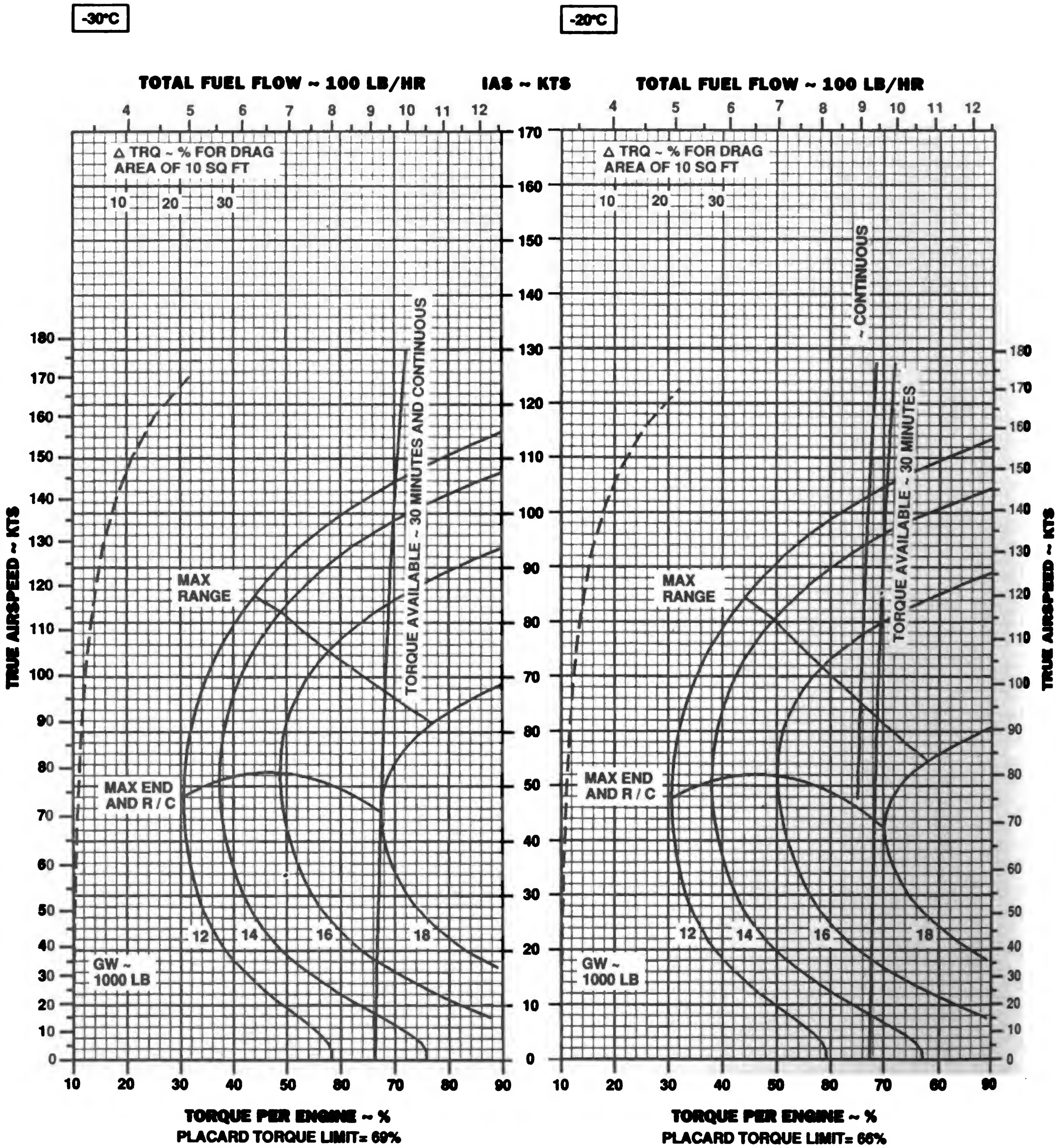
UH60A_167602_1 (R1C13)

Figure 7.1-18.1. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 1 of 4)

CRUISE

PRESS ALT: 18000 FT

CRUISE
18000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

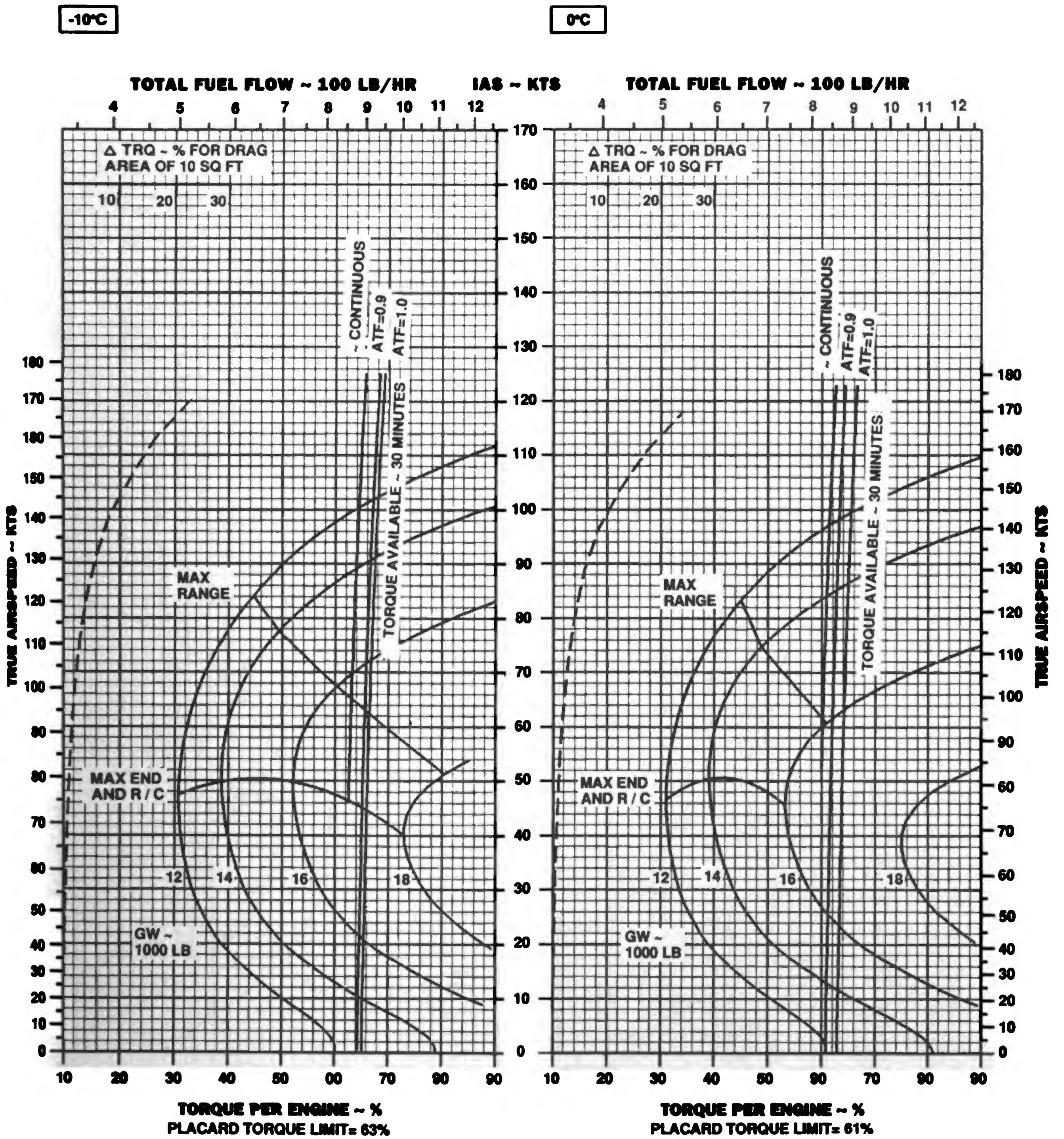
UH60A_167602_2 (R1C13)

Figure 7.1-18.1. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 2 of 4)

CRUISE

CRUISE
18000 FT
T701C (2)

PRESS ALT: 18000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

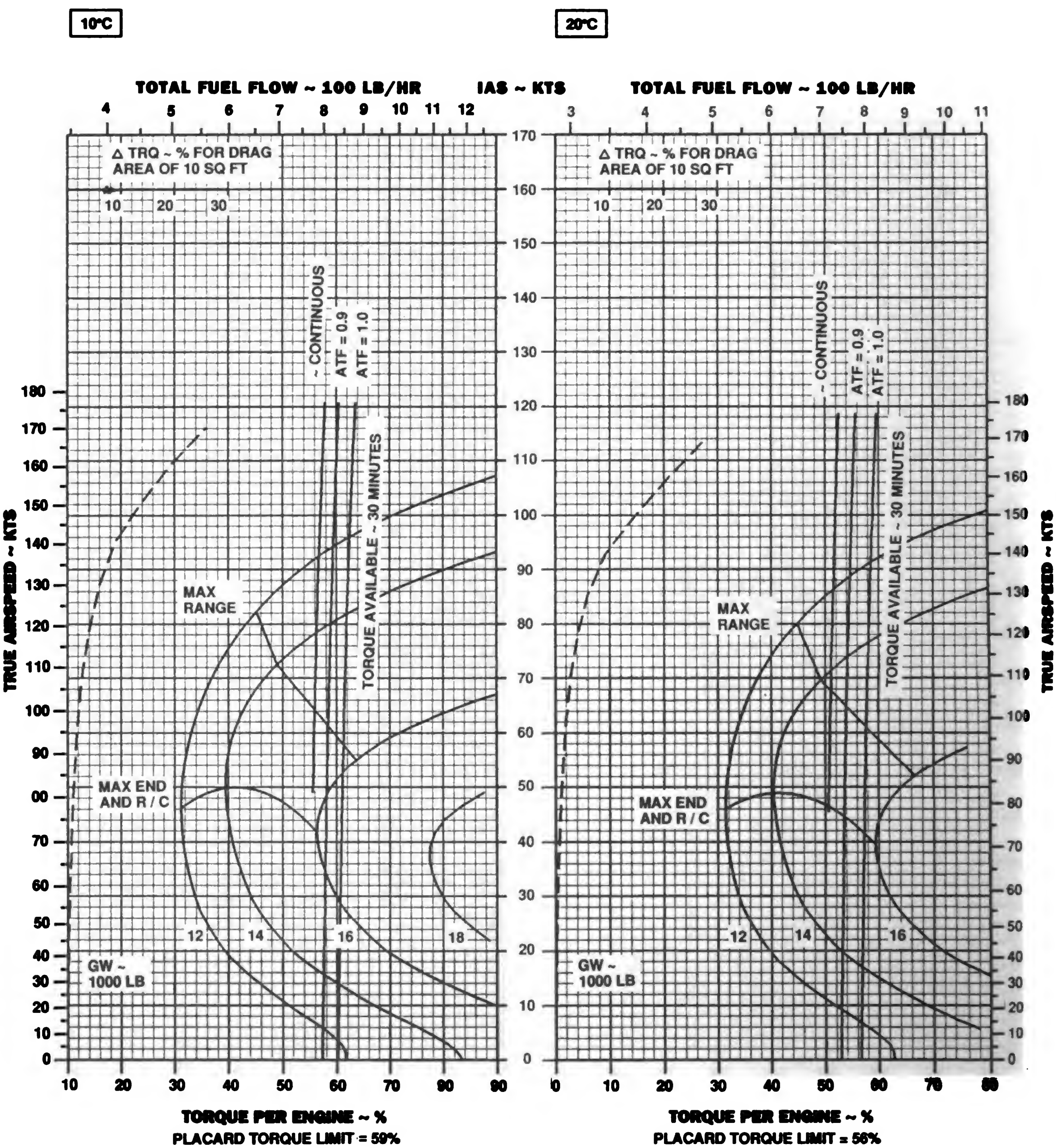
UH60A_167602_3 (R1C13)

Figure 7.1-18.1. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 3 of 4)

CRUISE

PRESS ALT: 18000 FT

CRUISE
18000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

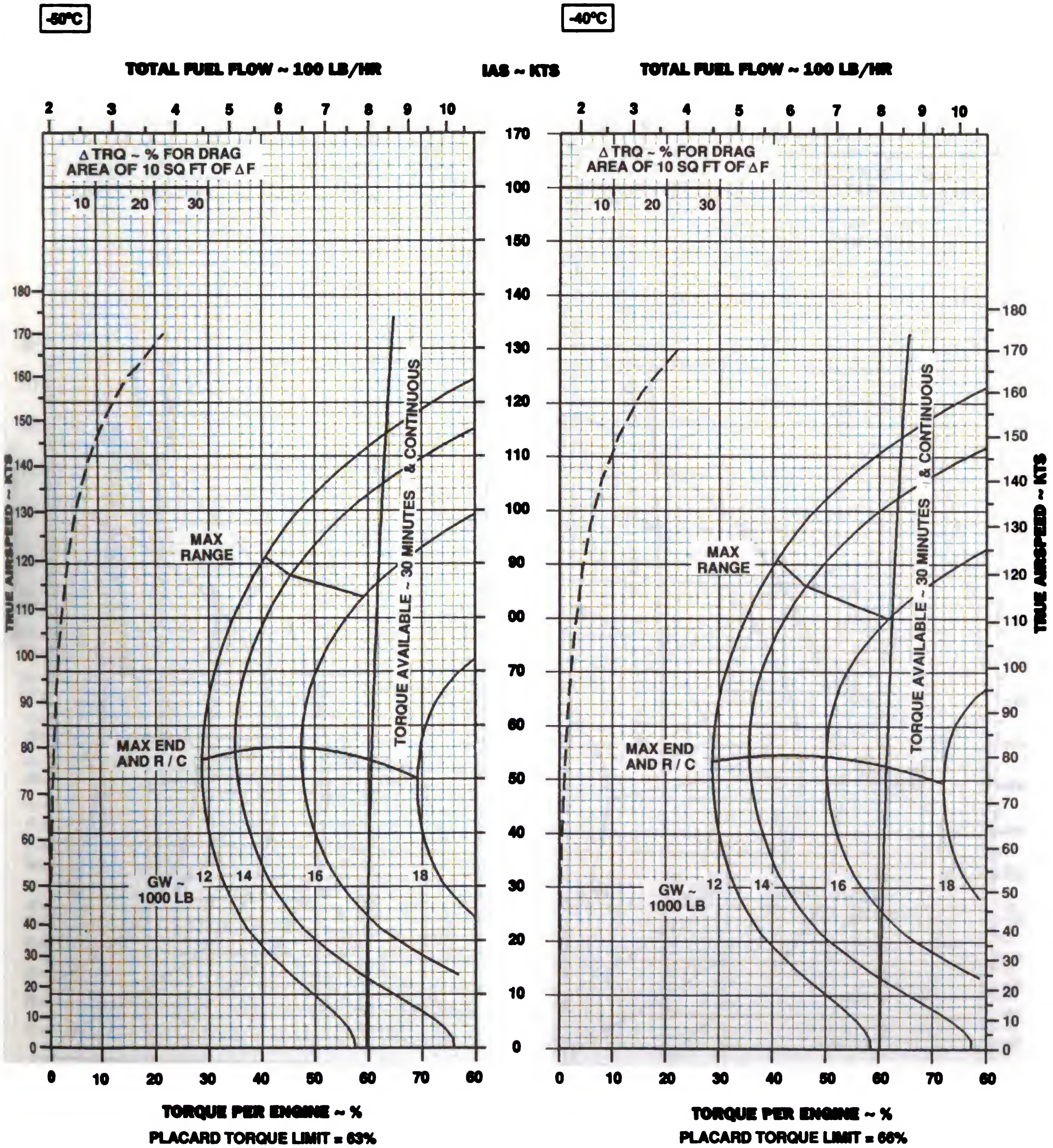
UH60A_167602_4 (R1C13)

Figure 7.1-18.1. Cruise High Drag - Pressure Altitude 18,000 Feet (Sheet 4 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 20,000 FT

CRUISE
20,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

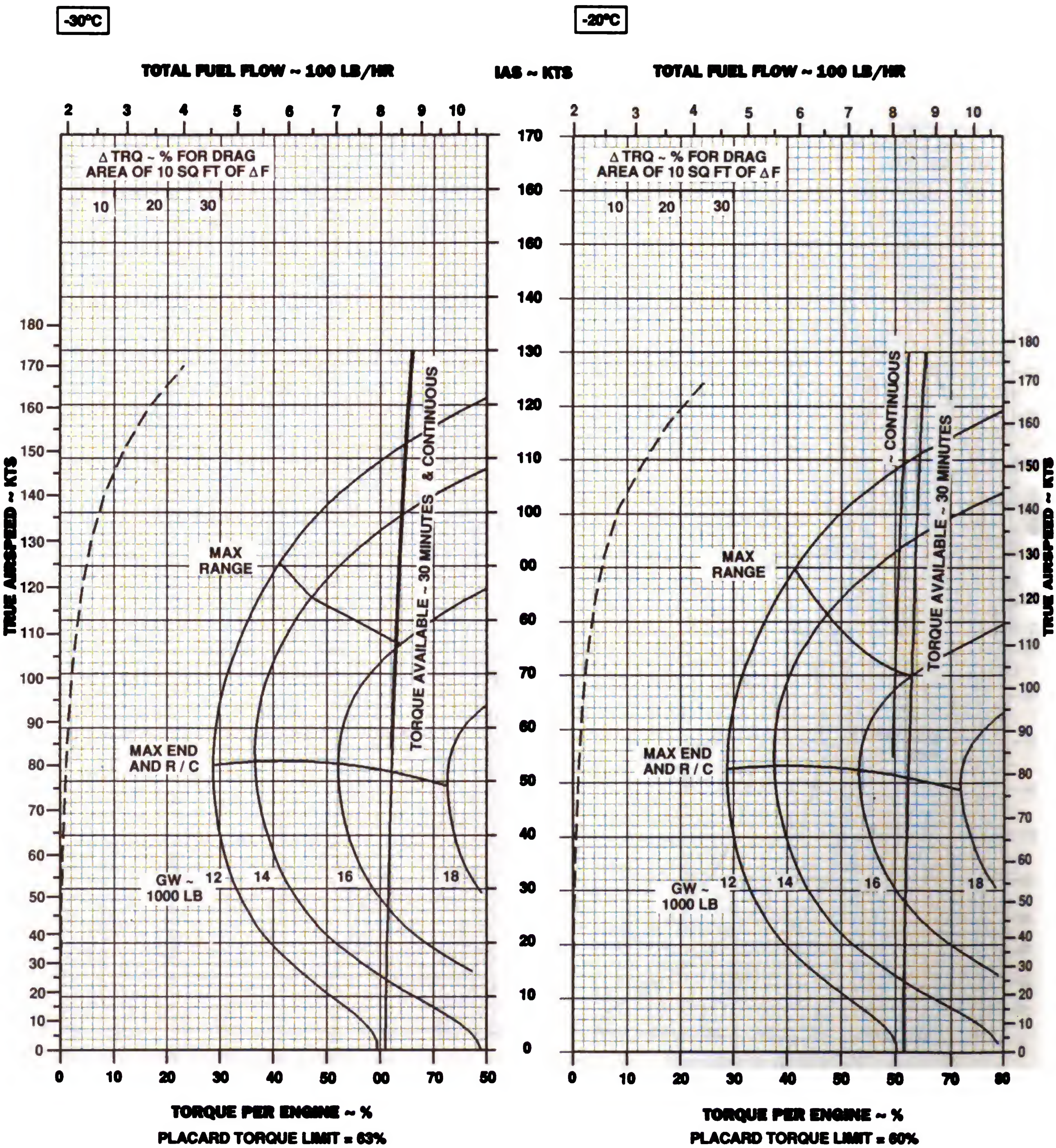
UH60A-156476.1 (C7)

Figure 7.1-19. Cruise - Pressure Altitude 20,000 Feet (Sheet 1 of 4)

CRUISE
20,000 FT
T701C (2)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 20,000 FT



DATA BASE: FLIGHT TEST

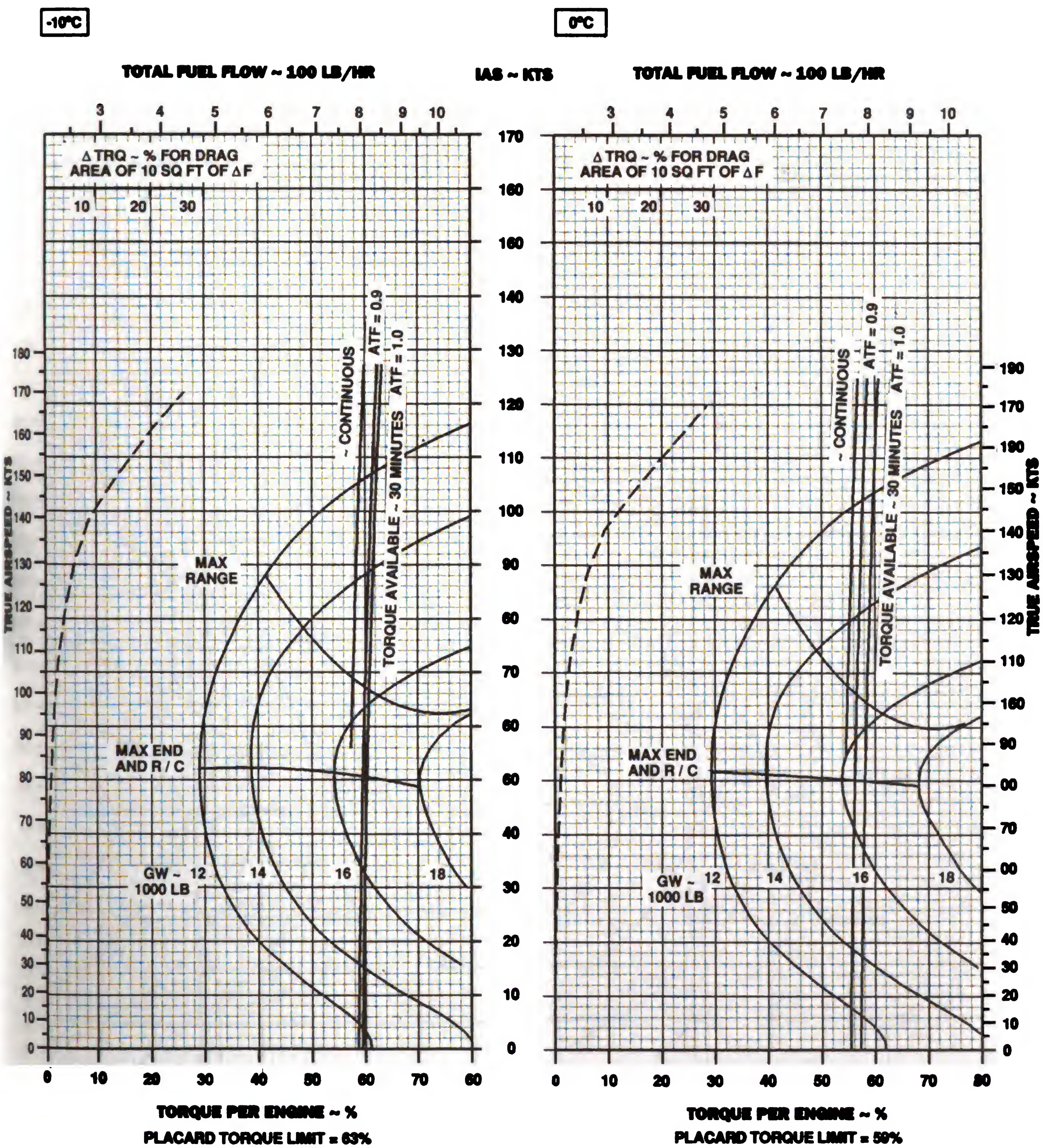
UH60A -159476.2 (C7)

Figure 7.1-19. Cruise - Pressure Altitude 20,000 Feet (Sheet 2 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 20,000 FT

CRUISE
20,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

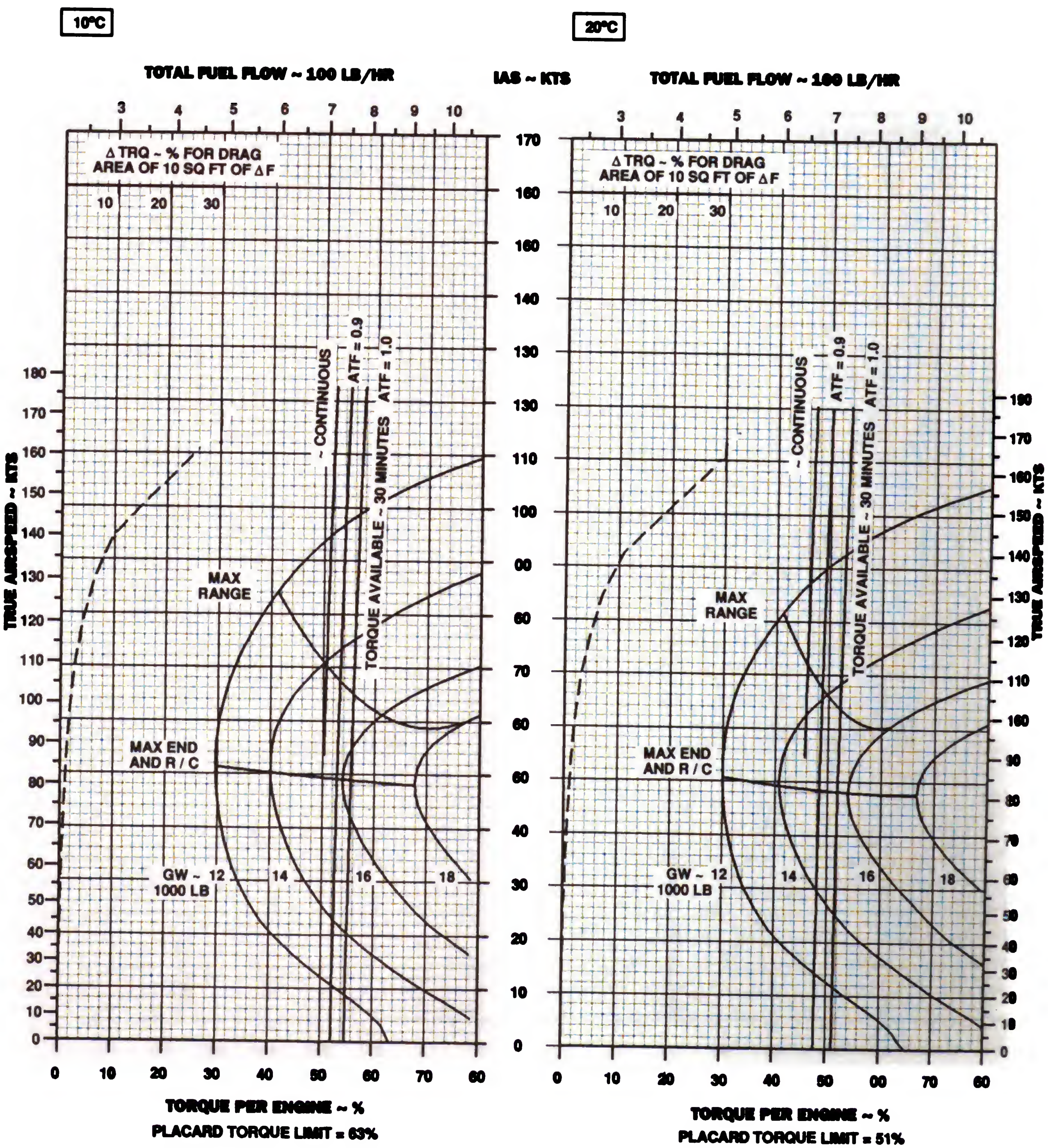
UH60A-158476.3 (C7)

Figure 7.1-19. Cruise - Pressure Altitude 20,000 Feet (Sheet 3 of 4)

CRUISE

CLEAN CONFIGURATION
PRESS ALT: 20,000 FT

CRUISE
20,000 FT
T701C (2)



DATA BASE: FLIGHT TEST

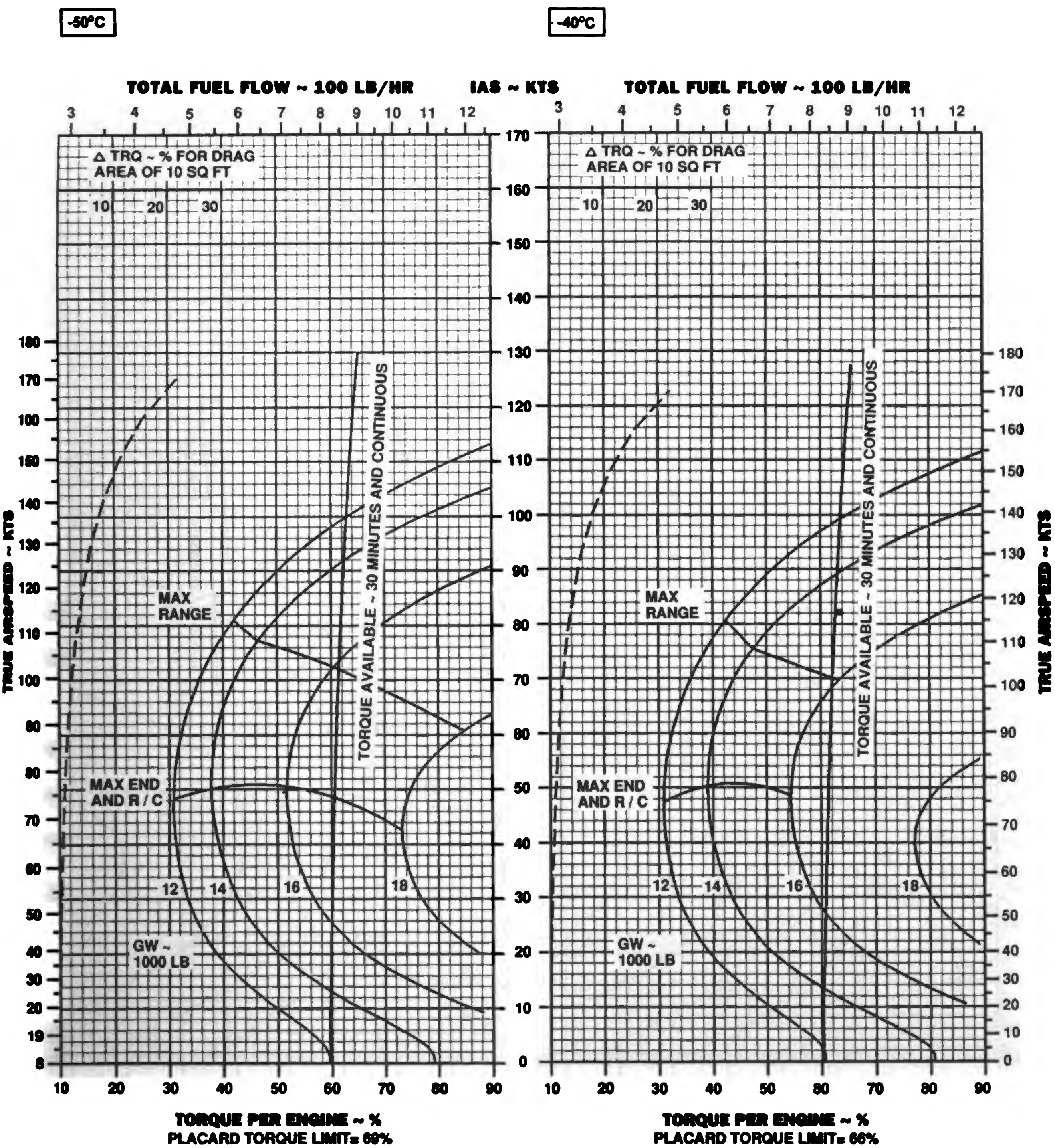
UH60A-198478.4 (C7)

Figure 7.1-19. Cruise - Pressure Altitude 20,000 Feet (Sheet 4 of 4)

CRUISE

PRESS ALT: 20000 FT

CRUISE
20000 FT
T701C (2)



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

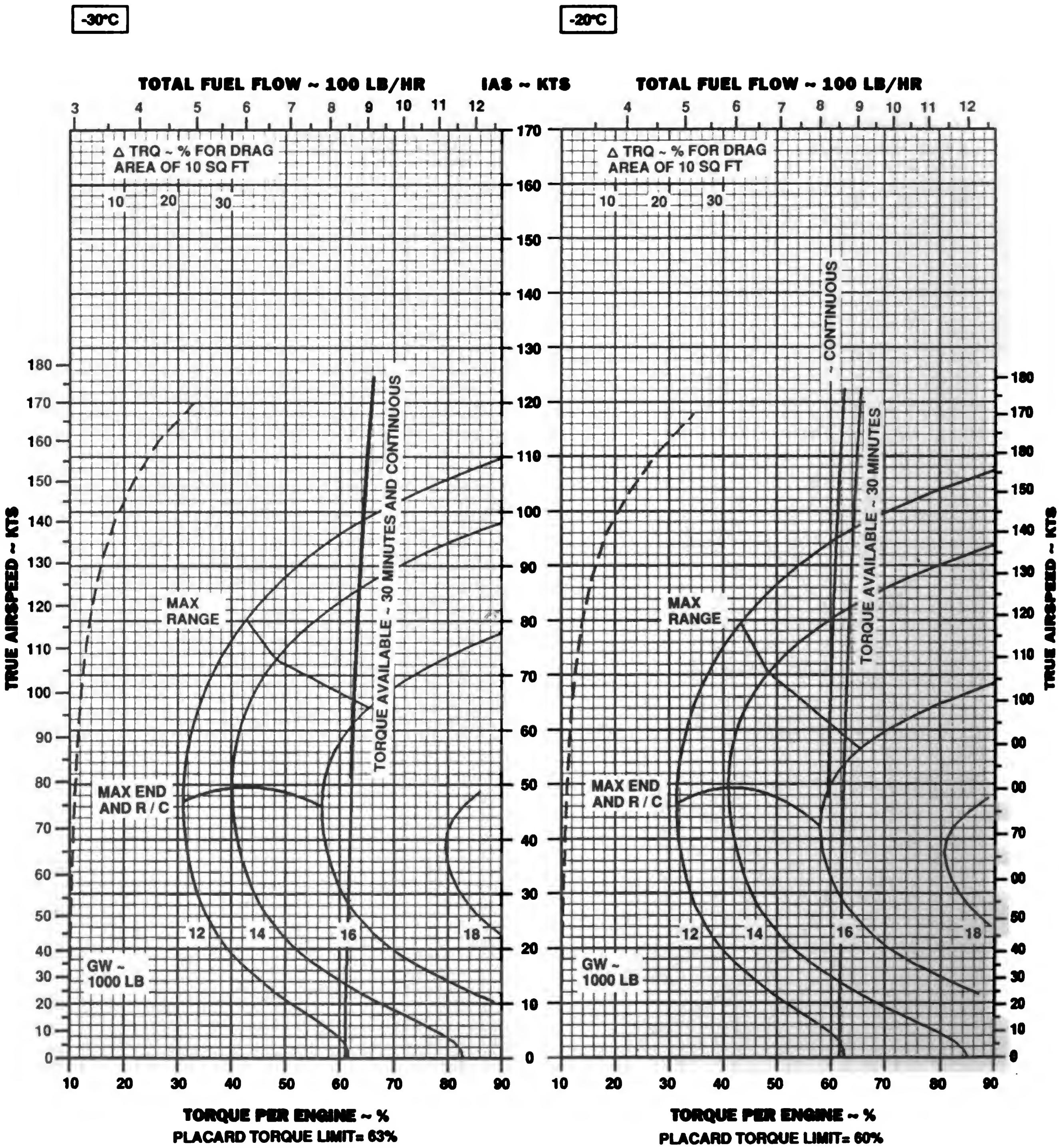
UH60A_167603_1 (R1C13)

Figure 7.1-19.1. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 1 of 4)

CRUISE

CRUISE
20000 FT
T701C (2)

PRESS ALT: 20000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

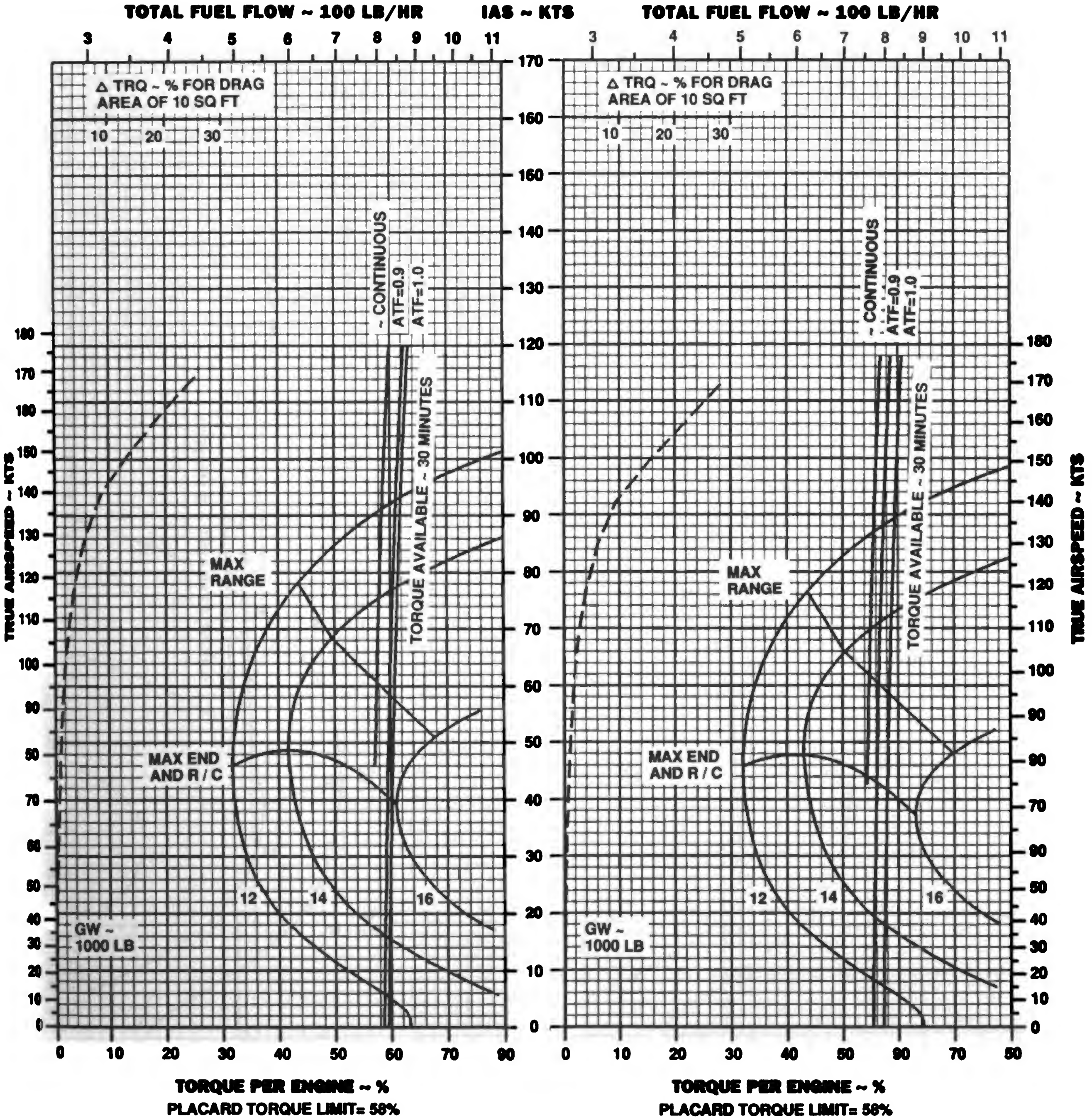
UH60A_167603_2 (R1C13)

Figure 7.1-19.1. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 2 of 4)

CRUISE

CRUISE
20000 FT
T701C (2)

PRESS ALT: 20000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

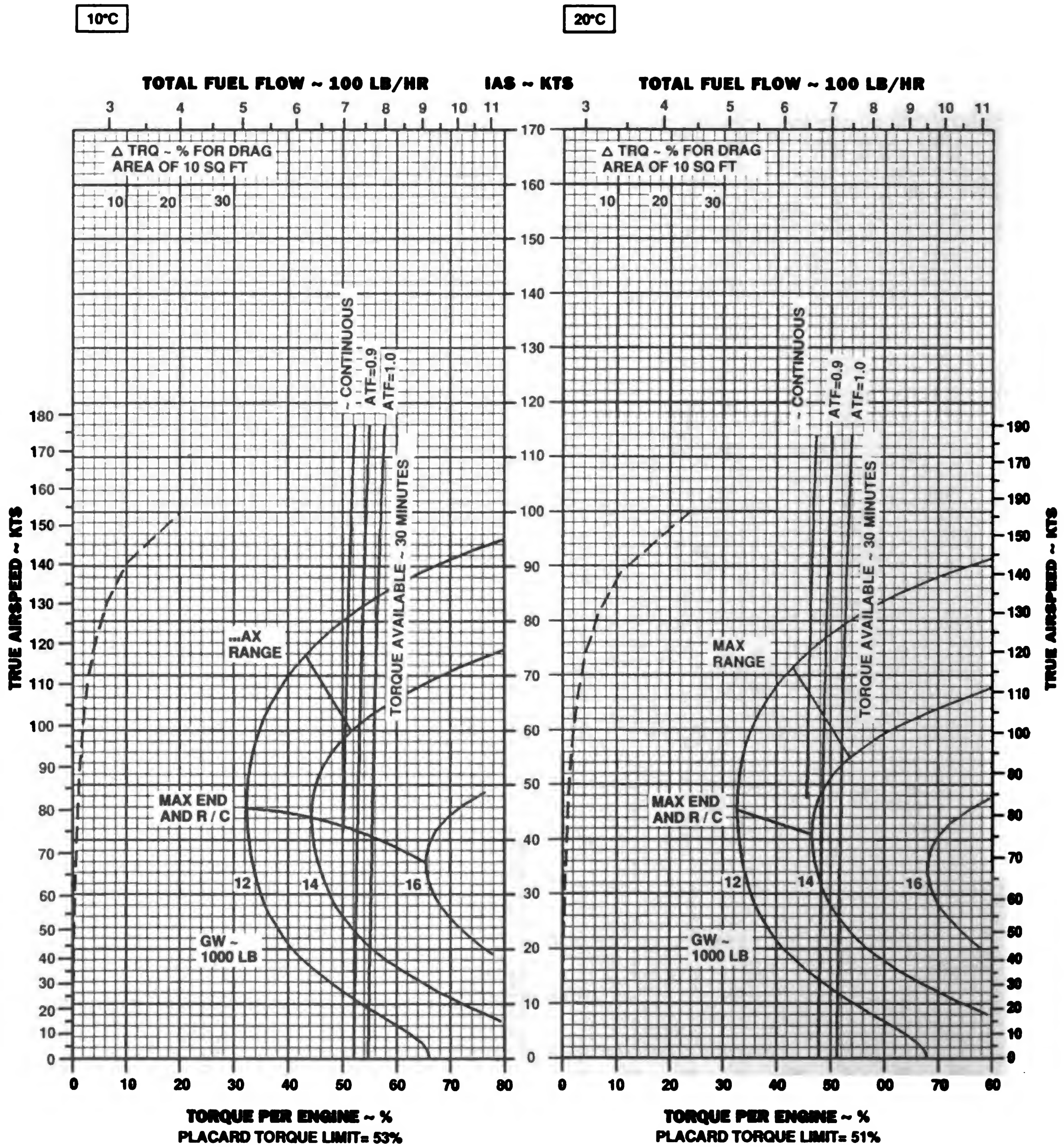
UH60A_167602_3 (R1C13)

Figure 7.1-19.1. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 3 of 4)

CRUISE

CRUISE
20000 FT
T701C (2)

PRESS ALT: 20000 FT



NOTE: SHORT DASH LINES: FERRY MISSION ONLY

DATA BASE: FLIGHT TEST

UH60A_167603_4 (R1C13)

Figure 7.1-19.1. Cruise High Drag - Pressure Altitude 20,000 Feet (Sheet 4 of 4)

Section VI OPTIMUM CRUISE

7.1-29. Optimum Range Charts.

This section presents a method to optimize cruise performance for long range missions when the altitudes flown are not restricted by other requirements. The optimum altitude for maximum range charts (Figures 7.1-20 and 7.1-20.1) provides the pressure altitude at which to cruise to obtain the maximum possible range for any gross weight and FAT conditions. The altitude determined for optimum range may also be used for optimum endurance. Enter the chart at a current cruise or takeoff temperature condition and move along the temperature guide lines to the anticipated gross weight for cruise and obtain the optimum pressure altitude. Turn to the cruise chart closest to the altitude and temperature predicted by the optimum range chart for specific cruise information. The use of this chart is shown by the example.

7.1-30. Deleted.

OPTIMUM RANGE

100 % RPM R CLEAN CONFIGURATION

EXAMPLE

WANTED

CRUISE ALTITUDE FOR OPTIMUM RANGE AND CORRESPONDING CRUISE CHART FOR FLIGHT CONDITIONS

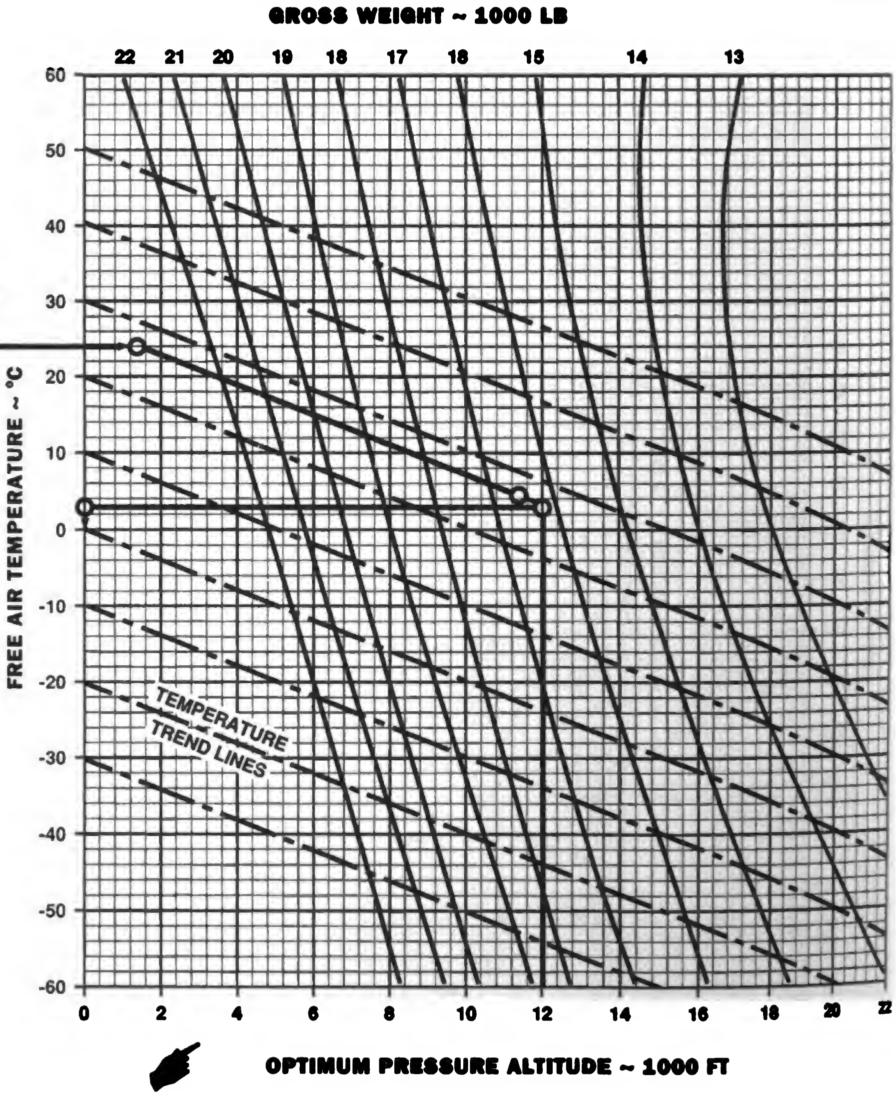
KNOWN

REFERENCE CONDITIONS OF:
PRESSURE ALTITUDE = 1,500 FT
FAT = 24°C
GW = 16,600 LB

METHOD

ENTER CHART AT FAT (24°C). MOVE RIGHT TO REFERENCE / OPTIMUM PRESSURE ALTITUDE (1,500 FT). MOVE PARALLEL WITH THE TEMPERATURE TREND LINE TO AIRCRAFT GROSS WEIGHT (16,600 LB). MOVE LEFT OR RIGHT PARALLELING THE TEMPERATURE TREND LINE TO THE NEAREST EVEN THOUSAND REFERENCE / OPTIMUM PRESSURE ALTITUDE LINE (12,000). MOVE LEFT TO FREE AIR TEMPERATURE LINE (3°). MOVE UP OR DOWN TO NEAREST TEN VALUE ON THE FREE AIR TEMPERATURE SCALE (0°C).

SELECT CRUISE CHART WITH ALTITUDE AND TEMPERATURE DATA AT THE NEAREST REFERENCE / OPTIMUM PRESSURE ALTITUDE (12,000 FT) AND THE NEAREST TEN DEGREE FREE AIR TEMPERATURE (0°C).



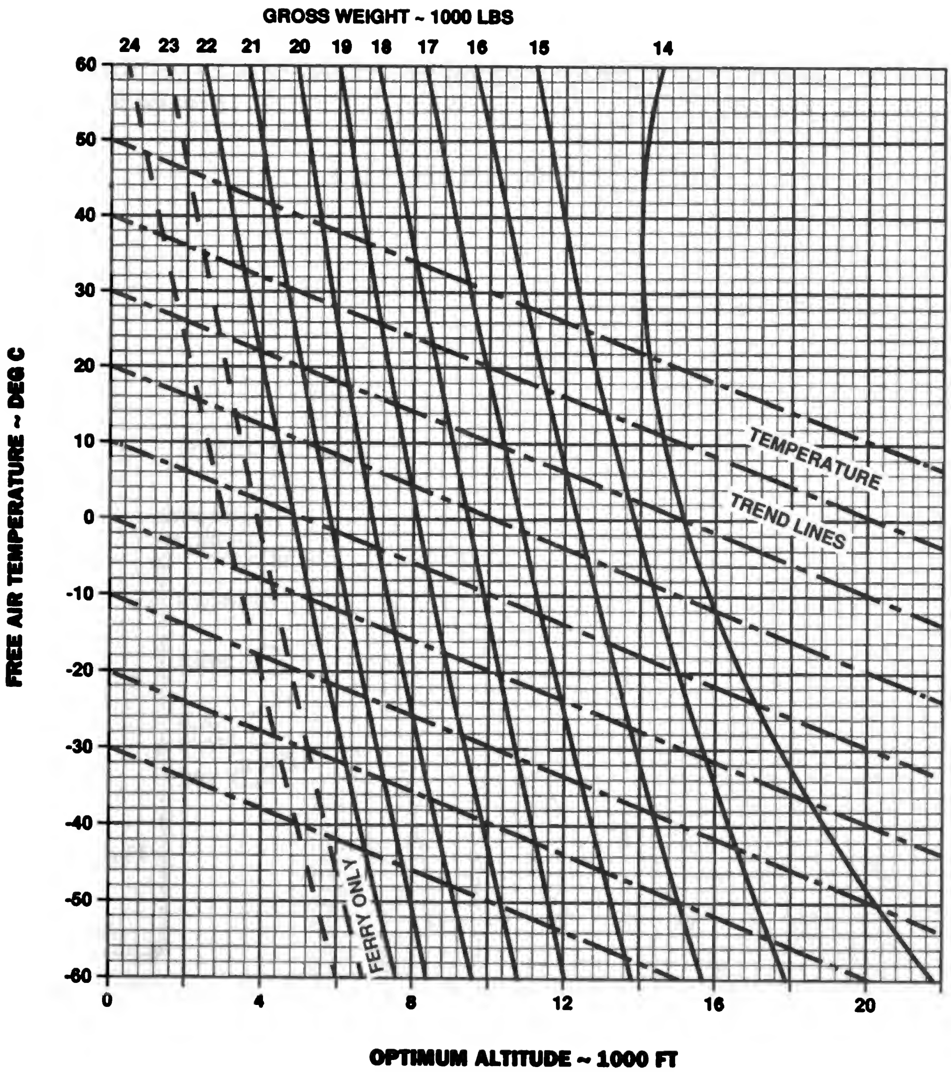
DATA BASIS: FLIGHT TEST

AL0618A

Figure 7.1-20. Optimum Altitude For Maximum Range

OPTIMUM RANGE

100% RPMR



AL0006
SA

Figure 7.1-20.1. Optimum Altitude for Maximum Range - High Drag

Section VII DRAG

7.1-31. External Load Drag Chart.

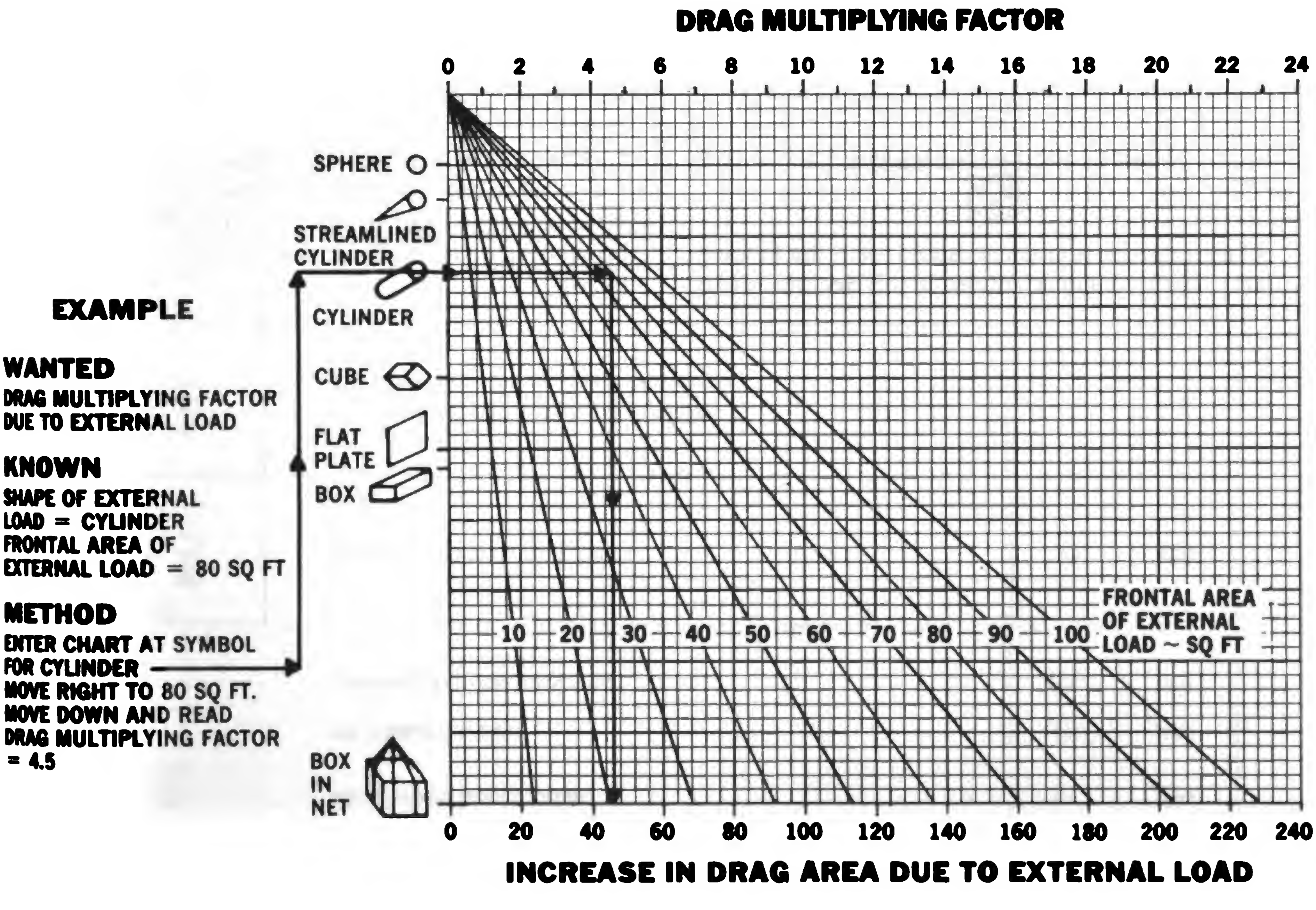
The general shapes of typical external loads are shown on Figure 7.1-21 as a function of the load frontal area. The frontal area is combined with the typical drag coefficient of the general shapes to obtain a drag multiplying factor for use with the 10 sq. ft. drag scale on each cruise chart. The ΔTRQ~% value obtained from the cruise chart is multiplied by the drag multiplying factor and added to indicated torque to obtain total torque required at any airspeed.

7.1-32. Aircraft Configuration Drag Changes For Use With Cruise Charts.

When external equipment or configuration differs from the baseline clean configuration as defined in Section I, a drag correction should be made similarly to the external drag load method. Typical configuration changes that have drag areas established from flight test or analysis along with their drag multiplying factor are listed below:

LOAD DRAG

EXTERNAL DRAG LOAD



DATA BASIS: ESTIMATED

UH60A-45293 (R1C12)

Figure 7.1-21. External Load Drag

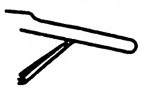
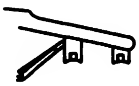
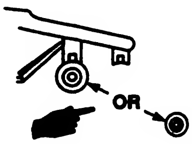
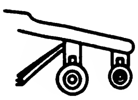
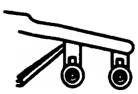
DRAG CHANGES FOR USE WITH CLEAN CRUISE CHARTS		
Item	Change in Flat Plate Drag Area - ΔF Sq. Ft.	Drag Multiplying Factor
a. Both cargo doors open	+6.0	0.60
b. Cargo doors removed	+4.0	0.40
c. Cargo mirror installed	+0.3	0.03
d. IR Countermeasure Transmitter (ALQ-144) installed	+0.8	0.08
e. Chaff Dispenser Installed	+0.3	0.03

Figure 7.1-21.1. Configuration Drag Change

7.1-32.1. Aircraft Configuration Changes For Use With High Drag Cruise Charts.

When external equipment differs from the baseline high drag configuration as defined in this Section, a drag correction shall be made using Figure 7.1-21.2 similar to the external drag load method. Typical high drag configuration changes that have been established from flight test or analysis along with the drag multiplying factors are shown.

DRAG CONFIGURATIONS

		CHANGE IN FLAT PLATE DRAG ΔF SQ FT	DRAG MULTI-PLYING FACTOR
	HIGH DRAG CRUISE CHART BASELINE SPECIAL MISSION EQUIPMENT CONFIGURATIONS		
	ESSS - CLEAN, PYLONS REMOVED	-4.0	-0.40
	ESSS - FOUR PYLONS / NO STORES	-1.7	-0.17
	ESSS-TWO 450 GALLON TANKS INBOARD -TWO 230 GALLON TANKS INBOARD	0.5 0.0	0.05 0.00
	ESSS-TWO 230 GALLON TANKS OUTBOARD -TWO 450 GALLON -TANKS INBOARD	2.5	0.25
	ESSS - FOUR 230 GALLON TANKS	2.0	0.20
	VOLCANO SYSTEM INSTALLED	32.5	3.25
	SKI CONFIGURATION	3.0	0.30
	BOTH CARGO DOORS OPEN	6.0	0.60
	BOTH CARGO DOORS REMOVED	4.0	0.40
	CARGO MIRROR INSTALLED	0.3	0.03
	IR COUNTERMEASURE TRANSMITTER (ALQ-144) REMOVED	-0.8	-0.08
	CHAFF DISPENSER REMOVED	-0.3	-0.03

AA0685
8A

Figure 7.1-21.2. Configuration Drag Change - High Drag

Section VIII CLIMB-DESCENT

7.1-33. Climb Performance Chart.

The CLIMB chart (Figures 7.1-22 and 7.1-22.1) presents the time, fuel required, and distance traveled to climb from sea level to various cruise altitudes using dual engine (30-minute limit) power available as limited by the torque placard. The climb data are based on maintaining 80 KIAS which approximates the airspeed for maximum R/C in average flight conditions. If a more exact airspeed is required, the actual IAS for maximum R/C may be obtained from the cruise charts and corrected to IAS in climb as shown in section X. The actual IAS for maximum R/C will result in somewhat better climb capability and higher service ceilings. Warmup and takeoff fuel used are not included on this chart. The use of this chart is shown by the example.

7.1-34. Climb/Descent Chart.

The CLIMB/DESCENT chart (Figures 7.1-23 and 7.1-23.1) presents the rate of climb or descent resulting from an increase or decrease of engine torque from the value required for level flight above 40 KIAS. The data are presented at 100% RPM R for various gross weights. The charts may also be used in reverse to obtain the torque increase or reduction required to achieve a desired steady rate of climb or descent. The maximum R/C may be determined by subtracting the cruise chart torque required from the maximum torque available at the desired flight conditions. Then enter the difference on the torque increase scale of the climb chart, move up to the gross weight, and read the resulting maximum R/C.

CLIMB
CLEAN CONFIGURATION DUAL ENGINE
100% RPM R 80 KIAS 30 MINUTE LIMIT
HIRSS INSTALLED PLACARD TORQUE LIMIT
ATF = 1.0

CLIMB

EXAMPLE

WANTED

TIME TO CLIMB FUEL USED, AND DISTANCE REQUIRED TO CLIMB FROM 2,000 TO 12,000 FEET

KNOWN

GROSS WEIGHT = 17,000 POUNDS
TEMPERATURE AT 2,000 = + 14°C

METHOD

USING STANDARD LAPSE RATE, TEMPERATURE AT 12,000 FEET IS −6°C. AVERAGE TEMPERATURE IS

$$\frac{+14 + (-6)}{2} = +4°C$$

A. ENTER CHART AT 17,000 POUNDS GROSS WEIGHT, MOVE RIGHT TO 12,000 FEET THEN DOWN TO + 4°C ON TIME, DISTANCE, AND FUEL GRAPHS. MOVE LEFT TO READ 5.5 MINUTES, 120 POUNDS OF FUEL, AND 8.5 NM REQUIRED TO CLIMB FROM SEA LEVEL TO 12,000 FEET.

B. ENTER CHART AT 17,000 POUNDS GROSS WEIGHT, MOVE RIGHT TO 2,000 FEET THEN DOWN TO + 4°C ON TIME, DISTANCE, AND FUEL GRAPHS. MOVE LEFT TO READ 1.0 MINUTES, 20 POUNDS OF FUEL, AND 1.0 NM.

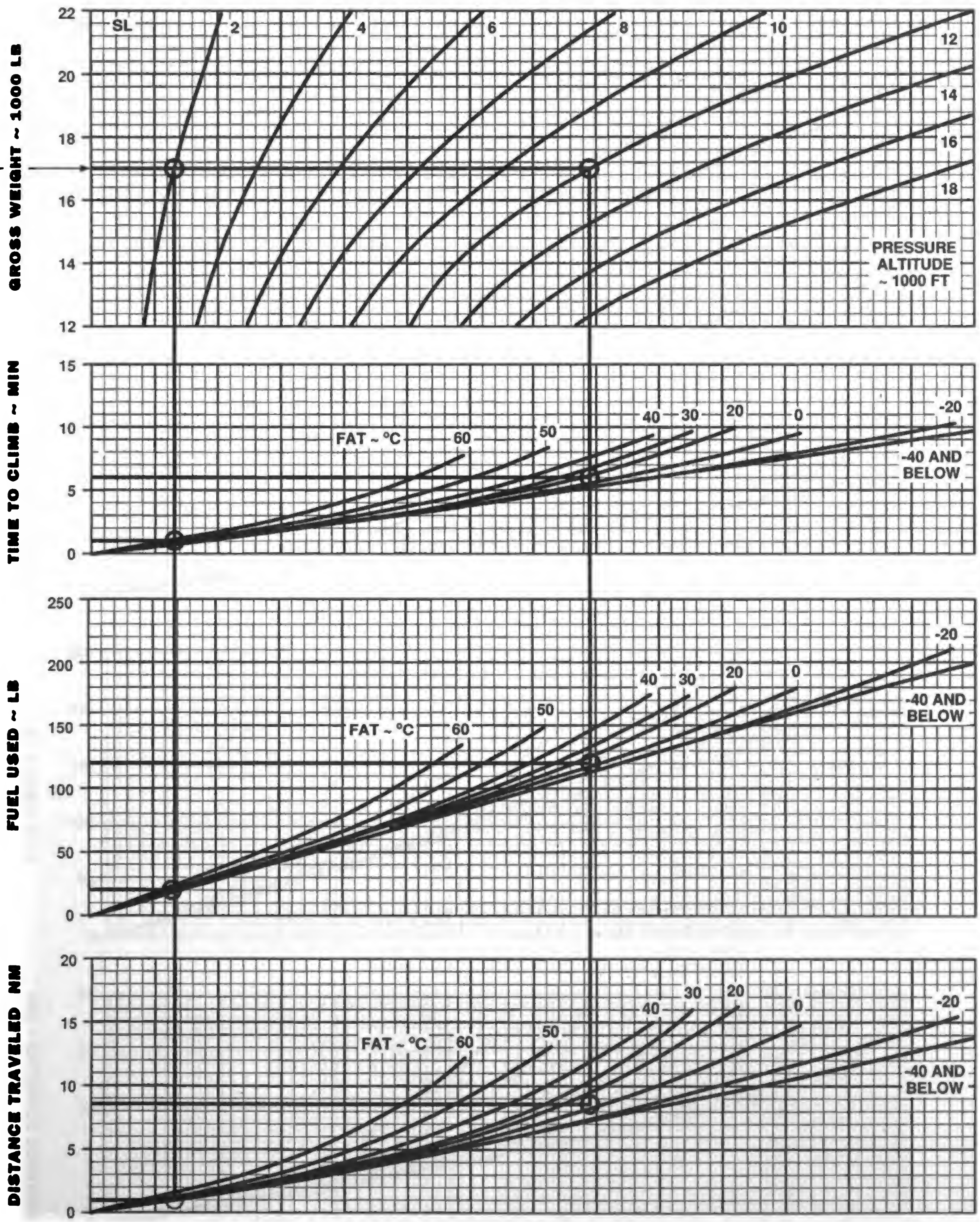
C. SUBTRACT DATA OBTAINED IN STEP B FROM DATA OBTAINED IN STEP A. THE DIFFERENCE IS 5.0 MINUTES, 100 POUNDS OF FUEL USED, AND 7.5 NM TRAVELED IS THE CLIMB DATA FOR CLIMB STARTED AT 2,000 FEET AND ENDING AT 12,000 FEET.

UH60L-163965.1 (R1C12)

Figure 7.1-22. Climb - 2 Engine, ATF=1.0 (Sheet 1 of 2)

CLIMB

CLEAN CONFIGURATION DUAL ENGINE 100% RPM R 80 KIAS
30 MINUTE LIMIT HIRSS INSTALLED PLACARD TORQUE LIMIT
ATF = 1.0



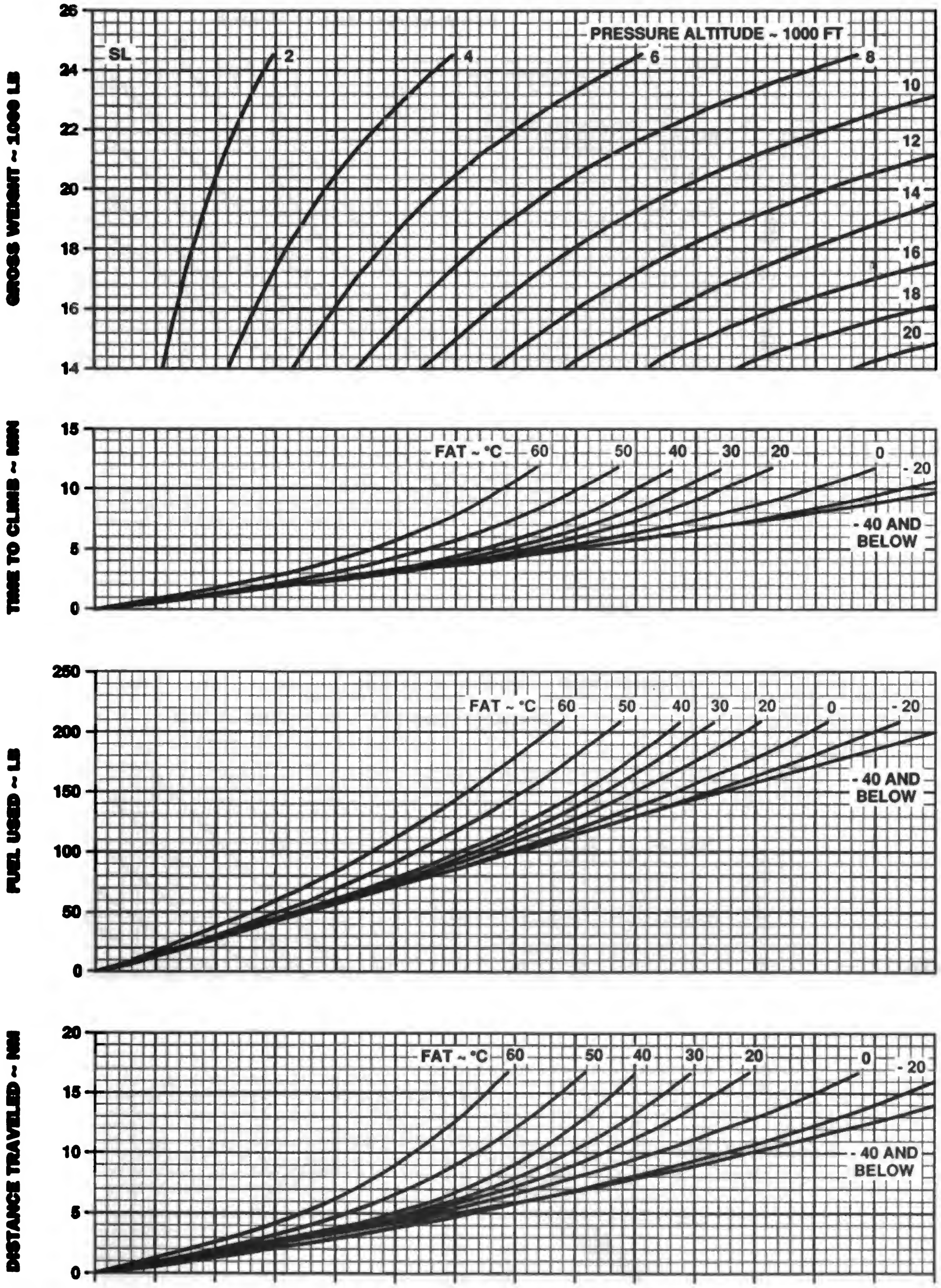
DATA BASIS: FLIGHT TEST

UH60L_45296_2 (R1C12)

Figure 7.1-22. Climb - 2 Engine, ATF=1.0 (Sheet 2 of 2)

CLIMB

DUAL ENGINE 100% RPM R 70 KIAS
30 MINUTE OR PLACARD TORQUE LIMIT HIRSS INSTALLED
ATF=1.0



DATA BASE: FLIGHT TEST

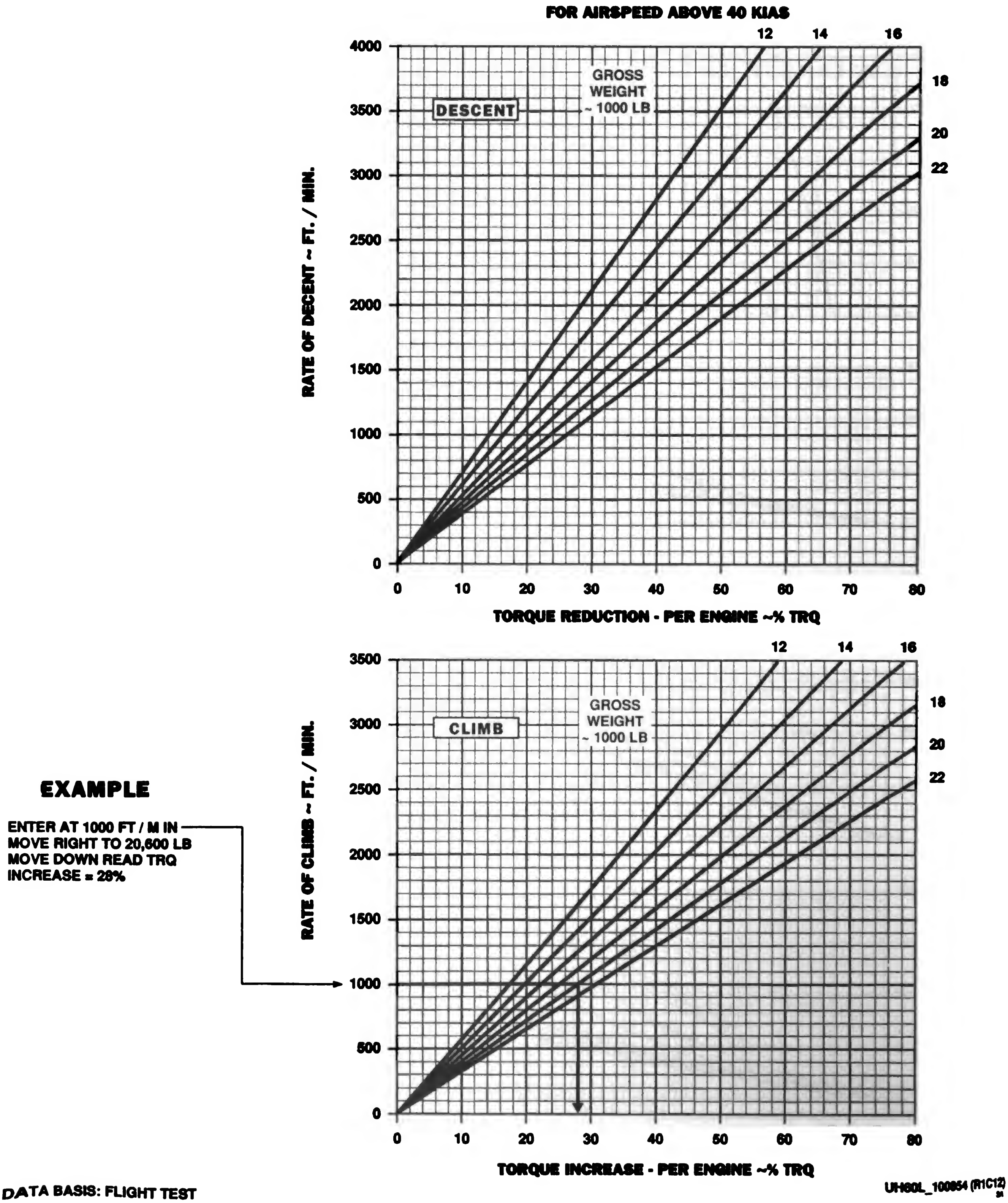
AL0006
SA

Figure 7.1-22.1. Climb - 2 Engine, ATF=1.0 - High Drag

CLIMB/DESCENT

100% RPM R CLEAN CONFIGURATION

CLIMB/DESCENT



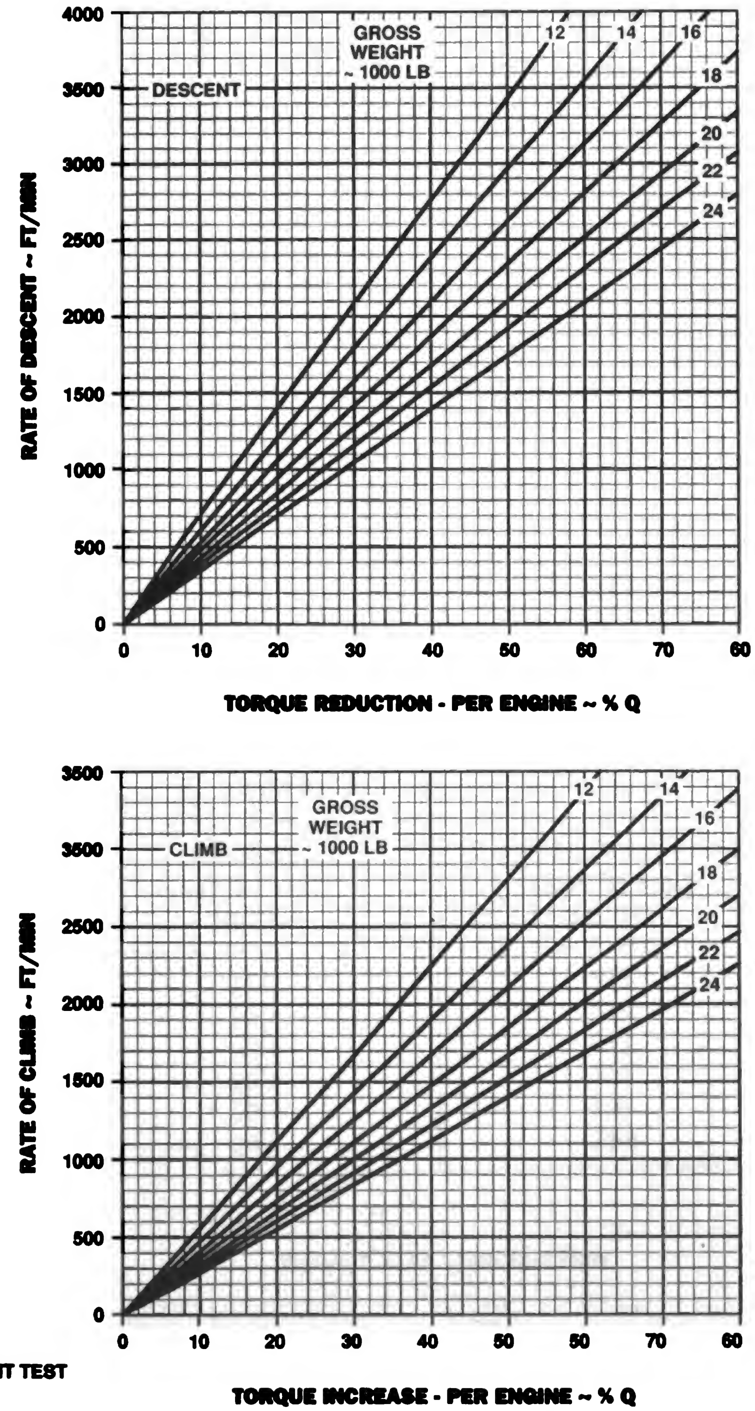
DATA BASIS: FLIGHT TEST

Figure 7.1-23. Climb/Descent

CLIMB DESCENT

100% RPM R
FOR AIRSPEED ABOVE 40 KIAS

CLIMB / DESCENT



DATA BASIS: FLIGHT TEST

AL0009 8A

Figure 7.1-23.1. Climb/Descent - High Drag

Section IX FUEL FLOW

7.1-35. Idle Fuel Flow.

Dual-engine idle fuel flow is presented as a function of altitude at 0°C FAT in Figure 7.1-24.

7.1-36. Single-Engine Fuel Flow.

Engine fuel flow is presented in Figure 7.1-25 for various torque and pressure altitudes at a baseline FAT of 0°C with engine bleed air extraction OFF. When operating at other than 0°C FAT, engine fuel flow is increased 1% for each 20°C above the baseline temperature and, decreased 1% for each 20°C below the baseline temperature.

To determine single-engine fuel flow during cruise, enter the fuel flow chart at double the torque required for dual-engine cruise as determined from the cruise charts and obtain fuel flow from the single-engine scale. The single-engine torque may not exceed the transmission limit shown on the chart. With bleed air extracted, fuel flow increases as follows:

a. Engine anti-ice on: + 50 lbs/hour

b. Cockpit heater on: + 6 lbs/hour

c. When the IR suppressor system is operating in the benign mode (exhaust baffles removed), the fuel flow will decrease about 7 lb/hour.

7.1-37. Dual-Engine Fuel Flow.

Dual-engine fuel flow may be obtained from Figure 7.1-24 when each engine is indicating approximately the same torque by averaging the indicated torques and reading fuel flow from the dual-engine fuel flow scale. When operating at other than the 0° FAT baseline, dual-engine fuel flow is increased 1% for each 20°C above baseline and is decreased 1% for each 20°C below baseline temperature. With bleed air extracted, dual engine fuel flow increases as follows:

a. Engine anti-ice on: + 100 lbs/hr

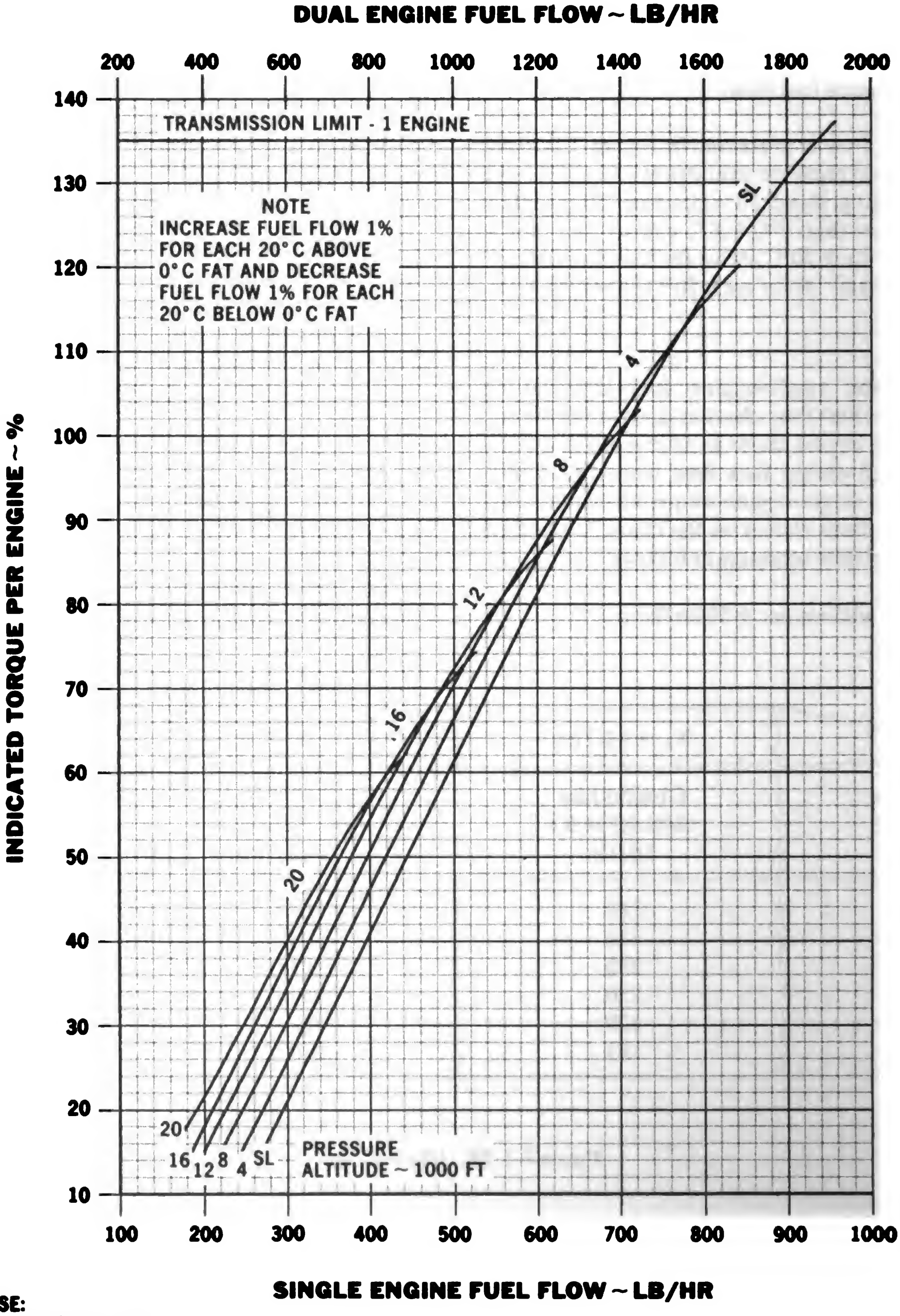
b. Cockpit heater on: + 12 lbs/hr

c. When the IR suppressor system is operating in the benign mode (exhaust baffles removed), the fuel flow decreases about 14 lbs/hr.

	N_g = 63-71%	N_g = 79-88%	
Pressure Altitude Feet	Ground Idle (66% RPM R) Lb/Hr	Flat Pitch (100% RPM R) Lb/Hr	APU (Nominal) Lb/Hr
0	360	590	120
4,000	310	515	105
8,000	280	445	90
12,000	250	400	75
16,000	220	340	65
20,000	185	280	55

Figure 7.1-24. Idle Fuel Flow

SINGLE/DUAL ENGINE FUEL FLOW
HIRSS SUPPRESSED MODE BLEED AIR OFF
100% RPM R FAT = 0°C



DATA BASE:
ENGINE MANUFACTURES
SPEC.

UH60A-153947 (C6)

Figure 7.1-25. Single/Dual-Engine Fuel Flow

Section X AIRSPEED SYSTEM CHARACTERISTICS

7.1-38. Airspeed System Description.

The UH-60L is equipped with the pitot-static system provided for the UH-60A with the ESSS provisions kit.

7.1-39. Airspeed Correction Charts.

All indicated airspeeds shown on the cruise charts are based on level flight. Figures 7.1-26 and 7.1-27 provides the airspeed correction to be added to the cruise chart IAS value to determine the related airspeed indicator reading for other than level flight mode. There are relatively large variations in airspeed system error associated with climbs and descents. These errors are significant and Figures 7.1-26 and 7.1-27 is provided primarily to show the general magnitude and direction of the errors associated with the various flight modes. If desired these figures may be used in the manner shown by the examples to calculate specific airspeed corrections.

7.1-40. Airspeed System Dynamic Characteristics.

The dynamic characteristics of the pilot and copilot airspeed indicating systems are normally satisfactory. However, the following anomalies in the airspeed and IVSI indicating system may be observed during the following maneuvers or conditions:

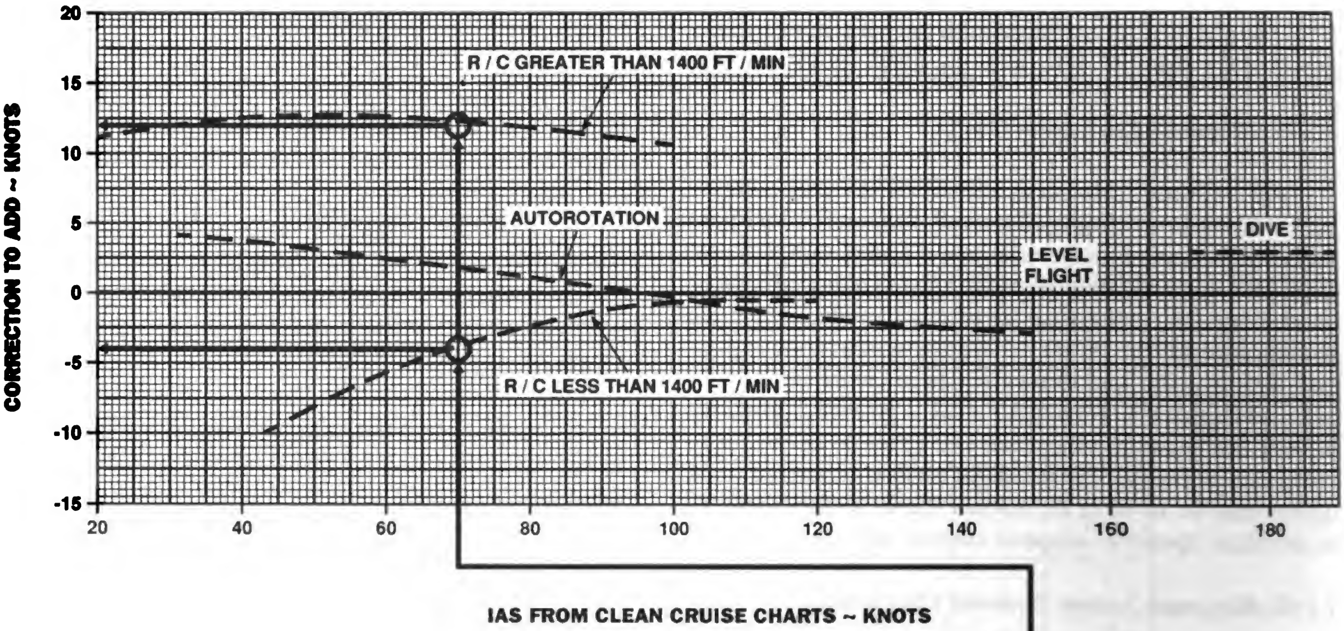
a. During takeoffs, in the speed range of 40 to 80 KIAS, 5 to 10 KIAS airspeed fluctuation may be observed on the pilot's and copilot's airspeed indicators.

b. Power changes in high power, low airspeed climbs may cause as much as 30 knot airspeed changes in indicated airspeed. Increase in power causes increase in indicated airspeed, and a decrease in power causes decrease in indicated airspeed.

c. The pilot and copilot airspeed indicators may be unreliable during high power climbs at low airspeeds (less than 50 KIAS) with the copilot system reading as much as 30 knots lower than the pilot system.

d. In-flight opening and closing of doors and windows may cause momentary fluctuations of approximately 300 feet per minute on the vertical speed indicators.

AIRSPEED SYSTEM CORRECTION



EXAMPLE

WANTED:

INDICATED AIRSPEED TO CLIMB AT MAXIMUM RATE OF CLIMB FOR AN AIRCRAFT WITH ESSS PROVISIONS KIT

KNOWN:

70 KIAS MAX END / AND R / C FROM APPROPRIATE CRUISE CHART FOR A GIVEN PRESSURE ALTITUDE, FAT, AND GROSS WEIGHT

METHOD:

ENTER AT KNOWN IAS FROM CRUISE CHART, MOVE UP TO R / C GREATER THAN 1,400 FPM, MOVE LEFT READ CORRECTION TO ADD TO IAS = +12.5 KTS, RE-ENTER AT KNOWN IAS FROM CRUISE CHART, MOVE UP TO R / C LESS THAN 1,400 FPM LINE, MOVE LEFT, READ CORRECTION TO ADD TO IAS = -4 KTS CALCULATE IAS FOR MAX R / C WHEN:

FOR R / C GREATER THAN 1,400 FPM, AIRSPEED = 70 KIAS +12.5 KIAS = 82.5 KIAS

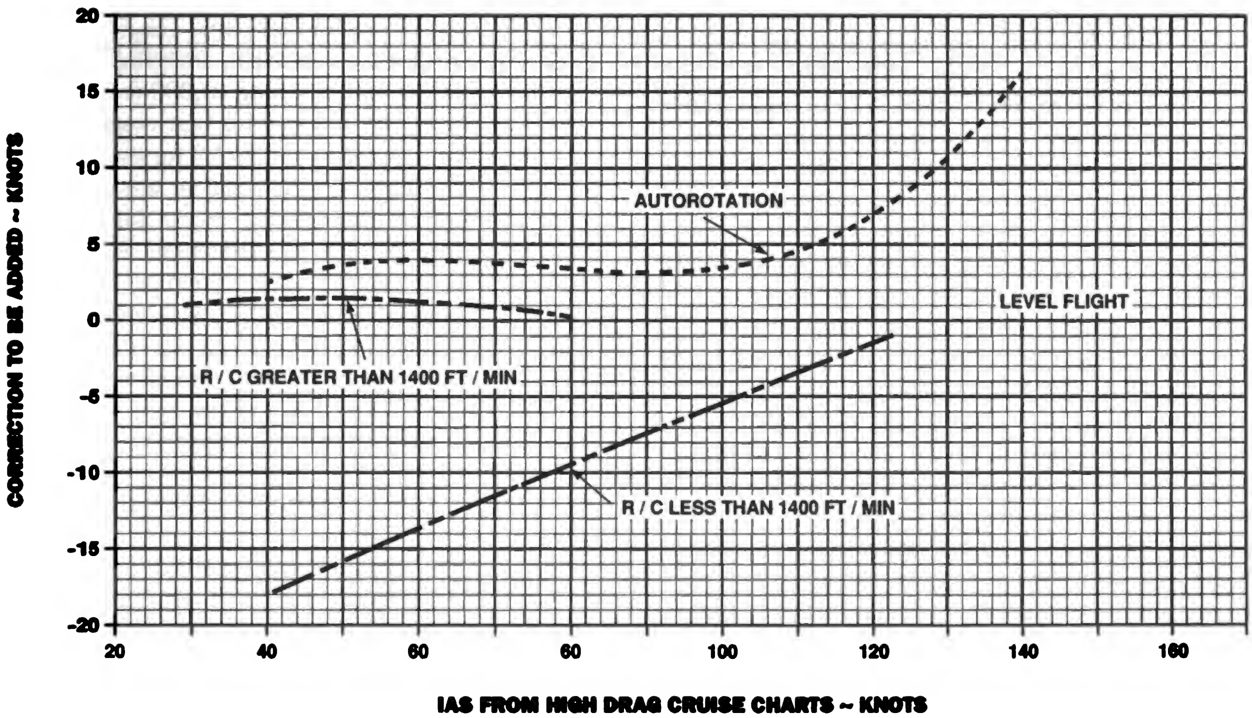
FOR R / C LESS THAN 1,400 FPM, AIRSPEED = 70 KIAS -4 KIAS = 66 KIAS

DATA BASE: FLIGHT TEST

AA0321
SA

Figure 7.1-26. Airspeed Correction

AIRSPEED SYSTEM CORRECTION



DATA BASE: FLIGHT TEST

AL0010 8A

Figure 7.1-27. Airspeed Correction Chart - High Drag

Section XI SPECIAL MISSION PERFORMANCE

7.1-41. Special Mission Flight Profiles.

Figures 7.1-28 through 7.1-30 show special mission flight profiles required to obtain near maximum range when equipped with the ESSS in three different tank configurations. The upper segment of each chart provides the recommended altitude profile along with the IAS and average TRQ versus distance traveled. An average value of elapsed time is also presented on the lower axis of the altitude scale. The lower segment of each chart provides the relationship between fuel remaining and distance traveled resulting from the flight profile shown. This portion may be utilized to check actual inflight range data to provide assurance that adequate range is being achieved. The chart is divided into 3 regions of Adequate Range, Inadequate range-return to base, and Inadequate range-requiring emergency action. When an in-flight range point is in the Adequate range region, the required mission range can be obtained by staying on the recommended flight profile. However, the range may not be achieved if stronger headwinds are encountered as the flight progresses, and normal pilot judgement must be used. These charts also assume that the flight track is within proper navigational limits. Standard temperature variation with PA is shown on the upper segment of the charts. A general correction for temperature variation is to decrease IAS by 2.5 KTS and total distance traveled by 0.5% for each 10°C above standard. Detailed flight planning must always be made for the actual aircraft configuration, fuel load, and flight conditions when maximum range is required.

(a) SELF-DEPLOYMENT MISSION.

The self-deployment mission is shown in Figue 7.1-28 and the ESSS is configured with two 230 gallon tanks outboard and two 450 gallon tanks inboard. In this configuration, the aircraft holds in excess of 11,000 lb of JP4 fuel and has a take-off gross weight of 24,500 pounds in order to achieve the desired mission range of 1,150 Nm. This gross weight is allowed for ferry missions only, requiring low load factors and less than 30 deg angle banked turns. This mission was calculated for a standard day with a constant 10 knot headwind added to be conservative. Since there may not be any emergency landing areas available, the misson should not be attempted if headwinds in excess of 10 knots are forecast. Take-off must be made with a minimum of fuel used (60 pounds) for engine start and warm-up, and a Climb to 2,000 feet should be made with max power and airspeed between 80 and 105 KIAS. The first sement should be maintained at 2,000 feet and 105 KIAS for 2 hours. The average engine TRQ should be about 79% for this segment, but will initially be a little more and gradually decrease. Altitude is increased in 2,000 feet increments to maintain the optimum altitude for max range to account for fuel burn. The first 2 segments are for 2 hours each, followed by 1 hr segments until reaching 10,000 feet. At this altitude, the airspeed for best range should also be reduced to 100 KIAS for the remainder of the flight. Engine bleed air was assumed to be off for this mission except for that required for fuel tank pressurization. Electrical cabin heat may be used. Removal of the HIRSS baffels (benign mode) will reduce fuel flow by about 12 lb/hr. If oxygen is available, continuation of the staircase climb sequence to 15,500 feet PA will result in about 23 additional Nm of range capability.

(b) ASSAULT MISSION PROFILE - 4 tanks

The assault mission profile is shown in Figure 7.1-29 with the ESSS configured with four 230 gallon tanks. In this configuration, the aircraft holds in excess of 8,300 pounds of JP4 fuel and assumes a take-off gross weight of 22,000 pounds which provides a maximum mission range of 980 Nm with 400 lbs reserve. This mission was calculated for a standard day with a zero headwind. Take-off must be made with a minimum of fuel used (80 pounds) for engine start and warm-up, and a Climb to 4,000 feet should be made with max power and airspeed between 80 and 108 KIAS. The first sement should be maintained at 4,000 feet and 108 KIAS for 1 hour. The average engine TRQ should be about 79% for this segment, but will initially be a little more and gradually decrease. Altitude is increased in 2,000 feet increments to maintain the optimum altitude for maximum range to account for fuel burn. The segments are for 1 hour each, until reaching 10,000 feet. At this altitude, the airspeed for best range should be reduced to 100 KIAS for the remainder of the flight.

(c) ASSAULT MISSION PROFILE - 2 tanks

The assault mission profile is shown in Figure 7.1-30 with the ESSS configured with two 230 gallon tanks. In this configuration, the aircraft holds in excess of 5,300 pounds of JP4 fuel and assumes a take-off gross weight of 22,000 pounds which provides a maximum mission range of 580 Nm. with 400 lb reserve. This mission was calculated for a standard day with a zero headwind. Take-off must be made with a minimum of fuel used (80 lbs) for engine start and warm-up, and a Climb to 4,000 feet should be made with max power and airspeed between 80 and 108 KIAS. The first sement should be maintained at 4,000 feet and 108 KIAS for 1 hour. The average engine TRQ should be about 77% for this segment, but will initially be a little more and gradually decrease as shown on each segment. Altitude is increased in 2,000 feet increments to maintain the optimum altitude for maximum range to account for fuel burn. At this altitude, the airspeed for best range should also be reduced to 100 KIAS for the remainder of the flight.

EXAMPLE:

WANTED:

Assurance of adequate aircraft range for mission defined.

KNOWN:

Flight position: 300 nm from base
Flight Track Within Limits
Fuel Remaining = 7,900 pounds
Elapsed flight time = 2 HRS, 50 MINS (2.83 HRS)
Target: Nominal Flight Conditions:
Airspeed = 105 KIAS
Press Alt = 2,000 feet
Approx Torque = 74%

METHOD:

(1) Enter chart at total distance flown and at fuel remaining, move to intersection and plot point. If point falls on or above fuel remaining line (adequate range), remaining fuel is adequate to complete the mission. If point falls below the fuel remaining line in the inadequate range, abort mission region, immediately return to departure point while continuing to utilize altitude profile using total elapsed flight time (see item 2). If point falls below the fuel remaining line in the adequate range region, consult emergency procedures for corrective action.

(2) To determine target nominal flight conditions, enter upper chart at elapsed flight time and move up to determine target airspeed, approximate torque, and pressure altitude.

Figure 7.1-28. Self Deployment Mission Profile (Sheet 1 of 2)

SELF DEPLOYMENT MISSION PROFILE

ESSS/2-230 AND 2-450 GALLON TANK CONFIGURATION
STANDARD DAY 10 KT HEADWIND
HIRSS SUPPRESSED MODE

GROSS WEIGHT = 24,500 LB **FUEL LOAD = 11,000 LB (JP4)**
BLEED AIR OFF **60 LB WARM UP**

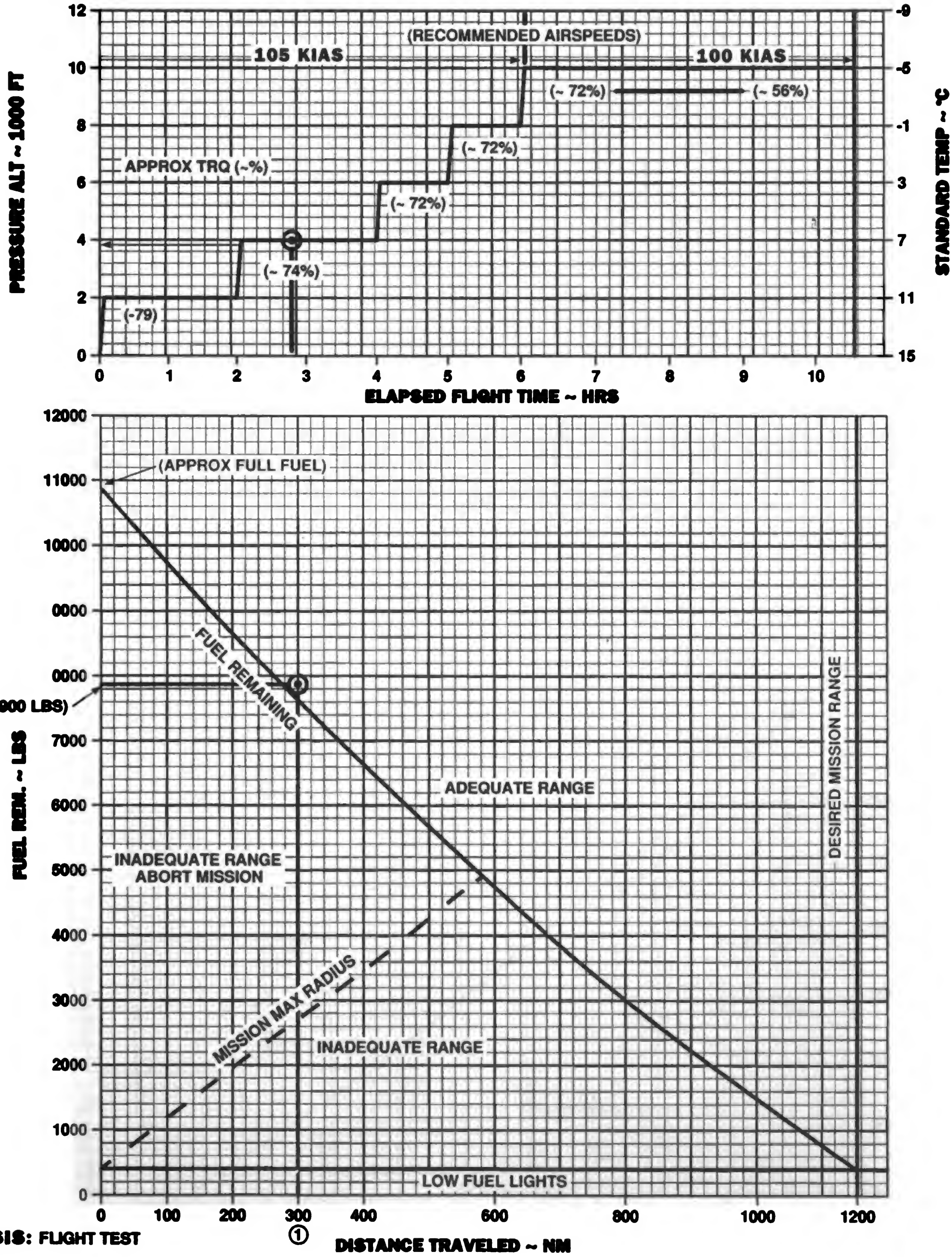


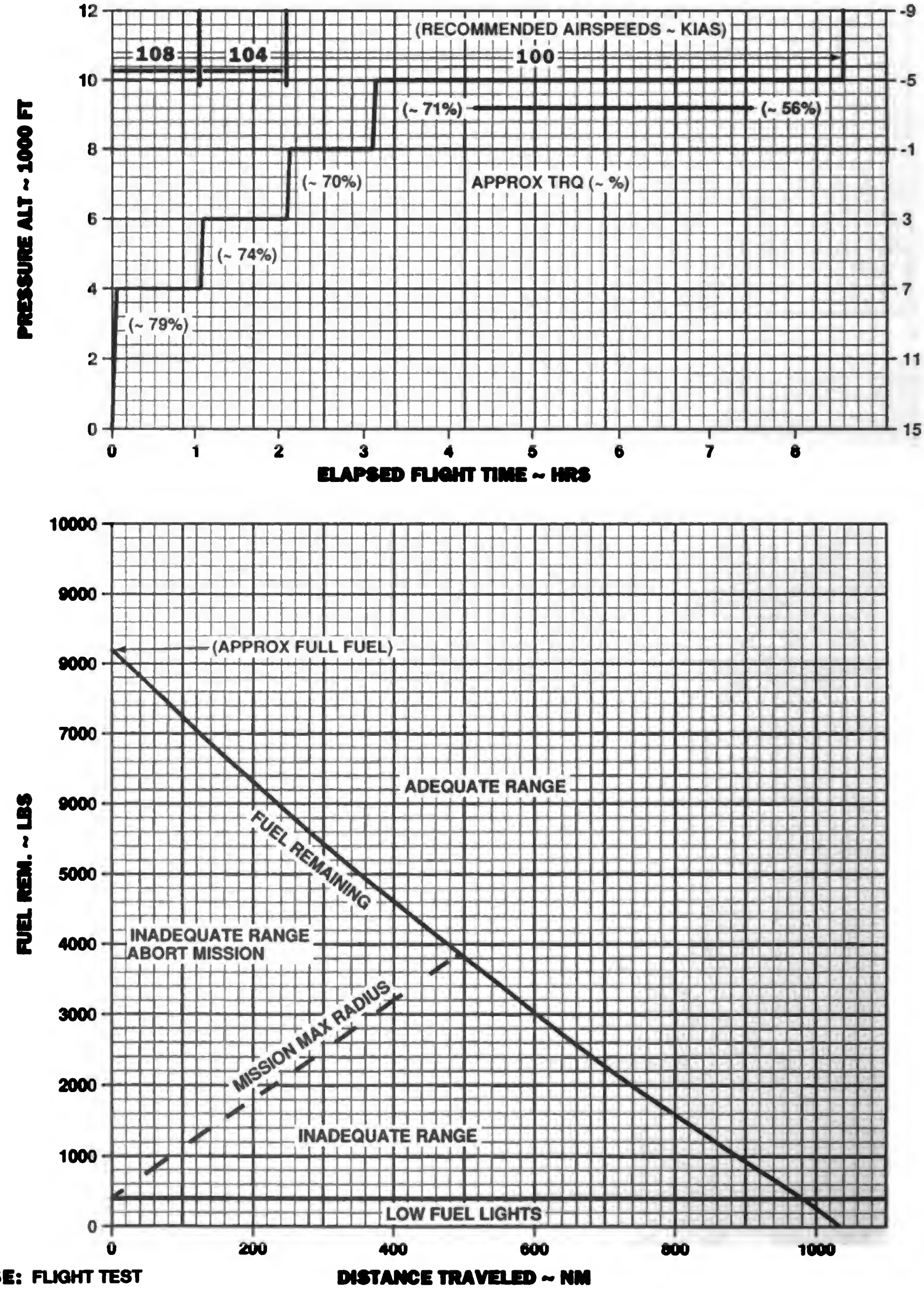
Figure 7.1-28. Self Deployment Mission Profile (Sheet 2 of 2)

ASSAULT MISSION PROFILE FOR MAX RANGE

ESSS/4-230 GALLON TANK CONFIGURATION
STANDARD DAY ZERO HEADWIND
HIRSS SUPPRESSED MODE

GROSS WEIGHT = 22000 LB
BLEED AIR OFF

FUEL LOAD = 8280 LB (JP4)
60 LB WARM UP



DATA BASE: FLIGHT TEST

AL0012

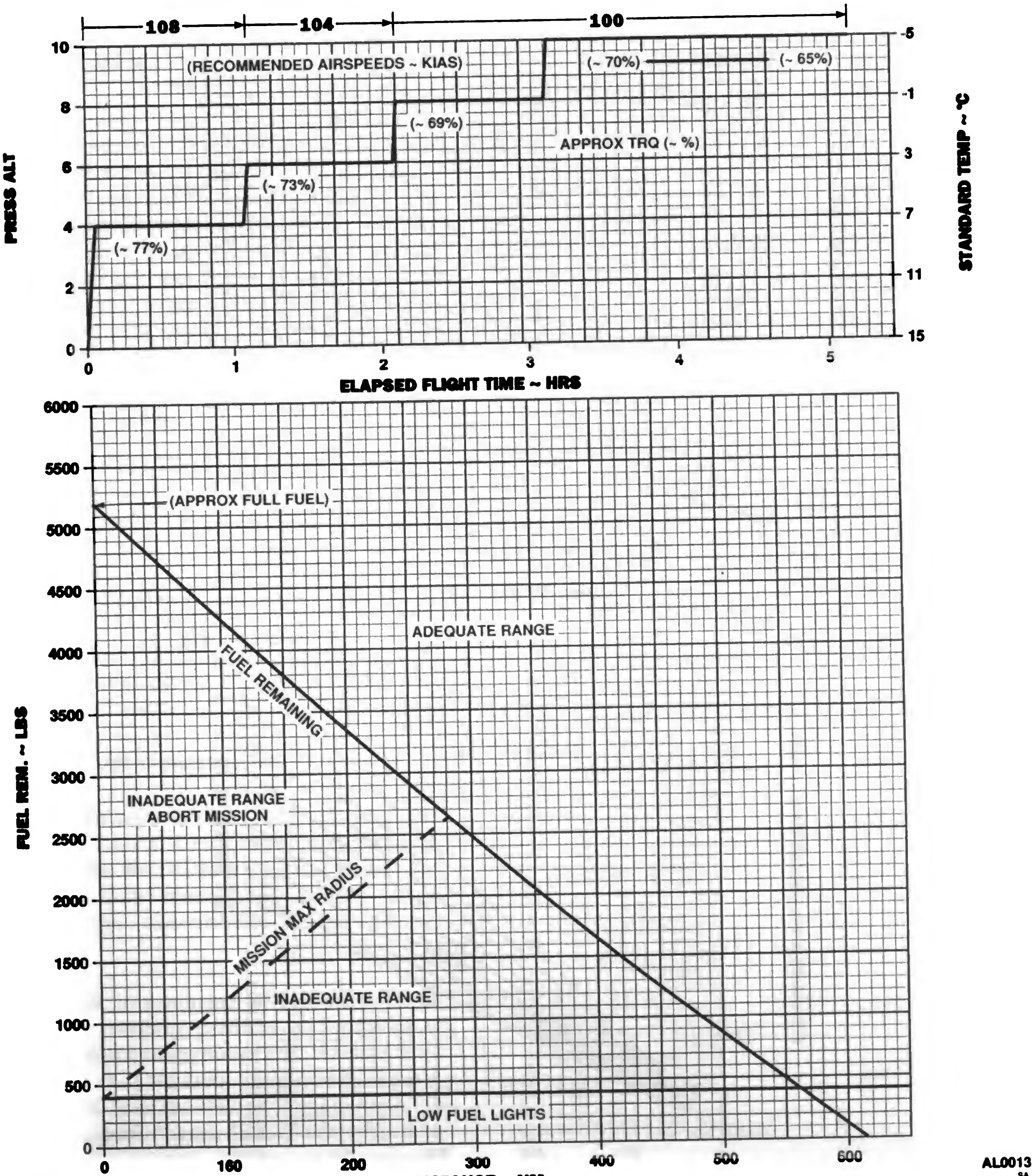
Figure 7.1-29. Assault Mission Profile (4 - 230 Gallon Tanks)

ASSAULT MISSION PROFILE FOR MAX RANGE
ESSS/2-230 GALLON TANK CONFIGURATION
STANDARD DAY ZERO HEADWIND
HIRSS SUPPRESSED MODE

ASSAULT MISSION 701C(2)

GROSS WEIGHT = 2,200 LB
BLEED AIR OFF

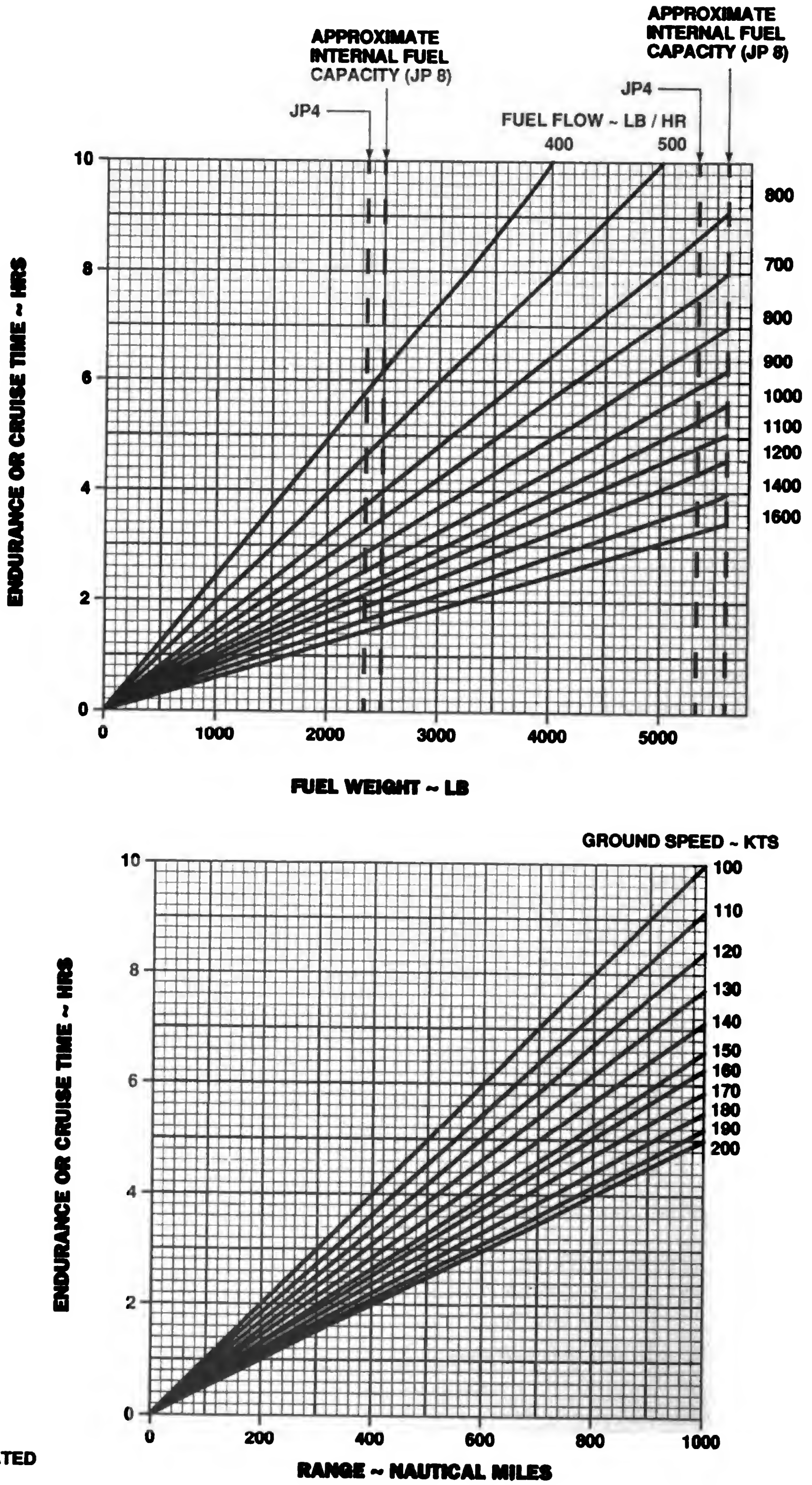
FUEL LOAD = 5,280 LB (JP4)
80 LB WARM UP



DATA BASE: FLIGHT TEST

Figure 7.1-30. Assault Mission Profile (2 - 230 Gallon Tanks)

CRUISE CAPABILITY
ESSS CONFIGURATION WITH 2-230 GAL TANKS



DATA BASE: CALCULATED

AL0014
8A

Figure 7.1-31. Cruise Capability

CHAPTER 8
NORMAL PROCEDURES

Section I MISSION PLANNING

8-1. MISSION PLANNING.

Mission planning begins when the mission is assigned and extends to the preflight check of the helicopter. It includes, but is not limited to checks of operating limits and restrictions; weight, balance, and loading; performance; publications; flight plan; and crew and passenger briefings. The pilot in command shall ensure compliance with the contents of this manual that are applicable to the mission and all aviation support equipment required for the mission (e.g., helmets, gloves, survival vests, survival kits, etc).

8-1.1. EH-60A Data. EH

AN/ALQ-151(V)2 mission operator duties, equipment checks, system initialization procedures, and self-test procedures are outlined in TM 32-5865-012-10.

8-2. AVIATION LIFE SUPPORT EQUIPMENT (ALSE).

All aviation life support equipment required for mission; e.g., helmets, gloves, survival vests, survival kits, etc., shall be checked.

8-3. CREW DUTIES/RESPONSIBILITIES.

The minimum crew required to fly the helicopter is two pilots. Additional crewmembers, as required, may be added at the discretion of the commander. The manner in which each crewmember performs his related duties is the responsibility of the pilot in command.

a. The pilot in command is responsible for all aspects of mission planning, preflight, and operation of the helicopter. He will assign duties and functions to all other crewmembers as required. Prior to or during preflight, the pilot will brief the crew on items pertinent to the mission; e.g., performance data, monitoring of instruments, communications, emergency procedures, taxi, and load operations.

b. The pilot must be familiar with the pilot duties and the duties of the other crew positions. The copilot will assist the pilot as directed.

c. The crew chief will perform all duties as assigned by the pilot.

8-4. CREW BRIEFING.

A crew briefing shall be conducted to ensure a thorough understanding of individual and team responsibilities. The briefing should include, but not be limited to, pilots, crew chief, mission equipment operator, ground crew responsibilities, and the coordination necessary to complete the mission in the most efficient manner. A review of visual signals is desirable when ground guides do not have direct voice communications link with the crew.

★ 8-5. PASSENGER BRIEFING.

The following guide may be used in accomplishing required passenger briefings. Items that do not pertain to a specific mission may be omitted.

a. Crew introduction.

b. Equipment.

(1) Personal, to include ID tags.

(2) Professional.

(3) Survival.

c. Flight data.

(1) Route.

(2) Altitude.

(3) Time en route.

(4) Weather.

d. Normal procedures.

(1) Entry and exit the helicopter.

(2) Seating.

(3) Seat belts.

(4) Movement in helicopter.

(5) Internal communications.

(6) Security of equipment.

(7) Smoking.

(8) Oxygen.

(9) Refueling.

(10) Weapons.

(11) Protective masks.

(12) Parachutes.

(13) Hearing protection.

(14) Aviation life support equipment (ALSE).

e. Emergency procedures.

(1) Emergency exits.

(2) Emergency equipment.

(3) Emergency landing/ditching procedures.

Section II OPERATING PROCEDURES AND MANEUVERS

8-6. OPERATING PROCEDURES AND MANEUVERS.

This section deals with normal procedures and includes all steps necessary to ensure safe and efficient operation of the helicopter from the time a preflight begins until the flight is completed and the helicopter is parked and secured. Unique feel, characteristics, and reaction of the helicopter during various phases of operation and the techniques and procedures used for taxiing, takeoff, climb, etc., are described, including precautions to be observed. Your flying experience is recognized; therefore, basic flight principles are avoided. Only the duties of the minimum crew necessary for the actual operation of the helicopter are included. Additional crew duties are covered as necessary in Section I Mission Planning. Mission equipment checks are contained in Chapter 4 Mission Equipment. Procedures specifically related to instrument flight that are different from normal procedures are covered in this section, following normal procedures. Descriptions of functions, operations, and effects of controls are covered in Section IV Flight Characteristics, and are repeated in this section only when required for emphasis. Checks that must be performed under adverse environmental conditions, such as desert and cold-weather operations, supplement normal procedures checks in this section and are covered in Section V Adverse Environmental Conditions.

8-7. SYMBOLS DEFINITION.

Items which apply only to night or only to instrument flying shall have an N or an I, respectively, immediately preceding the check to which it is pertinent. The symbol O shall be used to indicate "if installed". Those duties which are the responsibility of the non-flying pilot, will be indicated by a circle around the step number; i.e., (4). The symbol star ★ indicates an operational check is required. Operational checks are contained in the performance section of the condensed checklist. The asterisk symbol * indicates that performance of step is mandatory for all thru-flights. The asterisk applies only to checks performed prior to takeoff. Placarded items such as switch and control labels appear in uppercase type.

8-8. CHECKLIST.

Normal procedures are given primarily in checklist form, and amplified as necessary in accompanying paragraph form, when a detailed description of a procedure or maneuver is required. A condensed version of the amplified checklist, omitting all explanatory text, is contained in the operator's checklist. To provide for easier cross-referencing, the procedural steps in the checklist are numbered to coincide with the corresponding numbered steps in this manual.

8-9. PREFLIGHT CHECK.

The pilot's walkaround and interior checks are outlined in the following procedures. The preflight check is not intended to be a detailed mechanical inspection. The preflight order is a recommended sequence only. The expanded substeps do not need to be memorized or accomplished in order. The steps that are essential for safe helicopter operation are included. The preflight may be made as comprehensive as conditions warrant at the discretion of the pilot.

8-10. BEFORE EXTERIOR CHECK (Figure 8-1).

WARNING

Do not preflight until armament systems are safe, switches off, safety pins installed and locking levers in locked position.

1. Publications - Check DA Forms 2408-12, -13, -14, and -18; DD Form 365-4; required forms and publications, and availability of operator's manual(s) (-10) and checklist (-CL).

*2. Helicopter covers, locking devices, tiedowns, and grounding cables - Removed and secured.

*3. Fuel - Check quantity as required.

4. Fuel sample - As required. Check for contamination before first flight of the day and after adequate settling time after cold refueling, or if fuel source is suspected contaminated.

8-11. EXTERIOR CHECK.

Exterior walkaround diagram is shown in Figure 8-1.

8-12. NOSE SECTION (AREA 1).

CAUTION

Do not deflect main rotor blade tips more than 6 inches below normal droop position when attaching tiedowns. Do not tie down below normal droop position.

*1. Main rotor blades - Check.

2. Fuselage - Nose area, check as follows:

a. Windshield and wipers - Check.

O b. OAT sensor - Check.

c. Avionics compartment - Check equipment as required; secure door.

d. Antennas - Check.

e. Landing and search lights - Check.

8-13. COCKPIT - LEFT SIDE (AREA 2).

1. Cockpit area - Check as follows:

a. Cockpit door - Check.

b. Copilot seat, belts, and harness - Check.

c. FM and EH antennas - Check.

d. Landing gear support fairing and step - Check.

e. Position light - Check.

f. Main landing gear - Check.

ES O g. HSS, VSP, ejector rack locking levers locked, fairing, and external tanks - Check; refueling caps secure.

h. Gunner's window - Check.

i. Ambient sense port - Check.

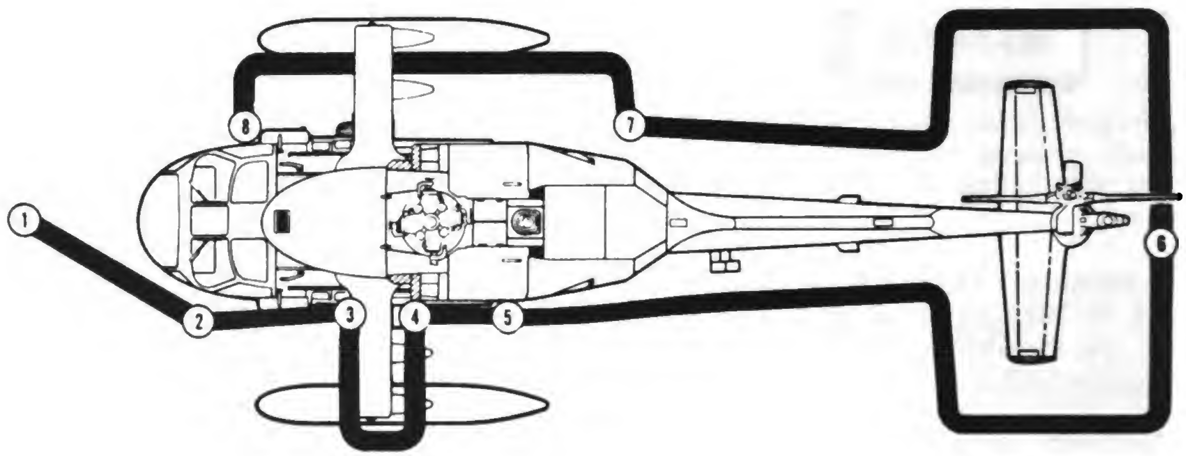
*2. Left engine oil level - Check.

8-14. CABIN TOP (AREA 3).

1. Cabin top - Check as follows:

a. Left engine - Check inlet.

b. Left pitot tube - Check.



AREA 1 NOSE SECTION
AREA 2 COCKPIT - LEFT SIDE
AREA 3 CABIN TOP
AREA 4 INTERIOR CABIN
AREA 5 FUSELAGE-LEFT SIDE
AREA 6 TAIL PYLON
AREA 7 FUSELAGE-RIGHT SIDE
AREA 8 COCKPIT-RIGHT SIDE

S 45320 (BH2)

Figure 8-1. Exterior Check Diagram

c. Control access - Check flight controls, hydraulic reservoir, and filter indicators. Check tempilabels for safe indication and security. Check area.

d. Control access cover - Close and check secured.

e. Right pitot tube - Check.

f. Right engine - Check; inlet.

O g. IRCM - Check.

2. APU - Check; oil level, use dipstick.

O 2.1. APU IPS - Check.

3. Gust lock - Check.

4. Main transmission - Check; oil level.

*5. Main rotor system - Check controls, dampers, head, and blades. BIM indicators - Check for safe indication (yellow color).

8-15. INTERIOR CABIN (AREA 4).

1. Cabin - Check as follows:

a. Fire extinguishers - Check.

b. First aid kits - Check.

c. Pilot's and copilot's tilt-back release levers - Lock position.

d. Cabin interior - Check security of stowed equipment.

e. Cabin seats and belts - Check.

2. APU accumulator pressure gage - Check minimum 2,800 psi.

3. Transmission oil filter impending bypass indicator - Check.

4. Survival gear and mission equipment Check as required.

8-16. FUSELAGE - LEFT SIDE (AREA 5).

1. Fuselage - Check as follows:

a. Cabin door - Check.

b. Fuel tank filler ports - Check; caps secure, doors secured.

c. External pneumatic inlet port - Door secured.

d. Engine exhaust - Check.

O d.1. APU IPS exhaust - Check.

e. APU exhaust - Check.

O f. Chaff and EH flare dispensers - Check; number and programmer settings.

g. Lower anticollision light - Check.

h. Antennas - Check.

i. Tail landing gear - Check.

*2. Intermediate gear box - Check; oil level.

8-17. TAIL PYLON (AREA 6).

1. Tail pylon - Check as follows:

a. Tail pylon - Check.

b. Stabilator - Check.

O c. Radar detector EH antennas - Check.

d. Position light - Check.

e. Upper anticollision light - Check.

*2. Tail rotor - Check.

*3. Tail rotor gear box - Check; oil level.

8-18. FUSELAGE RIGHT SIDE (AREA 7).

1. FUSELAGE - Check as follows:

a. Antennas - Check.

EH b. Aft avionics compartment circuit breakers and ECS fluid level - Check.

c. Fire bottles thermal plug - Check.

d. Engine exhaust - Check.

e. Fuel tank gravity filler port - Check cap secure; door secured.

f. Cabin door - Check.

8-19. COCKPIT - RIGHT SIDE (AREA 8).

*1. Right engine oil level - Check.

2. Cockpit area - Check as follows:

O a. Ice detector - Check.

b. Ambient sense port - Check.

O b1. HSS, VSP, ejector rack locking levers locked, safety pins installed, fairings, and external tanks - Check; refueling caps secure. EH

c. Gunners window - Check.

d. External electrical power receptacle - Door secured.

e. Main landing gear - Check.

f. Position light - Check.

g. Landing gear support fairing and step - Check.

h. FM and EH antennas - Check.

i. Cockpit door - Check.

j. Pilot seat, belt, and harness - Check.

O k. Set switch on dimmer control box as desired. NORM for IR Dimming.

★*3. Crew and passenger briefing - Complete as required.

8-20. BEFORE STARTING ENGINES.

*1. Copilots collective - Extended and locked.

2. Shoulder harness locks - Check.

3. PARKING BRAKES - Release, then set.

★4. Circuit breakers and switches - Set as follows:

a. Circuit breakers - In.

b. Avionics - Off, frequencies set.

c. BLADE DE-ICE POWER - OFF.

d. Radar altimeter - Set. EH Left LO bug 200 feet.

e. Clocks - Set and running.

f. BACKUP HYD PUMP - AUTO.

WARNING

White strobe lights may cause a safety hazard. Personnel may be affected by the brilliance and pulse of the light.

*g. ANTICOLLISION/POSITION LIGHTS - As required.

*h. Q/F PWR switch - OFF. EH

O *i. ECS panel switches - OFF. EH

j. CARGO HOOK EMER REL - OPEN, ARMING switch - SAFE.

k. APU CONTR switch - OFF; APU T-Handle - In.

l. Ground power unit - Connected if required.

*m. AIR SOURCE HEAT/START switch - APU (OFF for external air source).

n. EMER OFF T-Handles - Full forward.

*o. BATT switch - ON.

8-21. COCKPIT EQUIPMENT CHECKS.

*1. FUEL PUMP switch - APU BOOST.

*2. APU CONTR switch - ON.

NOTE

If the APU does not start and the APU ACCUM LOW advisory light is not on, the manual override lever on the accumulator manifold should be pulled to attempt another start, and held until the APU has reached self-sustaining speed.

If APU fails, note and analyze BITE indications before cycling BATT switch or before attempting another APU start.

WARNING

Stabilator will move to full trailing edge down position upon application of AC power. Assure stabilator area is clear prior to energizing stabilator system.

*3. APU generator - ON.

*4. EXT PWR switch - OFF and cable disconnected.

O★5. ESSS AUXILIARY FUEL MANAGEMENT panel - TEST. ES

EH *6. IINS system SELECT switches - DG and VG.

★*7. IINS - Align. EH

8. Caution/advisory/warning panels - Check as required.

a. Caution/advisory panel BRT/DIM-TEST switch - TEST. Caution/advisory/warning, CIS/MODE SEL and VSI advisory lights on. #1 and #2 FUEL LOW caution lights flashing. On helicopters equipped with NVG compatible lighting, AFCS FAILURE ADVISORY lights will illuminate. EH System select switches will illuminate. EH ASE advisory light - Press to test.

N b. INSTR LTS PILOT'S FLT control - ON.

N c. Caution/advisory BRT/DIM-TEST switch - BRT/DIM momentarily and then to TEST.

N d. All caution/advisory/warning panels CIS/MODE SEL and VSI advisory lights on at decreased intensity. On helicopters equipped with NVG compatible lighting, AFCS FAILURE ADVISORY lights will not dim.

8.1. DEC engine fault indicator codes - Check for signal validation as required. -701C

NOTE

If DEC signal validation codes are displayed on the % TRQ indicator, do not fly the helicopter.

N 9. Interior/exterior lighting - Set.

O★10. Mission equipment - Check.

★*11. Cold weather control exercise - Check if temperature is below − 17°C.

*12. AFCS FAILURE ADVISORY lights - If on, POWER ON RESET.

*13. SAS1 off, SAS2, TRIM, FPS, and BOOST switches - Push on.

★14. Flight controls - Check first aircraft flight of day as follows:

a. Collective - Midposition, pedals centered.

b. BOOST switch - Press off. BOOST SERVO OFF caution light on. MASTER CAUTION light should be on.

c. Right SVO OFF switch - 1ST STG. No allowable stick jump. #1 PRI SERVO PRESS, and MASTER CAUTION light should be on.

d. Move cyclic and pedals slowly through full range. There should be no binds or restrictions. Move collective through full range in about 1 to 2 seconds. Check #2 PRI SERVO PRESS caution light does not illuminate during movement of collective.

e. Right SVO OFF switch - 2nd STG. No allowable stick jump. #2 PRI SERVO PRESS and MASTER CAUTION light should be on.

f. Repeat step d. above. Check #1 PRI SERVO PRESS caution light does not illuminate during movement of collective.

NOTE

If #1 PRI SERVO PRESS or #2 PRI SERVO PRESS caution light illuminates during collective movement servo bypass valve may be jammed.

g. SVO OFF switch - Center.

NOTE

During steps h. and i., check for not more than 1.5 inches of freeplay in control.

h. Collective - Move through full range in no less than 5 seconds. Note slight increase in control forces but that full control range with no binds or restrictions present.

i. Pedals - Move both pedals through the full range in no less than 5 seconds. There should be no binding. Also note slight increase in control forces.

j. TAIL SERVO switch - BACKUP. #1 TAIL RTR SERVO caution and both MASTER caution lights illuminate, #2 TAIL RTR SERVO ON advisory light illuminates, move pedals through full range in no less than 5 seconds. There should be no binding. Also note slight increase in control forces.

k. TAIL SERVO switch - NORMAL. Caution and advisory lights out.

l. BOOST switch - ON. BOOST SERVO caution light should be off.

★15. Stabilator - Check.

NOTE

The left STAB POS indicator may vary from right indicator as much as ±2°.

a. STAB POS indicator should be at 34° to 42° DN.

b. TEST button - Press and hold. Check STAB POS indicator moves up 5° to 12°. MASTER CAUTION and STABILATOR caution lights on; stabilator audio heard.

c. AUTO CONTROL RESET switch - Press ON. Note that the STABILATOR caution light and audio are off, and STAB POS indicator moves to 34° to 42° down.

d. Either cyclic slew-up switch - Press and hold until STAB POS indicator moves approximately 15° trailing edge up, release, stabilator should stop. STABILATOR and MASTER CAUTION lights ON and beeping audible warning in pilot's and copilot's headsets. MASTER CAUTION - Press to reset audio tone.

e. Other cyclic slew-up switch - Press and hold until STAB POS indicator moves approximately 15° trailing edge up, release, stabilator should stop.

f. MAN SLEW switch - UP and hold until stabilator stops. STAB POS indicator should be 6° to 10° up.

g. MAN SLEW switch - DN and hold until STAB POS indicator reads 0°.

h. AUTO CONTROL RESET switch - Press ON. STAB POS indicator should move 34° to 42° DN. STABILATOR caution light off.

NOTE

If any part of stabilator check fails, do not fly helicopter.

*16. Avionics - ON.

*17. COMPASS switch - SLAVED. Set as required.

18. Radar Altimeter - SET. EH Left LO Bug set to 200'.

19. Barometric altimeters - Set.

*20. Cyclic and pedals centered. Collective raise no more than 1 inch (to prevent droop stop pounding) and friction.

21. BACKUP HYD PUMP switch - OFF. BACKUP PUMP ON advisory light off.

O★22. Blade deice system - Test as required.

NOTE

To prevent overheating of droop stops, blade deice test shall not be done more than one time within a 30-minute period when rotor head is not turning.

a. Ice rate meter PRESS TO TEST button - Press and release.

b. Ice rate meter indicator - Moves to half scale (1.0), holds about 50 seconds; then falls to 0 or below. ICE DETECTED and MASTER caution lights on after 15 - 20 seconds into the test, and FAIL flag should not be visible in flag window. Ice rate meter should move to zero within 75 seconds after pressing PRESS TO TEST button.

NOTE

PWR MAIN RTR, and PWR TAIL RTR fault monitor lights may flicker during tests in steps e. through r.

c. BLADE DE-ICE TEST panel. select switch - NORM.

d. BLADE DE-ICE POWER switch - TEST.

e. PWR MAIN RTR and TAIL RTR monitor lights - Check. MAIN RTR monitor light may go on for 2 - 4 seconds. If either light remains on for 10 seconds or more:

(1) BLADE DE-ICE POWER switch - OFF. If either light is still on,

(2) GENERATORS APU switch and/or EXT PWR - OFF.

f. TEST IN PROGRESS light - Check. The light should be on for 105 to 135 seconds. No other blade de-ice system lights should be on. PWR MAIN RTR and TAIL RTR monitor lights should go on for 2 - 4 seconds near end of test. The TEST IN PROGRESS light should then go off.

WARNING

Droop stop hinge pins and cams may become very hot during test. Use care when touching those components.

g. Crewman touch each droop stop cam - Cams should be warm to touch.

h. BLADE DE-ICE POWER switch - OFF.

i. BLADE DE-ICE TEST select switch - SYNC 1.

j. BLADE DE-ICE POWER switch - TEST. MR DE-ICE FAIL and MASTER CAUTION lights on.

k. BLADE DE-ICE POWER switch - OFF. MR DE-ICE FAIL and MASTER CAUTION lights off.

l. BLADE DE-ICE TEST panel select switch - SYNC 2.

m. BLADE DE-ICE POWER switch - TEST. MR DE-ICE FAIL and MASTER CAUTION lights on.

n. BLADE DE-ICE POWER switch - OFF. MR DE-ICE FAIL and MASTER CAUTION lights off.

o. BLADE DE-ICE TEST SELECT switch - OAT.

p. BLADE DE-ICE POWER switch - TEST. MR DE-ICE FAIL, TR DE-ICE FAIL, and MASTER CAUTION lights on.

q. BLADE DE-ICE POWER switch - OFF. MR DE-ICE FAIL, TR DE-ICE FAIL, and MASTER CAUTION lights off.

23. Avionics - Check as required.

8-22. STARTING ENGINES.

*1. ENG FUEL SYS selector(s) - XFD for first start of day.

*2. FUEL BOOST PUMP CONTROL switch(es) - As required. (ON when operating with JP-4 fuel.)

*3. ENGINE IGNITION switch - ON.

*4. GUST LOCK caution light - Off.

*5. Fire guard - Posted if available.

*6. Rotor blades - Check clear.

★*7. Engine(s) - Start as follows:

CAUTION

If start is attempted with ENGINE IGNITION switch OFF, do not place switch ON. Complete EMER ENG SHUTDOWN procedure.

a. If any of these indications occur, perform EMER ENG SHUTDOWN as required.

(1) No TGT indication within 45 seconds.

(2) No ENG OIL PRESS within 45 seconds.

(3) No % RPM 1 or 2 within 45 seconds.

(4) ENGINE STARTER caution light goes off before reaching 52% Ng SPEED.

(5) TGT reaches 850°C before idle is attained (Ng 63%).

CAUTION

To avoid damage to the engine start switch actuators, do not move the ENG POWER CONT lever from IDLE to OFF while pressing the starter button.

During engine start and runup ensure that cyclic is kept in neutral, collective no more than one inch above full down, and pedals centered until % RPM R reaches 50% minimum to prevent damage to anti-flap bracket bushings.

b. Starter button(s) - Press until Ng SPEED increases; release.

NOTE

If an ENGINE STARTER CAUTION light goes off when the starter button is released, and the ENG POWER CONT lever is OFF, the start attempt may be continued by pressing and holding the starter button until 52% - 65% Ng SPEED is reached; then release button.

c. TGT - Check below 150°C 700 or 80°C 701C before advancing ENG POWER CONT levers.

d. ENG POWER CONT lever(s) - IDLE. Start clock.

e. System indications - Check.

f. ENGINE STARTER caution light(s). Check, OFF at 52% - 65% Ng SPEED. If ENGINE STARTER caution light remains on after 65% Ng.

(1) ENG POWER CONT lever - Pull out.

If caution light remains on:

(2) APU - OFF or engine air source remove as required.

*8. If single-engine start was made, repeat step 7 for other engine.

*9. Systems - Check.

a. Ng SPEEDS 63% or more.

b. % RPM - Check that % RPM 1 or 2 is not in the range of 20% to 40% and 60% to 90%. Advance ENG POWER CONT lever(s) as required.

c. XMSN PRESS - Check.

d. ENG OIL PRESS - Check.

e. #1 and #2 HYD PUMP caution lights - Check off.

*10. BACKUP HYD PUMP switch - AUTO.

★ 11. Hydraulic leak test system - Check as follows:

NOTE

EH It is normal for the IINS CDU screen to blank momentarily during the Hydraulic Leak Test system check.

NOTE

When performing the HYD LEAK TEST, all Leak detection/isolation system components are checked electrically. Manually holding the HYD LEAK TEST switch in the test position does not allow the Lead detection/isolation system to be checked automatically. It manually holds the circuits open. The switch must be placed in the TEST position and released.

a. HYD LEAK TEST switch - TEST. #1 TAIL ROTOR SERVO, BOOST SERVO OFF, SAS OFF, #1 and #2 RSVR LOW, BACKUP RSVR LOW, and MASTER CAUTION lights and #2 TAIL RTR SERVO ON and BACK-UP PUMP ON advisory lights on. During this check, it is normal for the collective and pedals to move slightly.

b. HYD LEAK TEST switch - RESET. The lights in step a. should go off.

NOTE

If the backup pump is still running following the hydraulic leak test, cycle the BACKUP PUMP switch to OFF then back to AUTO.

★12. Tail Rotor Servo Transfer - Check.

a. BACKUP HYD PUMP - AUTO with backup pump not running.

b. TAIL SERVO - BACKUP. #1 TAIL RTR SERVO caution light on and #2 TAIL RTR SERVO ON and BACK-UP PUMP ON advisory lights on within 3 - 5 seconds.

c. TAIL SERVO switch - NORMAL. #1 TAIL RTR SERVO caution light and #2 TAIL RTR SERVO ON advisory light off. BACK-UP PUMP ON advisory light remains on for approximately 90 seconds.

O 13. AUX CABIN HEATER switches - Desired.

NOTE

Cabin temperature must be below 29°C (84°F) for heat to go on, and above 10°C (50°F) for the heater to shut off.

★*14. Cold weather control exercise - Check if temperature is below −17°C.

8-23. ENGINE RUNUP.

*1. Flight controls - Hold.

CAUTION

Restrict the rate of ENG POWER CONT lever's movement, when the tailwheel lockpin is not engaged. Rapid application of ENG POWER CONT levers can result in turning the helicopter.

*2. ENG POWER CONT lever(s) - FLY.

*3. Droop stops - Check out 70% to 75% RPM R.

*4. #1 and #2 GEN caution lights - OFF.

CAUTION

During operation of the air conditioner system, the right cabin door should remain closed. If opening is required, the right cabin door should not remain open for more than 1 minute.

*4.1. ECS Panel switches - As desired. EH

NOTE

ECS heater will operate with either backup pump or windshield anti-ice operating, but not with both at same time.

O★5. DE-ICE EOT - Check as required.

CAUTION

In ambient temperatures above 21°C (70°F), operate rotor at 100% RPM R for 5 minutes before doing the deice EOT check, to prevent blade overheating. Do not do the deice EOT check if OAT is above 38°C (100°F).

a. BLADE DE-ICE TEST select switch - EOT.

b. BLADE DE-ICE MODE select switch - MANUAL M.

c. BLADE DE-ICE POWER switch - ON.

d. TR DE-ICE FAIL and MASTER CAUTION caution lights on after 15 - 30 seconds, and MR DE-ICE FAIL caution light on after 50 - 70 seconds.

e. BLADE DE-ICE POWER switch - OFF. TR DE-ICE FAIL, MR DE-ICE FAIL, and MASTER CAUTION lights off.

f. BLADE DE-ICE TEST select switch - NORM.

NOTE

If helicopter engine was started using external air source and/or external ac power, the APU must be started to do APU generator backup check.

g. NO. 1 or NO. 2 GENERATORS switch - OFF. Applicable GEN and MASTER CAUTION lights on.

h. BLADE DE-ICE POWER switch - ON. Wait 30 seconds; no deice lights on.

i. GENERATORS switch(es) - ON. Applicable GEN caution light(s) off.

j. BLADE DE-ICE POWER switch - OFF.

k. BLADE DE-ICE MODE select switch - AUTO.

*6. % TRQ 1 and 2 - Matched within 5%.

*7. Q/F PWR switch - As desired. EH

*8. FUEL PUMP switch - OFF.

*9. APU CONTR switch - OFF.

*10. AIR SOURCE HEAT/START switch - As required.

*11. ENG FUEL SYS selector - As required.

*12. SAS1 - ON.

*13. Collective friction - As required.

NOTE

A slight amount of collective friction (approximately 3 pounds) should be used to prevent pilot induced collective oscillations.

O *14. IINS NAVRDY light flashing - CDU mode select switch to NAV. EH

O *15. IINS SYSTEM SELECT switches - IINS. EH

16. Engine Health Indicator Test (HIT)/Anti-Icing Check - Accomplish. Refer to ENGINE HEALTH INDICATOR TEST/ANTI-ICE CHECK IN HELICOPTER LOG BOOK. HIT/ANTI-ICE checks while operating in adverse conditions (e.g., dust, desert, coastal beach area, dry river beds) may be deferred (maximum of 5 flight hours) until a suitable location is reached.

O ★ 17. ESSS extended range transfer valves - Check. ES

8-24. BEFORE TAXI.

O *1. Ejector rack lock levers unlocked and safety pins removed. ES

O *2. Chaff, EH flare electronic module(s) safety pin(s) - Remove.

*3. Chocks - Removed.

*4. Doors - Secure.

*5. PARKING BRAKE - Release.

*6. TAIL WHEEL switch - As required.

8-25. GROUND TAXI.

CAUTION

When performing these maneuvers, cyclic inputs should be minimized to prevent droop-stop pounding.

Forward Taxiing. Increase collective and place cyclic forward of neutral to start forward movement. Minimize forward cyclic movement to prevent droop stop pounding. Reduce collective to minimum required to maintain forward movement. Soft or rough terrain may require additional collective pitch. The use of excessive collective pitch during taxi, especially at light gross weights, can cause the tailwheel to bounce. Regulate taxi speed with cyclic and collective and control heading with pedals. Use brakes as required.

8-26. HOVER CHECK.

1. Systems - Check caution/advisory panel, CDU and PDU(s) for normal indication.

2. Flight instruments - Check as required.

3. Power - Check. The power check is done by comparing the indicated torque required to hover with the predicted values from performance charts in Chapter 7.

Page 8-12.1/8-12.2 Deleted.

8-27. BEFORE TAKEOFF.

WARNING

Pitot heat and anti-ice will be on during operations in visible moisture with ambient temperature of 4°C and below.

*1. ENG POWER CONT levers - FLY.

*2. Systems - Check.

*3. Avionics - As required.

*4. Crew, passengers, and mission equipment - Check.

8-28. TAKEOFF.

NOTE

If the stabilator has not begun trailing edge up movement by 30-50 KIAS, abort the takeoff.

a. Align the helicopter with the desired takeoff course at a stabilized 10-foot hover (wheel height) or, an altitude permitting safe obstacle clearance. Increase collective pitch approximately 10% above hover torque, but not to exceed aircraft limitations, and apply forward cyclic to maintain desired angle of climb. Simultaneously, adjust pedal pressure as necessary to maintain desired heading. Adjust power for desired rate of climb and trim helicopter as required.

b. Refer to the height-velocity diagram, Figure 9-2, for avoid areas. Since suitable landing areas are often not available, operating outside avoid areas during takeoff and climb will provide the highest margin of safety.

8-29. MAXIMUM PERFORMANCE.

A takeoff that demands maximum performance from the helicopter may be necessary because of various combinations of heavy helicopter loads, limited power and restricted performance due to high density altitudes, barriers or terrain features that must be cleared. The decision to use the following takeoff techniques must be based on an evaluation of the conditions and helicopter performance. The copilot should assist the pilot by monitoring TGT to assess proximity to TGT limits and should advise the pilot when approaching the TGT limits.

a. Coordinated climb. Align the helicopter with the desired takeoff course at a stabilized hover of about 10 feet (wheel height). Apply forward cyclic pressure smoothly and gradually, while simultaneously increasing collective pitch, begin a coordinated acceleration climb. Adjust pedal pressure as necessary to maintain the desired heading. Maximum torque available should be applied (without exceeding helicopter limits) as the helicopter attitude is established that will permit safe obstacle clearance. The climbout is continued at the attitude and power setting until the obstacle is cleared. After the obstacle is cleared, adjust helicopter attitude and collective pitch as required to establish a climb at the desired rate and airspeed. Continuous coordinated application of control pressures is necessary to maintain trim, heading, flight path, airspeed, and rate of climb. This technique is desirable when OGE hover capability exists. Takeoff may be made from the ground by positioning the cyclic slightly forward of neutral prior to increasing collective pitch.

b. Level acceleration/obstacle clearance takeoff.

(1) This procedure is intended for use when a takeoff *must* be made under conditions when hover capability is limited. Prior to attempting a level acceleration/obstacle clearance takeoff, thorough performance planning must be accomplished to ensure that adequate distance is available to clear any obstacles in the takeoff path. To ensure that a successful takeoff can be performed within the obstacle clearance distances presented in Figure 7-6, all takeoffs must be initiated from 5 feet, regardless of hover capability.

(2) Once it has been determined that a level acceleration/obstacle clearance takeoff is required and that sufficient distance is available to clear any obstacles, the following procedure shall be used.

(3) Align helicopter with the desired takeoff heading and stabilize at 5-foot main wheel height hover. Note helicopter hover pitch attitude on the primary attitude indicator. Apply forward cyclic pressure smoothly while simultaneously increasing collective to begin a level acceleration. The maximum available power should be applied before reaching the desired climb airspeed. Additional forward cyclic pressure will be required during the acceleration to overcome the tendency of the aircraft to climb. Approximately 5 KIAS prior to desired climb airspeed, rotate the helicopter to the hover pitch attitude previously noted. Check to ensure that maximum available power is applied. Adjust pitch attitude as necessary, to maintain desired climb airspeed. Once the obstacle has been cleared, adjust helicopter attitude and collective, as required, to establish the desired airspeed and rate of climb.

c. Comparison of techniques. Refer to Chapter 7 Performance Data, for a comparison of takeoff techniques. When OGE hover power is available, the coordinated climb technique will give a shorter distance over lower obstacles and the level acceleration technique will give a shorter distance over obstacles higher than 50 feet. The two techniques give about the same distance over a 50-foot obstacle when the helicopter can barely hover OGE. As hover capability is decreased, the level acceleration technique gives increasingly shorter distances than the coordinated climb technique. In addition to the distance comparison, the main advantages of the level acceleration technique are: (1) It requires less or no time in the avoid area of the height velocity diagram (Figure 9-2); (2) Performance is more consistent since reference to attitude which changes with loading and airspeed is not required; (3) At the higher climbout airspeeds, reliable indicated airspeeds are available for accurate airspeed reference from the beginning of the climbout, therefore minimizing the possibility of descent. The main advantage of the coordinated-climb technique is that the climb angle is established early in the takeoff and more distance and time are available to abort the takeoff if the obstacle cannot be cleared. Additionally, large attitude changes are not required to establish climb airspeed.

8-30. After Takeoff.

CAUTION

Fuel transfer sequence must be carefully planned and executed in order to maintain CG within limits. EH

O★1. Extended range fuel system transfer - As required. ES

2. ASE - As required (See WARNING and NOTE in Chapter 4, paragraph 4-12). EH

8-31. BEFORE LANDING.

1. TAIL WHEEL switch - As required.

2. PARKING BRAKE - As required.

3. Crew, passengers, and mission equipment - Check.

a. ASE check - As required. EH

O b. ECM ANTENNA switch - RETRACT. Check ANTENNA RETRACTED advisory light - ON. ECM operator report ANTENNA DEPLOYED light - OFF. EH

O c. IINS TACAN - OFF. EH

O d. AUXILIARY FUEL MANAGEMENT FUEL XFR MODE switch - OFF. ES

O e. AUXILIARY FUEL MANAGEMENT panel PRESS switch(es) - Off. ES

8-32. LANDING.

CAUTION

During roll-on landing aerodynamic braking with aft cyclic is permitted with the tail wheel contacting the ground. Once the main wheels touchdown, the cyclic must be centered prior to reducing collective. Excessive aft cyclic may cause droop stop pounding and contact between main rotor blades and other portions of the aircraft. Aerodynamic braking is prohibited once the main landing gear touches down. Use brakes to stop the aircraft.

NOTE

Because of the flat profile of the main transmission, pitching the helicopter nose up as in hover, may cause a transient drop in indicated main transmission oil pressure, depending on degree of nose-up attitude.

a. Roll-on landing. A roll-on landing may be used when the helicopter will not sustain a hover, to avoid hovering in snow or dust, or if tail rotor control is lost. A shallow approach angle is recommended. If possible, select a landing site with a smooth surface such as a runway or road. The approach is normally flown at 80 KIAS; however, other airspeeds may be used. At a point from which obstacles in the flight path can be cleared, assume a decelerating attitude as necessary while maintaining the desired angle of approach with collective. Effect a smooth touchdown on the tailwheel below 60 KIAS, but not below effective translational lift (ETL). Use enough collective to cushion touchdown of the tail wheel and main gear. After landing, center cyclic, lower collective, and apply brakes as necessary.

CAUTION

EH When landing the EH-60A in a nose downslope configuration, exercise extreme caution to prevent the main rotor blades from contacting the aft DF antennas. When the main wheels contact the ground, center the cyclic prior to reducing collective. The cyclic should be centered before the collective is placed in full down to prevent possible rotor/airframe contact. If droop stop contact is felt prior to the main wheels touching the ground, abort landing attempt.

b. Slope landing. The tailwheel should be locked and the parking brake should be set. For slope landings and all ground operations, avoid using combinations of excessive cyclic and low collective settings. Where minimum collective is used, maintain cyclic near neutral position and avoid abrupt cyclic inputs. During nose-down slope landings, low-frequency oscillations may be eliminated by moving cyclic toward neutral and lowering collective.

8-33. AFTER LANDING CHECK.

1. TAIL WHEEL switch - As required.
2. Exterior lights - As required.
3. Avionics/mission equipment - As required.

8-34. PARKING AND SHUTDOWN.

1. TAIL WHEEL switch - As required.
2. PARKING BRAKE - Set.
3. Landing gear - Chocked.

O 4. Ejector rack locking levers - Locked. ES

O 5. Chaff, EH flare electronic module safety pin(s) - Install.

5.1. IINS SYSEM SELECT switches - DG/VG. EH

O 6. IINS - OFF. EH

O 7. ECS panel switches - OFF. EH

8. SAS 1 - OFF.

9. DE-ICE, PITOT, ANTI-ICE, EH Q/F PWR, and HEATER switches - OFF.

10. AIR SOURCE HEAT/START switch - APU.

11. FUEL PUMP switch - APU BOOST.

12. APU CONTR switch - ON. The APU ON, BACKUP PUMP ON, and APU ACCUM LOW advisory lights - ON.

NOTE

If external electrical power is required for shutdown, it shall be connected and EXT PWR switch placed to reset; then ON. If external ac power is not available, complete normal shutdown on right engine before continuing.

13. Collective raise no more than 1 inch.

14. Flight controls - Hold.

CAUTION

During shutdown ensure that cyclic is kept in neutral or displaced slightly into prevailing wind, collective no more than one inch above full down and pedals centered.

Restrict the rate of ENG POWER CONT lever's movement, when the tailwheel lockpin is not engaged. Abrupt application of ENG POWER CONT levers can result in turning the helicopter.

15. ENG POWER CONT levers - IDLE.

16. ENGINE IGNITION switch - OFF.

17. Cyclic - As required to prevent anti-flap pounding.

18. Droop stops - Verify in, about 50% RPM R. If one or more droop stops do not go in during rotor shutdown, accelerate rotor to above 75% RPM R. Repeat rotor shutdown procedures, slightly displacing cyclic in an attempt to dislodge jammed droop stop. If droop stops still do not go in, make certain that rotor disc area is clear of personnel and proceed with normal shutdown procedures while keeping cyclic in neutral.

CAUTION

To prevent damage to anti-flap stops, do not increase collective pitch at any time during rotor coast-down.

19. BACKUP HYD PUMP switch - OFF.

20. Stabilator - Slew to 0° after last flight of the day.

21. BACK-UP PUMP ON advisory light - Check off.

CAUTION

Before moving ENG POWER CONT lever OFF, engine must be cooled for 2 minutes at an N_g SPEED of 90% or less. If an engine is shut down from a high power setting (above 90%) without being cooled for 2 minutes, and it is necessary to restart the engine, the restart should be done within 5 minutes after shutdown. If the restart can not be done within 5 minutes, the engine should be allowed to cool for 4 hours before attempting an engine restart.

22. ENG POWER CONT levers - OFF after 2 minutes at N_g speed of 90% or less.

23. ENG FUEL SYS selector - OFF.

O 24. AUX CABIN HEATER - OFF.

25. TGT - Monitor. If TGT rises above 540°C:

a. Start button - Press.

b. ENG POWER CONT lever(s) - Pull after TGT is below 540°C.

26. DEC torque indicator fault code - CHECK. 701C

27. Avionics - OFF.

O 28. FUEL BOOST NO. 1 and NO. 2 PUMP switch(es) - OFF.

29. Overhead switches - As required:

a. ANTICOLLISION/POSITION LIGHTS.

b. Left panel light controls.

c. WINDSHIELD WIPER.

d. VENT BLOWER.

e. Right panel light controls.

30. GENERATOR APU - OFF.

31. FUEL PUMP - OFF.

32. APU CONTR - OFF.

33. BATT - OFF.

8-35. BEFORE LEAVING HELICOPTER.

1. Walkaround - Complete, checking for damage, fluid leaks and levels.

2. Mission equipment - Secure.

3. Complete DA Form 2408-12 and -13.

4. Secure helicopter - As required.

Section III INSTRUMENT FLIGHT

8-36. INSTRUMENT FLIGHT.

a. Refer to FM 1-240 for instrument flying and navigation techniques.

b. Pitot heat and anti-icing equipment, if installed, shall be on during operations in visible moisture with ambient temperature of 4°C and below.

8-37. Deleted.

Section IV FLIGHT CHARACTERISTICS

8-38. GENERAL.

Refer to FM 1-203 Fundamentals of Flight for explanation of aerodynamic flight characteristics.

The safe maximum operating airspeed range is described in Chapter 5. While hovering in high wind, sideward and rearward flight should be limited to low ground speeds. The helicopter is directionally stable in forward flight. In sideward and rearward flight, directional control is more difficult. During approach, or slow flight as the airspeed reaches about 17 to 20 KIAS, a mild vibration will be felt.

8-39. GROUND RESONANCE.

Ground resonance is a self-excited vibration created when a coupling interaction occurs between the movement of the main rotor blades and the helicopter. For this to happen, there must be some abnormal lead/lag blade condition which would dynamically unbalance the rotor and a reaction between the helicopter and ground, which could aggravate and further unbalance the rotor. Ground resonance can be caused by a blade being badly out of track, a malfunctioning damper, or a peculiar set of landing conditions. Ground resonance may occur when a wheel reaction aggravates an out-of-phase main rotor blade condition such as a hard one-wheel landing, resulting in maximum lead and lag blade displacement. This helicopter does not have a history of ground resonance. If it should occur, get the helicopter airborne. If this is not possible, immediately reduce collective pitch, place ENG POWER CONT levers OFF, and apply wheel brakes.

8-40. MANEUVERING FLIGHT.

8-41. FLIGHT WITH EXTERNAL LOADS.

Refer to FM 55-450-1.

WARNING

Static electricity generated by the helicopter should be discharged before attempting a sling or rescue hoist pickup. Use a conductor between helicopter and the ground to discharge the static electricity.

WARNING

Caution must be exercised when transporting external loads that exhibit unstable characteristics. These loads may amplify any oscillation and cause the load to contact the aircraft.

8-42. FLYING QUALITIES WITH ESSS INSTALLED.

1. Pitch Attitude vs. Airspeed.

The ESSS installation naturally results in increased drag. Since this drag vector is below the center of gravity of the helicopter, the pitch attitude will be more nose-down for any speed beyond 60 - 70 KIAS.

NOTE

The slight pitch down at 50 - 55 KTS (due to an airspeed system characteristic) is slightly exaggerated by the above two factors.

At mid to high gross weights (and most especially at a forward C.G.) there is a slight pitch down at 50 -55 KIAS. This is normal to the basic aircraft and more pronounced with the unmodified (original) airspeed system. The installation of the ESSS results in a small increase in this nose-down tendency.

2. Tank Vibration.

It will be observed that the right hand tank(s) will vibrate more than the left tank(s). This is a normal occurrence.

3. Stabilator Angle vs. Airspeed.

With the increased drag of the ESSS, a given airspeed will require more collective which, due to the collective to stabilator coupling, results in a more trailing edge down stabilator angle. In the ferry configuration (full inboard 450 gallon tanks, full outboard 230 gallon tanks) the stabilator angle at higher speeds may be increased because of higher collective positions signal. This is normal as no stabilator program changes were made for the ESSS.

4. Roll Attitude Hold (FPS ON).

With only the ESSS wings installed, the roll attitude hold feature of the FPS is not noticeably affected. With full outboard 230 gallon tanks there is a very slight degradation of roll attitude stability, evidenced by a slower return to trim after an excitation (gust). With four full 230 gallon tanks the return to trim is a bit slower and with full inboard 450 gallon tanks and full outboard 230 gallon tanks the return to trim is slower. Since the return to trim is affected by the roll inertia of the helicopter, it is therefore recommended that for a four tank configuration the outboard tanks be burned down first.

5. Performance.

The ESSS, as mentioned previously, provides increased drag. Both the forward flight and hover performance (due to vertical drag from main rotor downwash) are adversely affected. New performance charts are being generated, and should be referred to for flights with the ESSS installed.

6. Slope Landings.

The ESSS outboard tank may be a consideration in some rough area or slope landing operations. Caution should be exercised to maintain tank to ground clearance when landing in sloping or rough terrain.

8-43. Collective Bounce/Pilot Induced Oscillation.

NOTE

The friction force refers to the breakaway force required to move the collective stick in an upward direction. The three (3) pounds force is measured with the BOOST servo and SAS amplifiers operating and collective at mid-range.

To prevent vertical oscillation (collective bounce) the collective control system requires a minimum friction of three (3) pounds measured at the collective head. Vertical oscillation can occur in any flight regime and may be caused by such events as SAS oscillation, turbulence, external load oscillation and inadvertent pilot input into the collective. The oscillation causes the aircraft to vibrate. This vibration will be felt as a vertical bounce at approximately three (3) cycles per second. If the severity of the oscillation is allowed to build, very high vibration levels will be experienced. During flight, if vertical oscillation is encountered, the pilot should remove the hand from the collective grip; this should eliminate the oscillation.

Section V ADVERSE ENVIRONMENTAL CONDITIONS

8-44. GENERAL.

This section informs the crewmembers of the special precautions and procedures to be followed during the various weather and climatic conditions that may be encountered. This will be additional material to that already covered in other chapters regarding the operation of the various helicopter systems. Refer to FM 1-202 for cold-weather operations.

8-45. COLD-WEATHER OPERATION.

The basic helicopter with normal servicing can operate at temperatures down to −34°C (−29°F).

WARNING

Static electricity generated by the helicopter should be discharged before attempting a sling or rescue hoist pickup. In cold, dry climatic conditions static electricity buildups are large. Use a conductor between the helicopter and the ground to discharge the static charge. Delay lowering rescue hoist hook until helicopter is over the load, to lessen static charge buildup.

NOTE

During operation in cold weather, particularly when snow or moisture is present, the tail wheel locking indicating systems may give erroneous cockpit indications.

8-46. Deleted.

8-47. COLD WEATHER PREFLIGHT CHECK.

CAUTION

Ice removal shall never be done by scraping or chipping. Remove ice by applying heat or deicing fluid.

Blade deice operation with erosion strips installed may cause blade damage.

a. In addition to the checks in Section II check aircraft for ice or snow. If ice or snow is found, remove as much as possible by hand and thaw aircraft with heated air or deicing fluid before attempting start. Failure to remove ice and snow may cause damage.

b. Check main rotor head and blades, tail rotor, flight controls and engine inlets and hand holds for ice and snow. Failure to remove snow and ice accumulations can result in serious aerodynamic, structural effects in flight and serious foreign object damage if ice is ingested into the engine. Check ENG POWER CONT levers for freedom of movement.

c. On aircraft equipped with Extended Range Fuel System, check ESSS and 230/450 gallon fuel tank for ice or snow. Remove as much as possible by hand and then use heated air. Start APU and turn on pressure to both INBD and OUTBD fuel tanks. Wing-mounted pressure regulator may require heated air applied directly onto the exhaust vent protruding from the ESSS wing. After regulator valve is operating and fuel tanks are pressurized, leave system on. DO NOT TURN OFF PRESSURE SWITCHES OR PRESSURE REGULATORS MAY FREEZE.

8-48. CONTROL EXERCISE.

After starting the APU, the controls must be exercised when operating in a temperature range of −17°C and below. The control exercise is required

1. At temperatures between −17° and −31°C, cycle collective control slowly for 1 minute.

a. Move collective up about 3 inches from lower stop, and down again 30 times during 1 minute of control cycling in step 1.

b. Move pedals alternately through 3/4 inch of travel from neutral position 30 times during 1 minute of control cycling in step 1.

2. At temperatures between −31° and −43°C, move cycle collective slowly for 2 minutes.

a. Move collective up about 1-1/2 inches from lower stop and down again during first minute, and 3 inches of travel during second minute of control cycling in step 2.

b. Move pedals alternately through 3/8 inch of travel from neutral position during first minute and 3/4 inch of travel during second minute of control cycling in step 2.

3. At temperatures between −43° and −54°C, move cycle collective slowly for 5 minutes.

Move collective and pedals through travel for times shown below:

Collective Travel (Approximately)	Pedals Travel (Approximately)	Time Duration
3/4 inch	1/8 inch	First minute
1-1/2 inches	1/4 inch	Second minute
1-3/4 inches	1/2 inch	Third minute
2-1/2 inches	5/8 inch	Fourth minute
3 inches	3/4 inch	Fifth minute

8-49. ENGINE OPERATION.

a. Even though cold weather does not particularly affect the engine itself, it still causes the usual problems of ice in the fuel lines, control valves, and fuel sumps, which frequently prevent a successful cold weather start. It may be found that certain elements or accessories need preheating.

CAUTION

When starting an engine that has been exposed to low temperatures, watch for rise in TGT within 45 seconds. If no TGT rise is evident, manually, prime the engine and attempt another engine start. If there is no overboard fuel flow during prime, inspect for ice in the sumps and filters. During cold weather operation, allow longer warmup period to bring transmission oil temperature up to desired operating range refer to Chapter 5. Monitor oil pressure and temperature closely. When advancing the power control levers, maintain transmission oil pressure in normal operating range.

b. When starting in cold weather (below −40°C), if light-off does not occur within 10 seconds after initial indication of Ng SPEED, quickly move ENG POWER CONT lever for the affected engine back to OFF, and then to IDLE detent three times, ending up at IDLE. If light-off still does not occur within 45 seconds, abort start and do the following:

1. ENG POWER CONT lever(s) - Hold at LOCKOUT.

2. FUEL BOOST PUMP CONTROL switch(es) - ON until crewmember reports fuel from the overflow drain.

3. FUEL BOOST PUMP CONTROL switch(es) - OFF.

4. ENG POWER CONT lever(s) - OFF.

5. Attempt another start.

8-50. ENGINE OIL SYSTEM CHARACTERISTICS.

1. It is normal to observe high engine oil pressure during initial starts when the ambient temperature is 0°C or below. Run engine at idle until oil pressure is within limits. Oil pressure should return to the normal range after operating 5 minutes. However, time required for warmup will depend on temperature of the engine and lubrication system before start.

2. During starts in extreme cold weather (near −54°C), the following oil pressure characteristics are typical:

a. Oil pressure may remain at zero for the first 20 to 30 seconds after initiating the start. Abort the start if oil pressure does not register within 1 minute after initiating a start.

b. Once oil pressure begins to indicate on the gage, it will increase rapidly and it will exceed the limit. This condition is normal. The time for oil pressure to decrease will depend on the ambient temperature, but should be normal within 5 minutes after starting the engine.

c. Oil pressure may increase above the maximum pressure limit of 100 psig if the engine is accelerated above idle while oil temperature is within normal operating range. The pressure will decrease to within the normal operating range as the oil temperature increases.

3. It is normal for the OIL FILTER BYPASS caution light to be on when starting an engine with oil temperatures below normal because of high oil viscosity and the accumulation of oil filter contaminants. When the engine oil temperature reaches about 38°C during warmup, the light should go off.

8-51. ENGINE WARMUP AND CONTROL EXERCISE.

CAUTION

Cyclic inputs shall be minimized and restrictive to prevent droop-stop pounding.

1. At temperatures between −17° and −31°C, warm engines at IDLE for 3 minutes. During engine warmup, position cyclic 3/4 inch forward of neutral and move pedal alternately 3/8 inch.

2. At temperatures between −31° and −43°C, warm engines for 3 minutes. During warmup, position cyclic 5/8 inch forward, gradually increasing stick movement to 3/4 inch. Move each tail rotor pedal 1/8 inch, and gradually increase movement to 1/2 inch.

3. At temperatures between −43° and −54°C, warm engines for 5 minutes. During engine warmup, position cyclic 1/2 inch forward of neutral, gradually increase stick movement to 3/4 inch. Move each tail rotor pedal 1/8 inch and gradually increase movement to 5/8 inch. The specific requirements are as follows:

Forward Cyclic (Approximately)	Pedal Travel (Approximately)	Time Duration
1/2 inch	1/8 inch	First minute
3/4 inch	1/4 inch	Second minute
1 inch	3/8 inch	Third minute
1 1/2 inches	1/2 inch	Fourth minute
1 1/2 inches	5/8 inch	Fifth minute

8-52. TAXIING.

The helicopter should not be taxied until all engine temperatures and system pressures are within the normal range. All taxiing should be done at low speeds with wide-radius turns. If the tires are frozen to the surface, a slight yawing motion induced by light pedal application should break them free. Taxiing in soft snow requires higher than normal power.

8-53. DESERT AND HOT WEATHER OPERATION.

Prolonged hovering flight in hot weather (+35°C) at higher gross weight may cause transmission oil temperature to rise into the yellow precautionary range. Hovering operations in the precautionary range under those conditions may be considered normal and the requirement for maintenance action in paragraph 5-10 does not apply.

8-54. Deleted.

8-55. TAXIING AND GROUND OPERATION.

Braking and ground operation should be minimized to prevent system overheating. During ground operations, if engine oil pressure falls into the red gauge range when the power control lever is in the idle position and/or the engine oil pressure caution light comes on when the power control lever is in the idle position, slightly advance the power control lever. If the engine oil pressure returns to the yellow range and the engine oil pressure caution light extinguishes, engine oil pressure is acceptable.

8-56. IN-FLIGHT.

WARNING

When the engines are operating at low N_g speeds with hot fuel (JP-4), they are susceptible to fuel-low pressure/flameouts. Rapid collective changes and low-power settings should be avoided. BOOST PUMP switches shall be turned ON when hot fuel limitations are exceeded.

8-57. THUNDERSTORM OPERATION.

CAUTION

Avoid flight in or near thunderstorms, especially in areas of observed or anticipated lightning discharges.

1. Tests have shown that lightning strikes may result in loss of automatic flight controls (including stabilator), engine controls or electrical power. The high currents passing through the aircraft structure are expected to produce secondary effects whereby damaging voltage surges are coupled into aircraft wiring.

2. If a lightning strike occurs whereby all aircraft electrical power and electronics subsystems and controls are lost (including the engine 700 ECU/DEC 701C and the engine-driven alternator), both engines go immediately to maximum power with no temperature limiter or overspeed protection. 701C In addition the 701C engine overspeed may result in single or dual engine shutdown without automatic relight. Accordingly, flight crew would have to react instantly to retard the engine power control levers to idle and enter autorotation. The crew could then slowly increase the engine power control levers and restore power by sound and feel, since all engine instruments and all of the engine automatic control functions would be inoperative.

8-58. TURBULENCE.

1. Recommended maximum turbulance penetration airspeeds. For moderate turbulence, limit airspeed to the MAX RANGE (Chapter 7) or V_{ne} minus 15 knots, whichever is less.

2. In turbulent air - Maintain constant collective and use the Vertical Situation Indicator as the primary pitch instrument. The altimeter and vertical velocity indicator may vary excessively in turbulence and should not be relied upon. Airspeed indication may vary as much as 40 KIAS. By maintaining a constant power setting and a level-flight attitude on the Vertical Situation Indicator, airspeed will remain relatively constant even when erroneous readings are presented by the airspeed indicator.

8-59. ICE AND RAIN OPERATION.

8-60. IN-FLIGHT ICING.

CAUTION

Activation of anti-ice systems after entry into potential icing conditions creates the possibility of engine FOD caused by ice shedding. The ice detector has been designed primarily as a sensor to indicate the requirement for activation of the blade deice system.

a. All anti-ice systems must be turned on prior to entering visible moisture at ambient temperatures of +4°C (39°F) or less.

b. If icing conditions are encountered, turn on all anti-icing equipment immediately. If torque required increases 20% above that required for level flight at the airspeed being maintained before entering icing, exit the icing environment or land as soon as possible. A 20% torque increase indicates that normal autorotational rotor rpm may not be possible, should dual-engine failure occur.

c. When the helicopter is equipped with an operating blade deice, and icing conditions are encountered, a recurring torque increase up to 14% per engine may be experienced during normal operation of the blade deice system because of ice build-up. The crew should closely monitor engine instruments to prevent exceeding limits and/or rotor droop. Significant power losses and increased fuel consumption will occur with the activation of blade deice and/or engine inlet anti-icing systems. Refer to Chapter 7 for torque available. The main rotor hub and the blades collect ice before initiation of a deice cycle. When enough ice has collected on the blades, moderate vibration levels of short duration can be expected in controls and airframe during normal de-icing cycles. If the blade deice system is not operating, unbalanced loads of ice, resulting from asymmetric shedding, may cause severe vibrations. However, these vibrations normally subside after 30 - 60 seconds when ice from other blades is shed.

d. When helicopter is equipped with External Extended Range Fuel System turn on pressure to both INBD and OUTBD fuel tanks. This will prevent ice accumulation and assure pneumatic pressure for fuel transfer.

NOTE

After pressurizing the External Extended Range Fuel Tanks, DO NOT TURN OFF if ambient temperature is below 0°C.

8-61. GROUND OPERATIONS.

a. Strong gusty winds may cause increased flapping of the main rotor blades during shutdown following an icing encounter, because the anti-flap restrainers may be frozen in the fly position.

b. During flight in icing conditions when droop stop heaters are not installed or fail to operate properly, the droop stop hinges may become iced, resulting in the droop stops not returning to the static position during rotor coast down. When the droop stops do not return to the static position, the main rotor blades may droop to within 4 feet of the ground during shutdown. Strong gusty winds may also cause excessive flapping of the main rotor blades, presenting the additional hazard of potential contact with the aft fuselage. If the droop stops are suspected to be stuck in the fly position, caution must be taken during shutdown to be sure personnel remain clear of the helicopter.

8-62. CROSSWIND/SIDE FLIGHT OPERATION - HIGH ALTITUDE/HEAVY WEIGHT

Operations while hovering in a 15 to 25 knot right crosswind or during 15 to 25 knot right sideward flight under conditions of high gross weight and high altitude can result in momentary contact of the left pedal stop. The occurrence is caused by rotor and airframe aerodynamic interaction, particularly in ground effect, which results in increased pilot directional control pedal motion activity. For conditions of 0 to 15 knots and 25 knots to maximum allowable, the pilot pedal activity decreases as the rotor and airframe interaction is substantially reduced or eliminated. In left sideward flight conditions or while hovering in a left crosswind, pedal motion activity can be just as high in the 15 to 20 knot speed range. This is due to the tail rotor crossing through the region where thrust direction changes. This normally is not a problem, however, as more right directional control margin is available due to the increased left pedal anti torque requirements for the heavy/high conditions.

CHAPTER 9
EMERGENCY PROCEDURES

Section I AIRCRAFT SYSTEMS

9-1. HELICOPTER SYSTEMS.

This section describes the helicopter systems emergencies that may reasonably be expected to occur and presents the procedures to be followed. Emergency operation of mission equipment is contained in this chapter, insofar as its use affects safety of flight. Emergency procedures are given in checklist form when applicable. A condensed version of these procedures is contained in the condensed checklist TM 55-1520-237-CL.

9-2. IMMEDIATE ACTION EMERGENCY STEPS.

NOTE

The urgency of certain emergencies requires immediate and instinctive action by the pilot. The most important single consideration is helicopter control. All procedures are subordinate to this requirement. The MASTER CAUTION should be reset after each malfunction to allow systems to respond to subsequent malfunctions. If time permits during a critical emergency, transmit MAY DAY call, set transponder to emergency, jettison external stores, and lock shoulder harnesses.

Those steps that must be performed immediately in an emergency situation are underlined. These steps must be performed without reference to the checklist. Nonunderlined steps should be accomplished with use of the checklist.

9-3. DEFINITION OF EMERGENCY TERMS.

For the purpose of standardization, these definitions shall apply.

a. The term LAND AS SOON AS POSSIBLE is defined as landing at the nearest suitable landing area (e.g., open field) without delay. (The primary consideration is to ensure the survival of occupants.)

b. The term "LAND AS SOON AS PRACTICABLE" is defined as landing at a suitable landing area. (The primary consideration is the urgency of the emergency.)

c. The term AUTOROTATE is defined as adjusting the flight controls as necessary to establish an autorotational descent and landing.

d. The term "EMER ENG SHUTDOWN" is defined as engine shutdown without delay. Engine shutdown in flight is usually not an immediate-action item unless a fire exists. Before attempting an engine shutdown, identify the affected engine by checking engine-out warning lights, torque meters, TGT indicators, NG, NP, and engine oil pressure indicators.

1. ENG POWER CONT lever(s) - OFF.
2. ENG FUEL SYS selector - OFF.

CAUTION

If TGT rises above 540°C after shutdown, place AIR SOURCE HEAT/START switch as required, turn ENG IGNITION switch off, and press starter to motor engine for 30 seconds or until TGT decreases below 540°C.

e. The term "LOCKOUT" is defined as manual control of engine RPM while bypassing ECU 700, or DEC 701C functions. Bypass of the engine control will be required when % RPM 1 or 2 decreases below normal demand speed.

CAUTION

When engine is controlled with engine power control lever in lockout, engine response is much faster and TGT limiting system is inoperative. Care must be taken not to exceed TGT limits and keeping % RPM R and % RPM 1 and 2 in operating range.

ENG POWER CONT lever - Pull down and advance full forward while maintaining downward pressure, then adjust to set % RPM R as required. Engine control malfunctions can result in % RPM R increasing or decreasing from normal demand speed. Under certain failure conditions, % TRQ, N_p, and N_g may not be indicating and the possibility of the engine-out warning light and audio activating exists. The most reliable indication of engine power will be TGT.

f. The term EMER APU START is defined as APU start to accomplish an emergency procedure.

1. Fuel pump switch - APU BOOST.

2. APU CONTR switch - ON.

9-4. AFTER EMERGENCY ACTION. After a malfunction of equipment has occurred, appropriate emergency actions have been taken and the helicopter is on the ground, an entry shall be made in the Remarks Section of DA Form 2408-13 describing the malfunction. Ground and flight operations shall be discontinued until corrective action has been taken.

9-5. EMERGENCY EXITS.

Emergency exits are shown in Figure 9-1. Emergency exit release handles are yellow and black striped.

WARNING

For helicopters without a roll-trim actuator, the cyclic shall be held at all times with the rotor turning. In cases where emergency exit is required prior to rotor coasting to a stop, make sure that the cyclic stick is centered until the last crewmember can depart the cockpit. Since the main rotor has a 3° forward tilt, an exit to the right rear or left rear will provide the greatest rotor clearance safety.

a. Each cockpit door is equipped with a jettison system for emergency release of the door assembly. Jettison is done by pulling a handle marked EMERGENCY EXIT PULL, on the inside of the door (Figure 9-1). To release the door, the jettison handle is pulled to the rear; the door may then be pushed out.

b. Cabin door window jettison. To provide emergency exit from the cabin, two jettisonable windows are installed in each cabin door. To release the windows, a handle (under a jettison lever guard) marked EMERGENCY EXIT PULL AFT, (left side; right side, PULL FWD) on the inside of the cabin door (Figure 9-1), is moved in the direction of the arrow, releasing the windows. The windows can then be pushed out.

9-6. EMERGENCY EQUIPMENT (PORTABLE).

Emergency equipment consists of two handheld fire extinguishers, one crash ax, and three first aid kits, as shown in Figure 9-1.

9-7. ENGINE MALFUNCTION - PARTIAL OR COMPLETE POWER LOSS.

WARNING

Prior to movement of either power-control lever, it is imperative that the malfunctioning engine and the corresponding power-control lever be identified.

The indications of engine malfunction, either partial or complete power loss, may be as follows: Changes in affected engine RPM, change in rotor RPM, low rotor and/or engine-out audio warning, illumination of the low-rotor and/or engine-out warning lights, change in engine noise, and left yaw. The indications will depend on the specific malfunction, e.g., compressor stall as opposed to complete power loss on one or both engines.

9-8. FLIGHT CHARACTERISTICS.

The flight characteristics and the required crew member control responses after a dual engine failure

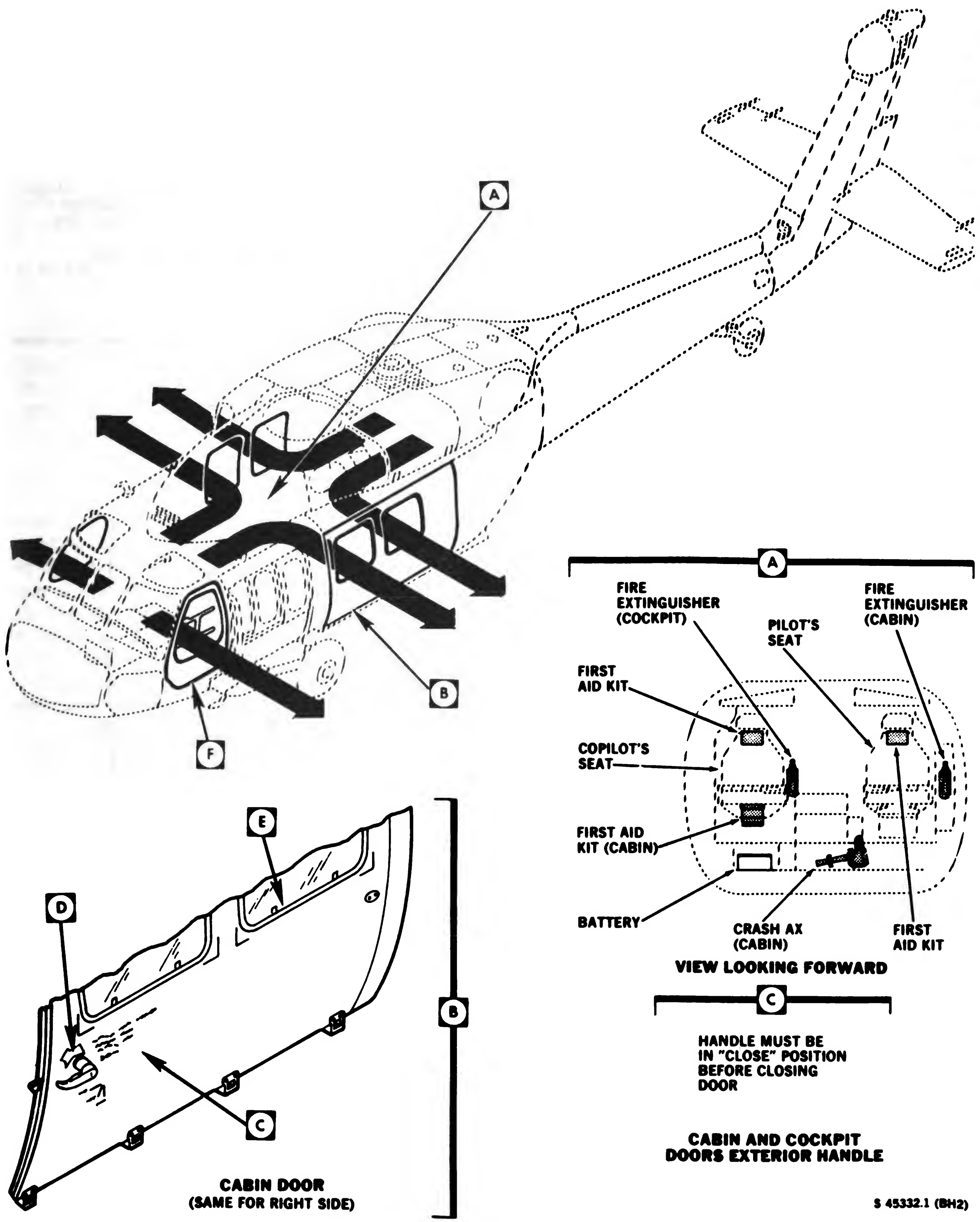
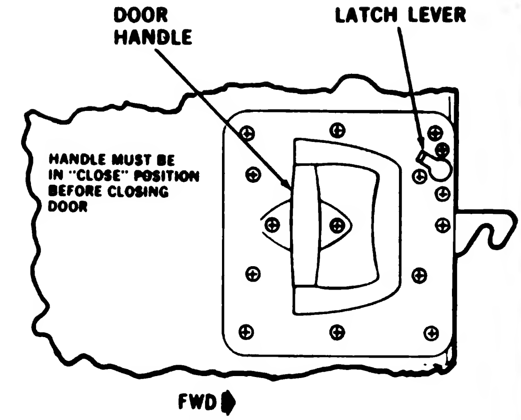
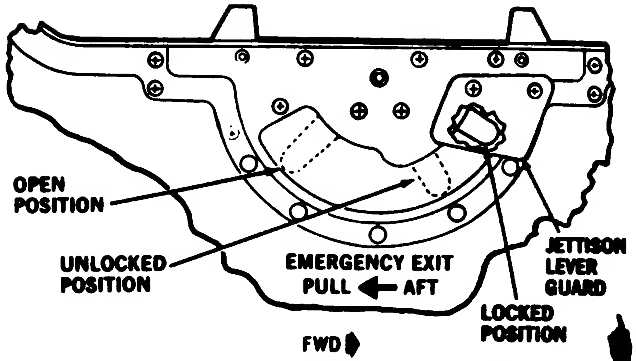


Figure 9-1. Emergency Exits and Emergency Equipment Diagram (Sheet 1 of 2)



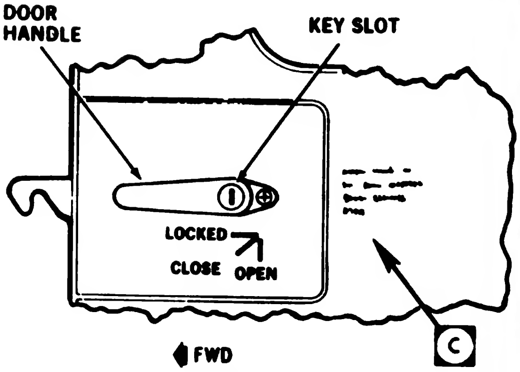
CABIN DOOR
INTERIOR RELEASE HANDLE
VIEW LOOKING OUTBOARD
LEFT SIDE
(SAME FOR RIGHT SIDE)



CABIN DOOR WINDOW JETTISON LEVER
VIEW LOOKING OUTBOARD
LEFT SIDE
(RIGHT SIDE PULL → FWD)

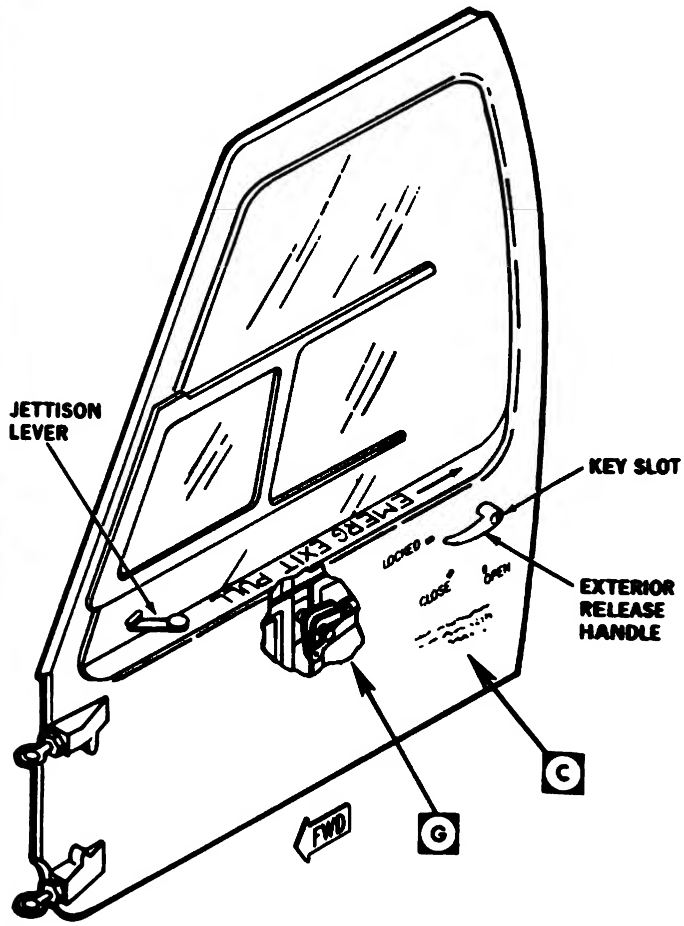
E

D



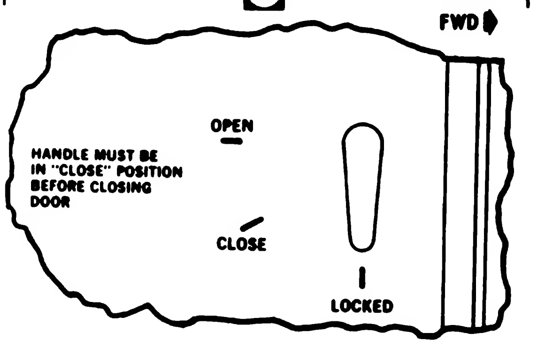
CABIN DOOR
EXTERIOR RELEASE HANDLE
VIEW LOOKING INBOARD
LEFT SIDE
(SAME FOR RIGHT SIDE)

F



COCKPIT DOOR
INTERIOR JETTISON LEVER
VIEW LOOKING INBOARD
LEFT SIDE
(SAME FOR RIGHT SIDE)

G



INTERIOR COCKPIT DOOR RELEASE HANDLE
VIEW LOOKING OUTBOARD
LEFT SIDE
(SAME FOR RIGHT SIDE)

S 45332.2 (BH2)

Figure 9-1. Emergency Exits and Emergency Equipment Diagram (Sheet 2 of 2)

are similar to those during a normal power-on descent. Full control of the helicopter can be maintained during autorotational descent. When one engine has failed, the helicopter can often maintain altitude and airspeed until a suitable landing site can be selected. Whether or not this is possible becomes a function of such combined variables as aircraft weight, density altitude, and height above ground and airspeed at the time of the engine failure. Crew member response time and control technique may be additional factors.

9-9. SINGLE-ENGINE FAILURE - GENERAL.

Proper response to an engine failure depends on various factors: density altitude, airspeed, aircraft weight, single-engine performance, and environmental conditions. The light regions in the height velocity avoid region diagrams (Figures 9-2 and 9-2.1) define the ground speed and wheel-height combinations that will permit a safe landing in event of an engine failure for various gross weights at both sea level 15°C, and 4,000 feet/35°C ambient condition. Crew member recognition of a single-engine failure and subsequent action are essential and should be based on the following general guidelines. At low altitude and low airspeed, it may be necessary to lower the collective only enough to maintain NR at a value less than 100 percent. At higher altitude, however, the collective may be lowered significantly to increase NR to 100 percent. When hovering in ground effect, the collective should be used only as required to cushion the landing, and the primary consideration is in maintaining a level attitude. In forward flight at low (as in takeoff) airspeed, when a single-engine capability to maintain altitude does not exist, a decelerating attitude will initially be required to prepare for landing. Conversely, if airspeed is low and altitude sufficient, the helicopter should be placed in an accelerating attitude to gain sufficient airspeed for single-engine fly-away to a selected landing site. When the power available during single-engine operation is marginal or less, consideration should be given to jettisoning the external stores. The engine anti-ice and cabin heater switches should be turned off as necessary to ensure maximum power is available on the remaining engine. After an engine failure has occurred, an EMERGENCY ENGINE SHUTDOWN should be performed on the affected engine if time permits.

9-10. SINGLE-ENGINE FAILURE.

WARNING

Do not respond to engine-out audio and warning light until checking TGT and % RPM R.

If continued flight is not possible:

Land as soon as possible.

If continued flight is possible:

Land as soon as practicable.

9-11. ENGINE RESTART DURING FLIGHT.

After an engine failure in flight, an engine restart may be attempted. If it can be determined that it is reasonably safe to attempt a start, the APU should be used. Use of a crossbleed start could result in a power loss of up to 18% on the operational engine.

9-12. DUAL-ENGINE FAILURE - GENERAL.

a. If both engines fail, immediate action is required to make a safe autorotative descent. The altitude and airspeed (Figure 9-3) at which a two-engine failure occurs will dictate the action to be taken. After the failure, main rotor rpm will decay rapidly and the aircraft will yaw to the left. Unless a two-engine failure occurs near the ground, it is mandatory that autorotation be established immediately. During cruise, reduce collective immediately to regain NR and then adjust as required to maintain % rpm within power off rotor speed limits. The cyclic should be adjusted as necessary to attain and maintain the desired airspeed. The recommended airspeed for autorotation is 80 KIAS. Autorotation below 80 knots is

UH-60A/EH-60A
HEIGHT VELOCITY AVOID REGIONS
SINGLE ENGINE FAILURE

EXAMPLE

WANTED:

A TAKEOFF PROFILE WHICH WILL PERMIT A SAFE LANDING AFTER AN ENGINE SUDDENLY BECOMES INOPERATIVE.

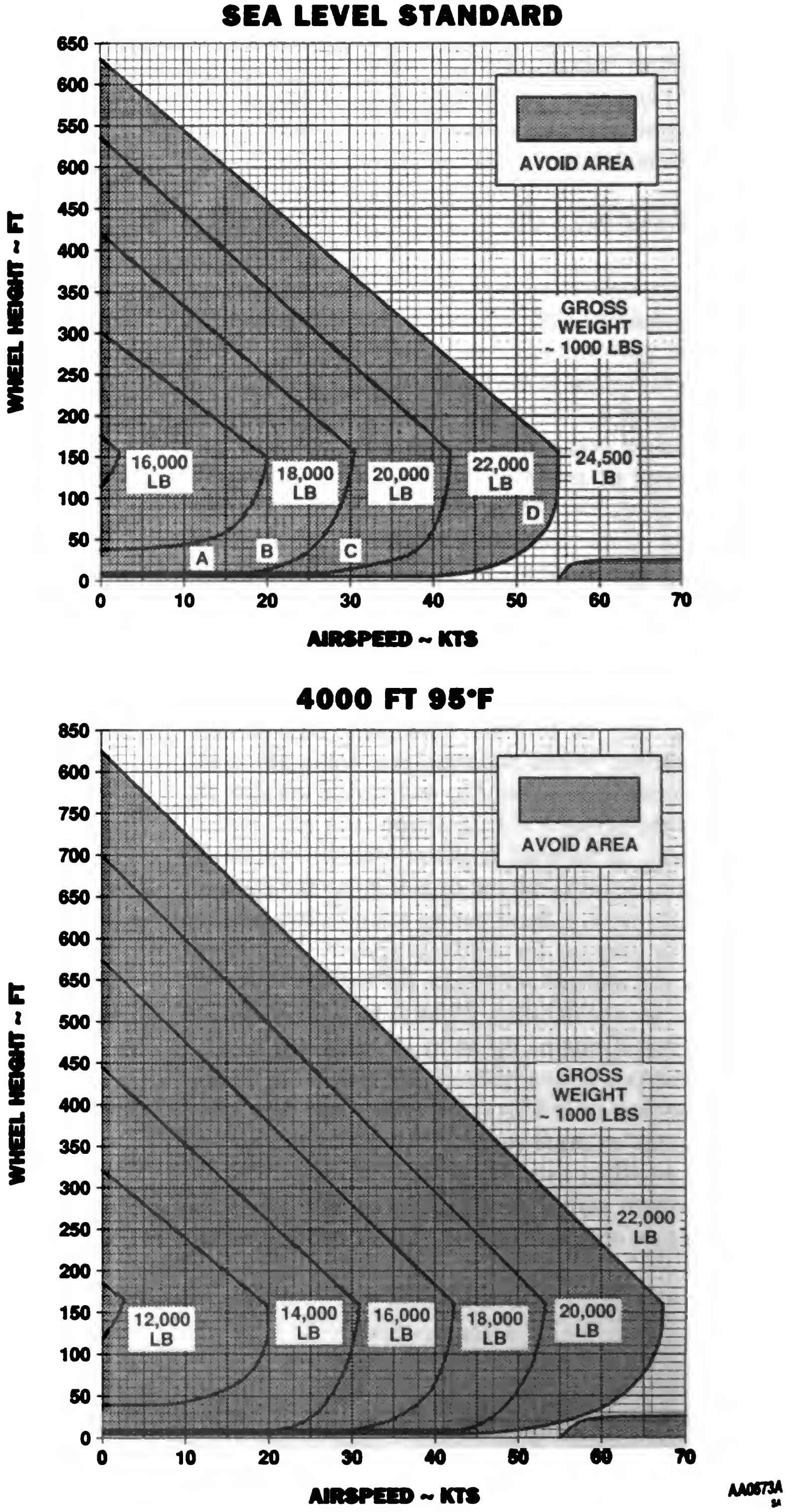
KNOWN:

AIRCRAFT GROSS WEIGHT = 18,000 LBS
AMBIENT CONDITIONS:
TEMPERATURE = 15 °C
PRESSURE ALTITUDE = SEA LEVEL
WIND = 0 KTS

METHOD:

TRACE ALONG GROSS WEIGHT LINE NOTING WHEEL HEIGHT / AIRSPEED COMBINATIONS WHICH WILL KEEP THE TAKEOFF PROFILE BELOW AND TO THE RIGHT OF THE AVOID REGION.

POINT	AIRSPEED	WHEEL HEIGHT
A	0	10
B	10	10
C	20	15
D	42	155



NOTE:
BASED ON 85% OF CONTINGENCY RATED POWER.
WEIGHTS GREATER THAN 22,000 LBS ARE FOR FERRY MISSION ONLY, FOR WHICH A FLIGHT RELEASE IS REQUIRED.

DATA BASE: CALCULATED

Figure 9-2. Height Velocity Diagram UH 60A EH

HEIGHT VELOCITY AVOID REGIONS
SINGLE ENGINE FAILURE

EXAMPLE

WANTED

A TAKEOFF PROFILE WHICH WILL PERMIT A SAFE LANDING AFTER AN ENGINE SUDDENLY BECOMES INOPERATIVE.

KNOWN

AIRCRAFT GROSS WEIGHT = 22,000 LBS
AMBIENT CONDITIONS:
TEMPERATURE = 15 °C
PRESSURE ALTITUDE = SEA LEVEL
WIND = 0 KTS

METHOD

TRACE ALONG GROSS WEIGHT LINE NOTING WHEEL HEIGHT / AIRSPEED COMBINATIONS WHICH WILL KEEP THE TAKEOFF PROFILE BELOW AND TO THE RIGHT OF THE AVOID REGION.

POINT	AIRSPEED	WHEEL HEIGHT
A	10	15
B	20	28
C	30	150

NOTE

BASED ON 90% OF CONTINGENCY RATED POWER.
WEIGHTS GREATER THAN 22,000 LBS ARE FOR FERRY MISSION ONLY, FOR WHICH A FLIGHT RELEASE IS REQUIRED.

DATA BASE: ESTIMATED

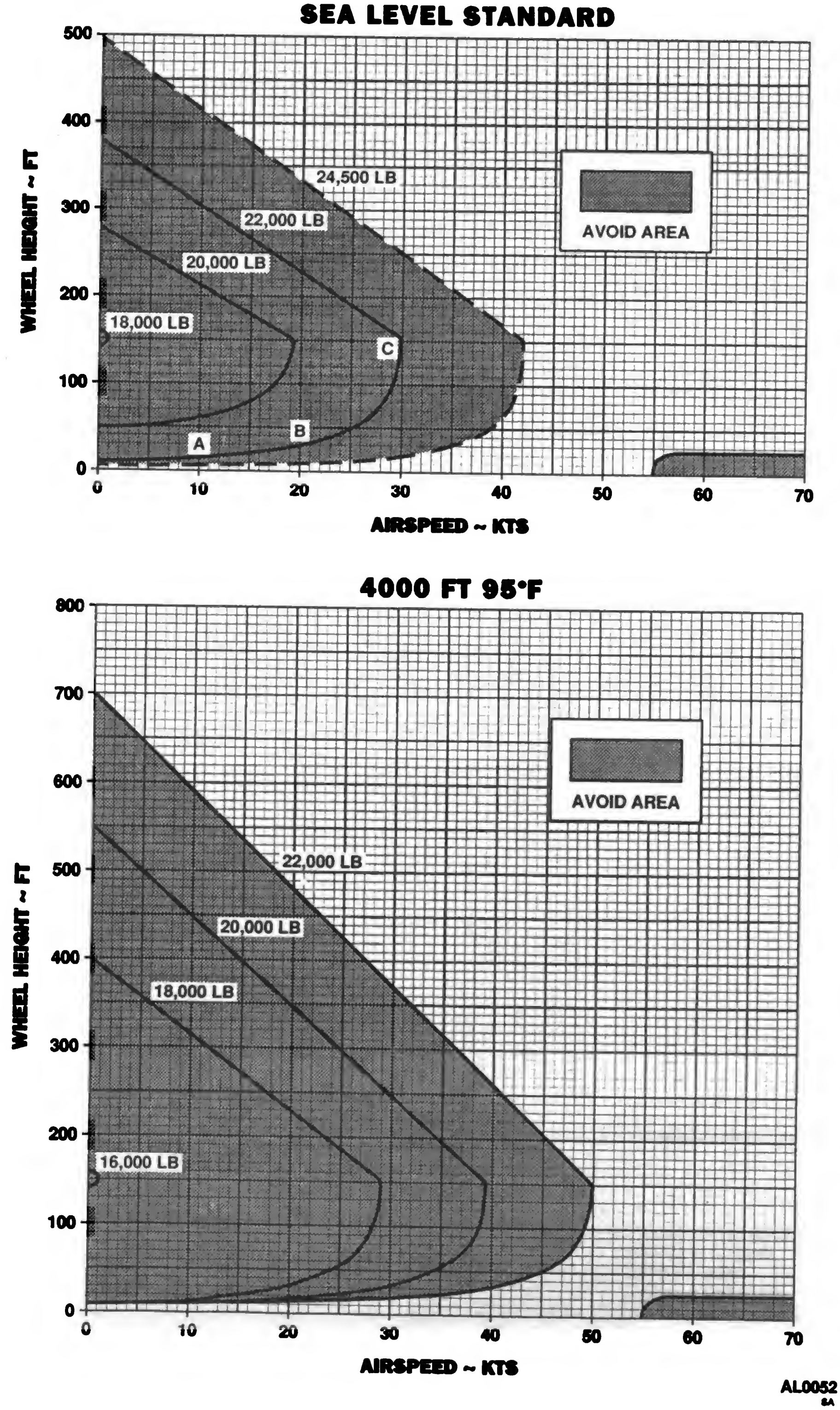
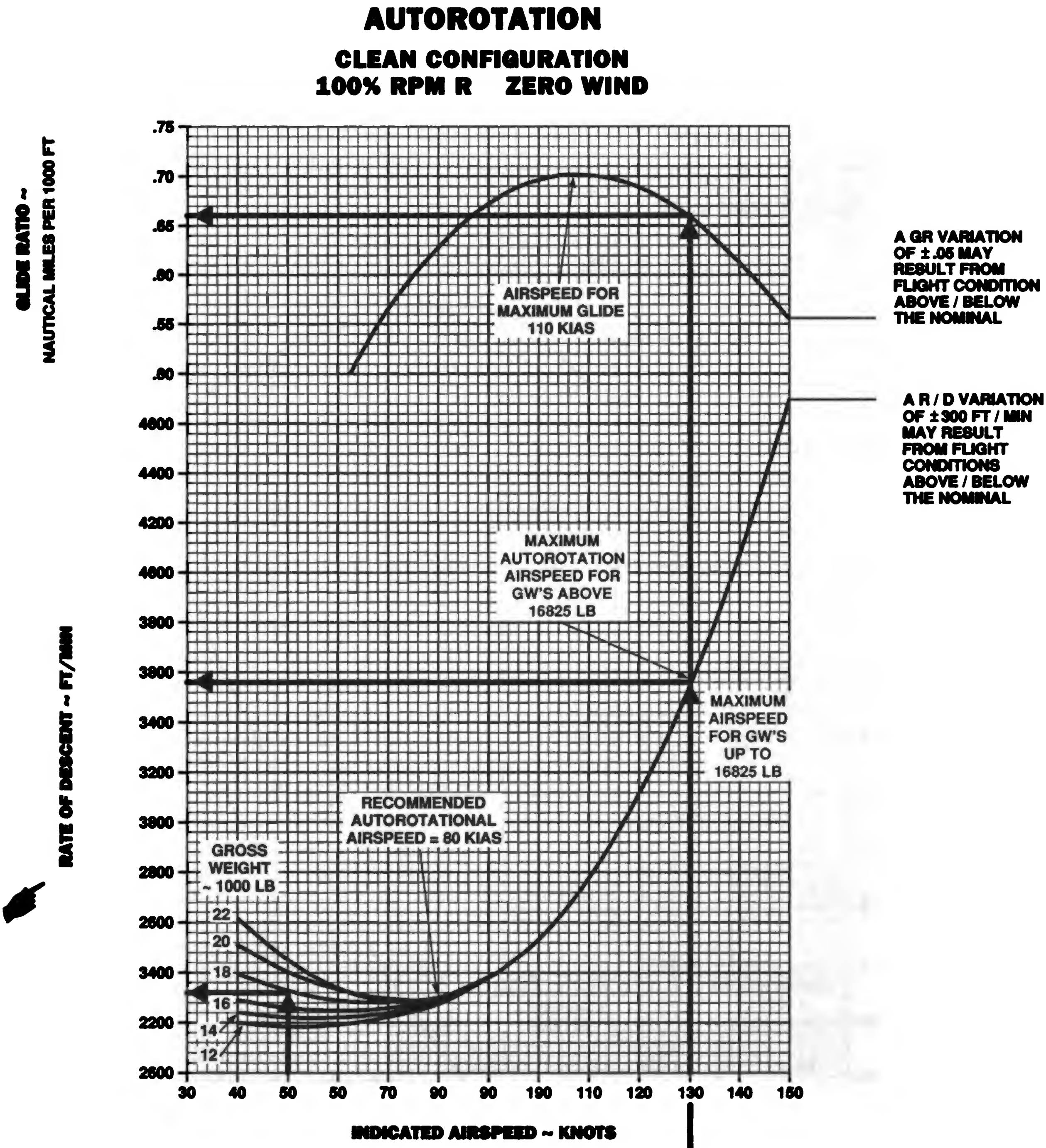


Figure 9-2.1. Height Velocity Diagram UH 60L



EXAMPLE

WANTED:

RATE OF DESCENT AND GLIDE RATIO IN STEADY STATE AUTOROTATION AT IAS'S OF:
A. 130 KIAS
B. 50 KIAS

KNOWN:

RPM R = 100%
GROSS WEIGHT = 18,000 LB

METHOD:

A. ENTER AUTOROTATION CHART AT 130 KIAS, MOVE UP TO INTERSECTION OF R / D LINE, MOVE LEFT, READ RD = 3,800 FT / MIN
B. ENTER AUTOROTATION CHART AT 50 KIAS, MOVE UP TO 18,000 LB GW LINE, MOVE LEFT, READ R / D = 2,325 FT / MIN

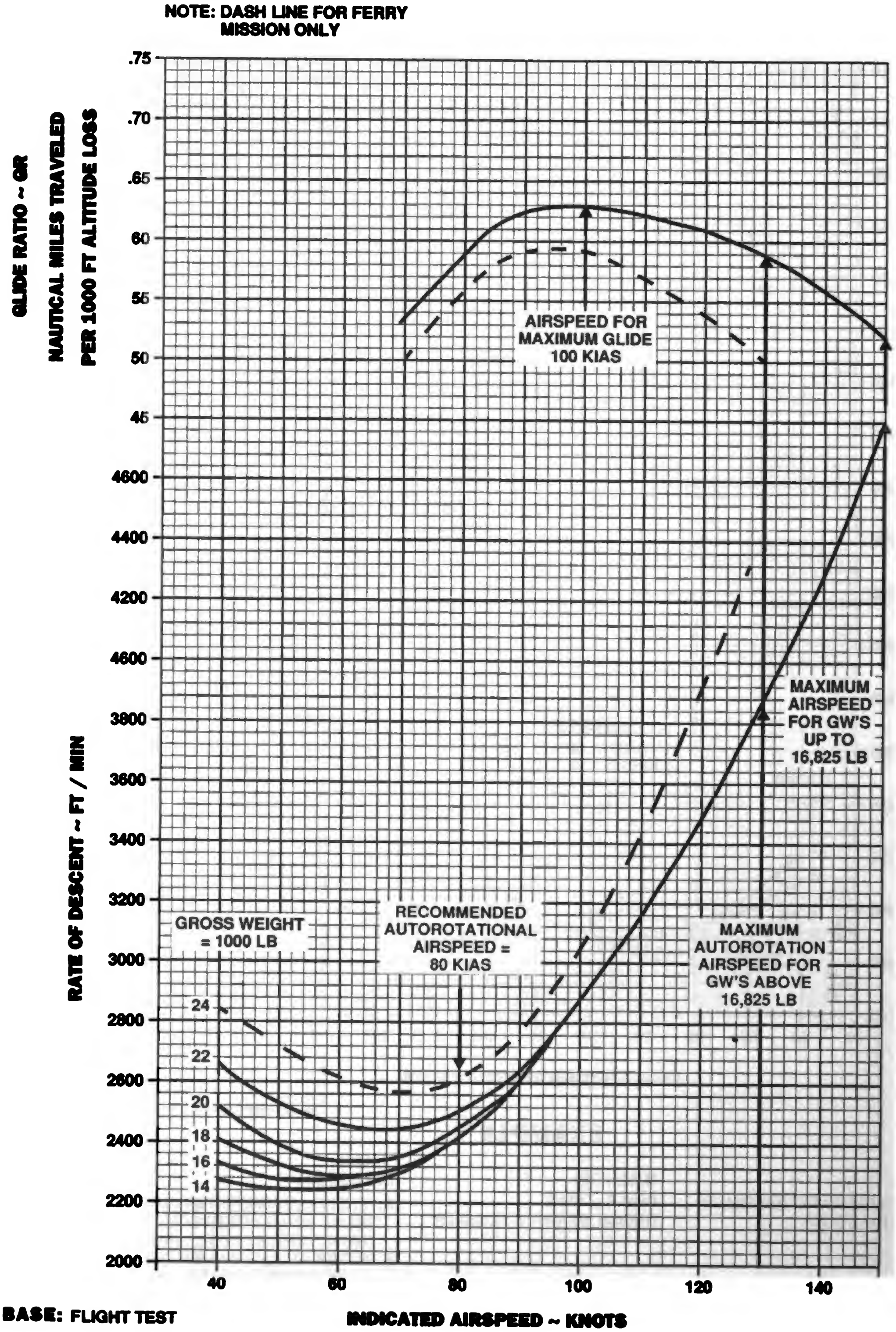
THE GLIDE RATIO IS NOT PROVIDED FOR LOW AIRSPEEDS

DATA BASE: FLIGHT TEST

AA0322A
8A

Figure 9-3. Autorotative Glide Distance Chart

AUTOROTATION
100% RPM R



DATA BASE: FLIGHT TEST

AL0015 9A

Figure 9-3.1. Autorotative Glide Distance Chart - High Drag

not recommended because the deceleration does not effectively arrest the rate of descent. Adjusting the cyclic and collective control to maintain 100% RPM R and 110 KIAS will result in achieving the maximum glide distance. A landing area must be selected immediately after both engines fail. Throughout the descent, adjust collective as necessary to maintain NR within normal range. Figure 5-1 shows the rotor limitations. NR should be maintained at or slightly above 100 percent to allow ample rpm before touchdown.

b. Main rotor rpm will increase momentarily when the cyclic is moved aft with no change in collective pitch setting. An autorotative rpm of approximately 100 percent provides for a good rate of descent. NR above 100 percent will result in a higher rate of descent. At 50 to 75 feet AGL, use aft cyclic to decelerate. This reduces airspeed and rate of descent and causes an increase in NR. The degree of increase depends upon the amount and rate of deceleration. An increase in NR can be desirable in that more inertial energy in the rotor system will be available to cushion the landing. Ground contact should be made with some forward speed. Pitch attitudes up to 25° at the point of touchdown normally result in an adequate deceleration and safe landing. If a rough area is selected, a steeper deceleration and a touchdown speed as close to zero as possible should be used. With deceleration beyond 25°, there is the possibility of ground contact with the stabilator trailing edge. It is possible that during the autorotative approach, the situation may require additional deceleration. In that case, it is necessary to assume a landing attitude at a higher altitude than normal. Should both engines fail at low airspeed, initial collective reduction may vary widely. The objective is to reduce collective as necessary to maintain NR within normal range. In some instances at low altitude or low airspeed, settling may be so rapid that little can be done to avoid a hard-impact landing. In that case, it is critical to maintain a level landing attitude. Cushion the landing with remaining collective as helicopter settles to the ground. At slow airspeeds, where altitude permits, apply forward cyclic as necessary to increase airspeed to about 80 KIAS. Jettison external cargo as soon as possible to reduce weight and drag, improve autorotational performance, and reduce the chance of damage to the helicopter on landing.

9-13. DUAL-ENGINE FAILURE.

WARNING

Do not respond to engine-out audio and warning lights until after checking TGT and RPM R.

AUTOROTATE.

9-14. DECREASING % RPM R.

If an engine control unit fails to the low side and the other engine is unable to provide sufficient torque, % RPM R will decrease.

CAUTION

When engine is controlled with engine power-control lever lockout, engine response is much faster and the TGT limiting system is inoperative. Care must be taken not to exceed TGT limits and keeping % RPM R and % RPM 1 and 2 in operating range.

1. Collective - Adjust to control RPM R.

2. ENG POWER CONT lever - LOCKOUT low power/TGT engine maintain TRQ approximately 10% below other engine.

3. Land as soon as practicable.

9-15. INCREASING % RPM R.

% RPM R increasing will result from an engine control system failing to the high side. % RPM 1 and 2 (N_P) will increase with the rotor (% RPM R).

1. Collective - Adjust to control RPM R.

2. ENG POWER CONT lever - Retard high power/TGT engine, maintain TRQ approximately 10% below other engine.

3. Land as soon as practicable.

9-15.1. %RPM INCREASING/DECREASING (OSCILLATION).

It is possible for a malfunction to occur that can cause the affected engine to oscillate. The other engine will respond to the change in power by also oscillating, usually with smaller amplitudes. The suggested pilot corrective action is to pull back the ENG POWER CONT lever of the suspected engine until oscillation stops. If the oscillation continues, the ENG POWER CONT lever should be returned to FLY position and the other ENG POWER CONT lever pulled back until the oscillation ceases. Once the malfunctioning engine has been identified, it should be placed in LOCKOUT and controlled manually.

1. Slowly retard the ENG POWER CONT lever on the suspected engine.

If the oscillation stops:

2. Place that engine in LOCKOUT and manually control the power.

3. Land as soon as practicable.

If the oscillation continues:

4. Place the ENG POWER CONT lever back to FLY and retard the ENG POWER CONT lever of the other engine.

When the oscillation stops:

5. Place the engine in LOCKOUT, manually control the power.

6. Land as soon as practicable.

9-16. % TRQ SPLIT BETWEEN ENGINES 1 AND 2.

It is possible for a malfunction to occur that can cause a % TRQ split between engines without a significant change in % RPM R. The % TRQ split can be corrected by manual control of the ENG POWER CONT lever on the affected engines.

1. If TGT of one engine exceeds the limiter (850°C 700, 870°C with low power engine above 50% TRQ or 896°C with low power engine below 50% TRQ 701C), retard ENG POWER CONT lever on that engine to reduce TGT. Retard the ENG POWER CONT lever to maintain torque of the manually controlled engine at approximately 10% below the other engine.

2. If TGT limit on either engine is not exceeded, slowly retard ENG POWER CONT lever on high % TRQ engine and observe % TRQ of low power engine.

3. If % TRQ of low power engine increases, ENG POWER CONT lever on high power engine - Retard to maintain % TRQ approximately 10% below other engine.

4. If % TRQ of low power engine does not increase, or % RPM R decreases, ENG POWER CONT lever - Return high power engine to FLY.

5. Land as soon as practicable.

9-17. ENGINE COMPRESSOR STALL.

An engine compressor stall is normally recognized by a noticeable bang or popping noise and possible aircraft yaw. These responses are normally accompanied by the rapid increase in TGT and fluctuations in N_g, TORQUE, and N_p reading for the affected engine. In the event of a compressor stall:

1. Collective - Reduce.

If condition persists:

2. ENG POWER CONT lever (affected engine) - Retard. (TGT should decrease.)

3. ENG POWER CONT lever (affected engine) - FLY.

If stall condition recurs:

4. EMER ENG SHUTDOWN (affected engine).

5. Refer to single-engine failure emergency procedure.

9-18. #1 OR #2 OIL FILTERS BYPASS CAUTION LIGHT ON.

1. ENG POWER CONT lever - Retard.

2. Land as soon as practicable.

9-19. ENGINE CHIP CAUTION LIGHT ON, ENG OIL PRESS HIGH/LOW, ENGINE OIL TEMP HIGH, ENGINE OIL TEMP CAUTION LIGHT ON, ENGINE OIL PRESS CAUTION LIGHT ON.

1. ENG POWER CONT lever - Retard to reduce torque on affected engine.

If oil pressure is below minimum limits or if oil temperature remains above maximum limits.

2. EMER ENG SHUTDOWN (affected engine).

3. Refer to single-engine failure emergency procedure.

9-20. ENGINE HIGH-SPEED SHAFT FAILURE.

Failure of the shaft may be complete or partial. A partial failure may be characterized at first by nothing more than a loud high-speed rattle and vibration coming from the engine area. A complete failure will be accompanied by a loud bang that will result in a sudden % TRQ decrease to zero on the affected engine. Percent N_p of affected engine will increase until overspeed system is activated.

1. Collective - Adjust.

2. EMER ENG SHUTDOWN (affected engine). Do not attempt to restart.

3. Refer to single-engine failure emergency procedure.

9-21. LIGHTNING STRIKE.

WARNING

Lightning strikes may result in loss of automatic flight control functions, engine controls, and/or electric power.

Lightning strike may cause one or both engines to immediately produce maximum power with no TGT limiting or overspeed protection. Systems instruments may also be inoperative. If this occurs, the flight crew would have to adjust to the malfunctioning engine(s) power-control lever(s) as required to control RPM by sound and feel. If practical, the pilot should reduce speed to 80 KIAS. This will reduce criticality of having exactly correct rotor speed 100%.

1. ENG POWER CONT levers - Adjust as required to control RPM.

2. Land as soon as possible.

9-22. ROTORS TRANSMISSIONS AND DRIVE SYSTEMS.

9-23. LOSS OF TAIL ROTOR THRUST.

Failure of the tail rotor gearbox, intermediate gearbox or tail rotor drive shaft will result in a loss of tail rotor thrust. The nose of the helicopter will yaw right regardless of the airspeed at which the failure occurs. Continued level flight may not be possible following this type failure. Loss of tail rotor thrust at low speed will result in rapid right yaw. At higher airspeed, right yaw may develop more slowly but will continue to increase. Autorotation should be entered promptly and engine control levers retarded to OFF position. Every effort should be made to establish and maintain an autorotative glide at or above minimum rate of descent airspeed. This will maximize the effectiveness of the deceleration during the landing sequence. If autorotation entry is delayed, large sideslip angles can develop causing low indicated airspeed with the stabilator programming down. This can make it more difficult to establish or maintain adequate autorotative airspeed.

1. Autorotate.

2. ENG POWER CONT levers - OFF.

9-24. LOSS OF TAIL ROTOR THRUST AT LOW AIRSPEED/HOVER.

Loss of tail rotor thrust at slow speed may result in extreme yaw angles and uncontrolled rotation to the right. Immediate collective pitch reduction should be initiated to reduce the yaw and begin a controlled rate of descent. If the helicopter is high enough above the ground, initiate a power-on descent.

Collective should be adjusted so that an acceptable compromise between rate of turn and rate of descent is maintained. At approximately 5 to 10 feet above touchdown, initiate a hovering autorotation by pwr levers - off.

1. Collective - Reduce

2. ENG POWER CONT levers - Off (5 to 10 feet above touchdown).

9-25. TAIL ROTOR QUADRANT CAUTION LIGHT ON WITH NO LOSS OF TAIL ROTOR CONTROL.

Loss of one tail rotor cable will be indicated by illumination of TAIL ROTOR QUADRANT caution light. No change in handling characteristics should occur.

Land as soon as practicable.

9-26. TAIL ROTOR QUADRANT CAUTION LIGHT ON WITH LOSS OF TAIL ROTOR CONTROL.

a. Helicopters prior to S/N 91-26360 not equipped with the improved main rotor flight controls and biased tail rotor will be evident by the installation of the UH-60L DUAL ENGINE TORQUE LIMITS placard installed on the instrument panel. If both tail rotor control cables fail, a centering spring will position the tail rotor servo linkage to provide 7-1/2 degrees of pitch. This will allow trimmed flight at about 45 KIAS and 120 KIAS (these speeds will vary with gross weight). At airspeed below 45 and above 120 KIAS, right yaw can be controlled by reducing collective. Between 45 and 120 KIAS, left yaw can be controlled by increasing collective.

b. Helicopters S/N 91-26360 and subsequent and helicopters prior to S/N 91-26360 equipped with the improved main rotor flight controls and biased tail rotor will be evident by the absence of the UH-60L DUAL ENGINE TORQUE LIMITS placard installed on the instrument panel. If both tail rotor control cables fail, a centering spring will position the tail rotor servo linkage to provide 10-1/2 degrees of pitch. This will allow trimmed flight at about 25 KIAS and 145 KIAS (these speeds will vary with gross weight). At airspeed below 25 above 145 KIAS, right yaw can be controlled by reducing collective. Between 25 and 145 KIAS, left yaw can be controlled by increasing collective.

c. A shallow approach to a roll-on landing technique is recommended. During the approach, a yaw to the left will occur. As the touchdown point is approached, a mild deceleration should be executed to reduce airspeed. As collective is increased to cushion touchdown, the nose of the helicopter will yaw right. Careful adjustment of collective and deceleration should allow a tail-low touchdown with approximately runway alignment. Upon touchdown, lower collective carefully. Use brakes to control heading.

1. Collective - Adjust.

2. Land as soon as practicable.

9-27. PEDAL BIND/RESTRICTION OR DRIVE WITH NO ACCOMPANYING CAUTION LIGHT.

When pedal bind/restriction or motoring is noted with no caution lights illuminated, the cause of the restriction may not be apparent. Normally, any trim or yaw SAS malfunction can be overridden by pilot inputs. In case of a pedal bind/restriction with no associated caution light:

1. Boost switch - OFF.

If tail rotor is not restored:

2. Boost switch - ON.

3. TAIL SERVO switch - BACKUP if tail rotor is not restored.

a. If the tail rotor quadrant becomes jammed, collective control is available, except that low collective with right pedal or high collective with a left pedal will be restricted. With a quadrant jam, complete collective travel is available for most control combinations, provided the pedals are allowed to move as the collective is displaced.

b. If tail rotor pitch becomes fixed during decreased power situations (right pedal applied), the nose of the helicopter will turn to the right when power is applied, possibly even greater than complete loss of tail rotor thrust. Some conditions may require entry into autorotation to control yaw rate. If continued flight is possible, a shallow approach at about 80 KIAS to a roll-on landing should be made. As the touchdown point is approached, a mild deceleration should be executed about 15 - 25 feet to reduce airspeed to about 40 KIAS. As collective is increased to cushion touchdown, the nose of the helicopter will turn to the right. Careful adjustment of collective and deceleration should allow a tail-low touchdown with approximate runway alignment. Upon touchdown, lower collective carefully and use brakes to control heading.

c. If tail rotor pitch becomes fixed during increased power situations (left pedal applied), the nose of the helicopter will turn left when collective is decreased. Under these conditions, powered flight to a prepared landing site and a powered landing is possible since the sideslip angle will probably be corrected when power is applied for touchdown. Adjust approach speed and rate of descent to maintain a sideslip angle of less than 20°. Sideslip angle may be reduced by either increasing airspeed or collective. Execute a decelerated touchdown tailwheel first, and cushion landing with collective. Upon touchdown, lower collective carefully and use brakes to control heading.

4. Land as soon as practicable.

9-28. #1 TAIL ROTOR SERVO CAUTION LIGHT ON AND BACKUP PUMP ON ADVISORY LIGHT OFF.

Automatic switch-over did not take place.

1. AIRSPEED - Adjust.

2. TAIL SERVO switch - BACKUP.

3. BACKUP HYD PUMP switch - ON.

4. Land as soon as practicable.

9-29. MAIN XMSN OIL PRESS CAUTION LIGHT ON/ XMSN OIL PRESS LOW/TRANS OIL TEMP HIGH OR XMSN OIL TEMP CAUTION LIGHT ON.

Loss of cooling oil supply will lead to electrical and/or mechanical failure of main generators. If the malfunction is such that oil pressure decays slowly, the generators may fail before MAIN XMSN OIL PRESS caution light goes on.

1. Land as soon as possible.

If time permits:

2. Slow to 80 KIAS.

3. EMER APU START.

WARNING

On certain helicopters, the stabilator amplifiers utilize filters which will result in the stabilator amplifier sensing zero airspeed for 1.5 - 2 seconds following restoration of aircraft power. This may also occur during the brief power interruption experienced when switching from main to APU generator. During this time, the stabilator will drive trailing edge down. After this time, the stabilator will drive to the appropriate angle.

4. GENERATORS NO. 1 and NO. 2 switches - OFF.

9-30. CHIP INPUT MDL LH OR RH CAUTION LIGHT ON.

1. ENG POWER CONT lever on affected engine - IDLE.

2. Land as soon as possible.

9-31. CHIP MAIN MDL SUMP, CHIP ACCESS MDL LH OR RH, CHIP TAIL XMSN OR CHIP INT XMSN/TAIL XMSN OIL TEMP OR INT XMSN OIL TEMP CAUTION LIGHT ON.

Land as soon as possible.

9-32. FIRE.

CAUTION

If AC electrical power is not available, only the reserve fire bottle can be discharged and fire extinguishing capability for the #2 engine will be lost.

The safety of helicopter occupants is the primary consideration when a fire occurs; therefore, it is imperative that every effort be made to extinguish the fire. On the ground, it is essential that the engine be shut down, crew and passengers evacuated, and fire fighting begun immediately. If time permits, a "May Day" radio call should be made before the electrical power is OFF to expedite assistance from fire-fighting equipment and personnel. If the helicopter is airborne when a fire occurs, the most important single action that can be taken by the pilot is to land. Consideration must be given to jettisoning external stores and turning FUEL BOOST PUMPS and XFER PUMPS off prior to landing.

9-33. ENGINE/FUSELAGE FIRE ON GEOUND.

1. ENG POWER CONT levers - OFF.

2. ENG EMER OFF handle - Pull if applicable.

3. FIRE EXT switch - MAIN/RESERVE, as required.

9-34. APU COMPARTMENT FIRE.

1. APU fire T-handle - Pull.

2. FIRE EXT switch - MAIN/RESERVE as required.

9-35. APU OIL TEMP HI CAUTION LIGHT ON.

APU CONTR switch - OFF. Do not attempt restart until oil level has been checked.

9-36. ENGINE FIRE IN FLIGHT.

WARNING

Attempt to visually confirm fire before engine shutdown or discharging extinguishing agent.

1. ENG POWER CONT lever (affected engine) - OFF.

2. ENG EMER OFF handle - Pull.

3. FIRE EXT switch - MAIN/RESERVE as required.

4. Land as soon as possible.

9-37. ELECTRICAL FIRE IN FLIGHT.

Prior to shutting off all electrical power, the pilot must consider the equipment that is essential to a particular flight environment which will be affected, e.g., flight instruments, flight controls, etc. If a landing cannot be made as soon as possible the affected circuit may be isolated by selectively turning off electrical equipment and/or pulling circuit breakers.

1. BATT and GENERATORS switches - OFF.

2. Land as soon as possible.

9-38. SMOKE AND FUME ELIMINATION.

WARNING

If battery overheats, do not remove battery cover or attempt to disconnect or remove battery. Battery fluid will cause burns, and an overheated battery could cause thermal burns and may explode.

Smoke or fumes in the cockpit/cabin can be eliminated as follows:

1. Airspeed - 80 KIAS or less.

2. Cabin doors and gunner's windows - Open.

3. Place helicopter out of trim.

9-39. FUEL SYSTEM.

9-40. #1 OR #2 FUEL FLTR BYPASS CAUTION LIGHT ON.

1. ENG FUEL SYS selector on affected engine - XFD.

2. Land as soon as practicable.

9-41. #1 AND #2 FUEL FLTR BYPASS CAUTION LIGHTS ON.

Land as soon as possible.

9-41.1. #1 FUEL LOW AND #2 FUEL LOW CAUTION LIGHTS ON.

Land as soon as practicable.

9-42. #1 OR #2 FUEL PRESS CAUTION LIGHT ON.

a. If the light illuminates, flameout is possible. Do not make rapid collective movements. This emergency procedure has been written to include corrective action for critical situations. Critical situations are those where the loss of an engine represents a greater hazard than the possibility of pressurizing a fuel leak.

If the light illuminates and the situation is critical:

FUEL BOOST PUMP CONTROL switch(es) No. 1 Pump and No. 2 Pump - ON.

b. This portion of the emergency procedure has been written to provide the best method of isolating the cause of the failure and prescribing the proper corrective action when the situation is not critical. This portion of the emergency procedure assumes the FUEL BOOST PUMP CONTROL switches are OFF when the malfunction occurs.

If the situation is not critical:

1. ENG FUEL SYS selector on affected engine - XFD.

If light stays on:

2. FUEL BOOST PUMP CONTROL switches No. 1 Pump and No. 2 Pump - ON.

If light stays on:

3. FUEL BOOST PUMP CONTROL switches - No. 1 Pump and No. 2 Pump - OFF.

4. Land as soon as practicable.

9-43. ELECTRICAL SYSTEM.

9-44. #1 AND #2 GENERATOR FAILURE (#1 AND #2 CONV AND AC ESS BUS OFF CAUTION LIGHTS ON).

1. SAS 1 switch - Press OFF.

WARNING

On certain helicopters, the stabilator amplifiers utilize filters which will result in the stabilator amplifier sensing zero airspeed for 1.5 - 2 seconds following restoration of aircraft power. This may also occur during the brief power interruption experienced when switching from main to APU generator. During this time, the stabilator will drive trailing edge down. After this time, the stabilator will drive to the appropriate angle. Before restoring ac power, the helicopter shall be slowed to 80 KIAS.

2. Airspeed - Adjust (80 KIAS or less).

3. GENERATORS NO. 1 and NO. 2 switches - RESET; then ON.

If caution lights remain on:

4. GENERATORS NO. 1 and NO. 2 switches - OFF.

5. EMER APU START.

6. SAS 1 switch - ON.

7. Land as soon as practicable.

9-45. #1 OR #2 GEN CAUTION LIGHT ON.

1. Affected GENERATORS switch RESET; then ON.

If caution light remains on:

2. Affected GENERATORS switch - OFF.

3. EMER APU START.

9-46. #1 AND #2 CONV CAUTION LIGHTS ON.

1. Unnecessary dc electrical equipment - OFF.

NOTE

When only battery power is available, battery life is about 22 minutes day and 14 minutes night for a battery 80% charged.

2. Land as soon as practicable.

9-47. BATTERY FAULT CAUTION LIGHT ON.

1. BATT switch - OFF; then ON. If BATTERY FAULT caution light goes on, cycle BATT switch no more than two times.

If light remains on:

2. BATT switch - OFF.

9-48. BATT LOW CHARGE CAUTION LIGHT ON.

BATT LOW CHARGE caution light on indicates charge is at or below 40%.

If light goes on after ground APU start:

1. BATT switch - OFF; then ON to reset charger analyzer logic. About 30 minutes may be required to recharge battery.

If light goes on in flight:

2. BATT switch - OFF, to conserve remaining battery charge.

9-49. HYDRAULIC SYSTEM.

9-50. #1 HYD PUMP CAUTION LIGHT ON.

1. TAIL SERVO switch - BACKUP; then NORMAL.

2. Land as soon as practicable.

9-51. #2 HYD PUMP CAUTION LIGHT ON.

1. POWER ON RESET switches - Simultaneously press and release.

2. Land as soon as practicable.

9-52. #1 AND #2 HYD PUMP CAUTION LIGHTS ON.

Land as soon as possible. Restrict control movement to moderate rates.

9-53. #1 OR #2 HYD PUMP CAUTION LIGHT ON AND BACKUP PUMP ON ADVISORY LIGHT OFF.

a. Loss of both the No. 1 hydraulic pump and backup pump results in both stages of the tail-rotor servo being unpressurized. The yaw boost servo is still pressurized and allows limited tail-rotor control. The initial aircraft reaction to loss of both stages of the tail-rotor servo is exactly the same as for loss of tail-rotor control. The collective need not be used to control the yawing tendency below 45 KIAS or above 120 KIAS, since the mechanical control system is still intact. Maximum pilot effort on the pedals and the output of the yaw boost servo are insufficient to produce the tail-rotor pitch required to hover; a roll-on landing technique is recommended.

b. Loss of both the No. 2 hydraulic pump and the backup pump results in the loss of pilot-assist servos. Boost should be turned off if the backup pump cannot be regained.

1. Airspeed - Adjust to a comfortable airspeed.

2. BACKUP HYD PUMP switch - ON.

If BACKUP PUMP ON advisory light remains off:

3. SAS, FPS, and BOOST switches - OFF (for #2 HYD PUMP caution light).

4. Land as soon as possible.

9-54. #1 OR #2 PRI SERVO PRESS CAUTION LIGHT ON.

1. SVO OFF switches - Check centered.

If caution light remains on:

2. Land as soon as possible.

9-55. #1 RSVR LOW AND #1 HYD PUMP CAUTION LIGHTS ON WITH BACKUP PUMP ON ADVISORY LIGHT ON.

1. Land as soon as practicable.

If the BACKUP RSVR LOW caution light also goes on:

2. SVO OFF switch - 1ST STG.

3. Land as soon as possible.

WARNING

If #2 PRI SERVO PRESS caution light goes on, establish landing attitude; minimize control inputs and begin a descent.

9-56. #2 RSVR LOW AND #2 HYD PUMP CAUTION LIGHTS ON WITH BACKUP PUMP ON ADVISORY LIGHT ON.

1. POWER ON RESET switches - Simultaneously press; then release.

2. Land as soon as practicable.

If BACKUP RSVR LOW caution light also goes on:

3. SVO OFF switch - 2ND STG.

4. Land as soon as possible.

WARNING

If #1 PRI SERVO PRESS caution light goes on, establish landing attitude, minimize control inputs, and begin a descent.

9-57. #2 RSVR LOW CAUTION LIGHT ON.

Pilot assist servos will be isolated; if they remain isolated, proceed as follows:

1. Airspeed - Adjust.
2. SAS, BOOST, and FPS switches - OFF.
3. Land as soon as practicable.

NOTE

Because logic module will close valves supplying pressure to pilot-assist servos, BOOST OFF, SAS OFF, and TRIM FAIL caution, lights will be on.

9-58. COLLECTIVE OR YAW BOOST SERVO HARDOVER/POWER PISTON FAILURE.

Hardover failure of the collective or yaw boost servo will increase control forces (as much as 150 pounds in collective, and 250 pounds on pedals). The increased control forces can be immediately eliminated by shutting off the boost servo. Resulting control loads will then be the same as for in-flight boost servo off.

1. BOOST switch - OFF.
2. Airspeed - Adjust to comfortable airspeed.
3. Land as soon as practicable.

9-58.1. PITCH BOOST SERVO HARDOVER.

Hardover failure of the pitch boost servo will increase the longitudinal cyclic control forces (approximately 20 pounds). The increased control forces can be immediately eliminated by shutting off SAS.

1. SAS (1 and 2) and FPS switches - OFF.
2. Airspeed as required.
3. Land as soon as practicable.

9-59. BOOST SERVO CAUTION LIGHT ON.

Lighting of the BOOST SERVO OFF caution light with no other caution lights on indicates a pilot valve jam in either the collective or yaw boost servo. Control forces in the affected axis will be similar to flight with boost off.

1. Airspeed - Adjust.
2. BOOST switch - OFF.
3. Land as soon as practicable.

9-60. LANDING AND DITCHING.

9-61. EMERGENCY LANDING IN WOODED AREAS. POWER OFF.

1. AUTOROTATE. Decelerate helicopter to stop all forward speed at treetop level.

2. Collective adjust to maximum before main rotor contacts tree branches.

9-62. DITCHING POWER ON.

The decision to ditch the helicopter shall be made by the pilot when an emergency makes further flight unsafe.

1. Approach to a hover.
2. Cockpit doors jettison and cabin doors open.
3. Pilot shoulder harness - Lock.
4. Survival gear - Deploy.
5. Personnel, except pilot, exit helicopter.
6. Fly helicopter downwind a safe distance and hover.
7. ENG POWER CONT levers - OFF.
8. Perform hovering autorotation, apply full collective to decay rotor RPM as helicopter settles.
9. Position cyclic in direction of roll.
10. Exit, when main rotor has stopped.

9-63. DITCHING - POWER OFF.

If ditching is imminent, accomplish engine malfunction emergency procedures. During descent, open cockpit and cabin doors. Decelerate to zero forward speed as the helicopter nears the water. Apply all of the collective as the helicopter nears the water. Maintain a level attitude as the helicopter sinks and until it begins to roll; then apply cyclic in the direction of the roll. Exit when the main rotor is stopped.

1. AUTOROTATE.

2. Cockpit and cabin doors - Open.

3. Cyclic - Position in direction of roll.

4. Exit when main rotor has stopped.

9-64. FLIGHT CONTROL/MAIN-ROTOR SYSTEM MALFUNCTIONS.

a. Failure of components within the flight control system may be indicated through varying degrees of feedback, binding, resistance, or sloppiness. These conditions should not be mistaken for malfunction of the AFCS.

b. Imminent failure of main rotor components may be indicated by a sudden increase in main rotor vibration and/or unusual noise. Severe changes in lift characteristics and/or balance condition can occur due to blade strikes, skin separation, shift or loss of balance weights or other material. Malfunctions may result in severe main-rotor flapping. If the main-rotor system malfunctions:

WARNING

Danger exists that the main rotor system could collapse or separate from the aircraft after landing. Exit when main rotor has stopped.

1. Land as soon as possible.

2. EMER ENG(S) SHUTDOWN after landing.

9-65. SAS FAILURE WITH NO FAILURE ADVISORY INDICATION.

If pilot vertical gyro becomes erratic and/or ac electrical power is lost to the gyro or SAS amplifier, moderate oscillations/pounding sounds may be experienced. If this occurs, disengage SAS 1. If the helicopter exhibits erratic motion without a corresponding failure advisory indication.

SAS 1 switch - Press off.

9-66. SAS 2 FAILURE ADVISORY LIGHT ON.

POWER ON RESET switches - Simultaneously press and then release.

9-67. SAS OFF CAUTION LIGHT ON.

1. FPS switch - Press off.

2. Airspeed - As required.

9-68. Deleted.

9-69. FLT PATH STAB CAUTION LIGHT ON.

An FPS malfunction will be detected by the SAS/FPS computer, which will disengage FPS function in the applicable axis and light the FLT PATH STAB caution light and corresponding FAILURE ADVISORY light:

With the Mode Select Panel switch in the IINS/IINS position, a failure of the IINS gyro will cause a failure of the FPS and may possibly cause SAS 2 to become erratic in roll motion. In addition to the failure indications on the IINS Control Display screen, the GYRO segment on the Failure Advisory Panel will illuminate. The copilot's VSI will fail with a ATT Warning Flag and both HSI's will fail with HDG Warning Flags. The aircraft may drift in pitch, roll and/or yaw axis due to FPS failure. EH

1. System Select - DG/VG. EH

2. POWER ON RESET switches - Simultaneously press and then release.

If failure returns, control affected axis manually.

WARNING

If the airspeed fault advisory light is illuminated, continued flight above 70 KIAS with the stabilator in the AUTO MODE is unsafe since a loss of the airspeed signal from the remaining airspeed sensor would result in the stabilator slewing full-down.

If an airspeed fault light remains illuminated on the AFCS panel:

NOTE

Use of the cyclic stabilator slew-up switch should be announced to the crew to minimize cockpit confusion.

3. Manually slew stabilator - Adjust to 0° if above 40 KIAS. The preferred method of manually slewing the stabilator up is to use the cyclic stabilator slew-up switch.

4. Land as soon as practicable.

9-70. PITCH, ROLL OR YAW/TRIM HARDOVER.

a. A pitch FPS/trim hardover will cause a change in pitch attitude and a corresponding longitudinal cyclic movement of about 1/2 inch. This condition will be detected by the SAS/FPS computer which will disengage FPS and trim functions in the pitch axis and light the FLT PATH STAB and TRIM FAIL caution lights.

b. A roll FPS/trim hardover will be characterized by a 1/2" lateral stick displacement, resulting in a corresponding roll rate and a constant heading sideslip condition, caused by the yaw FPS attempting to maintain heading. The SAS/FPS computer will detect the hardover condition and disengage lateral trim and illuminate the FLT PATH STAB and trim fail caution lights.

c. A yaw FPS/trim hardover is characterized by an improper motion of the pedals, resulting in about 1/4 inch of pedal motion followed by a corresponding change in helicopter heading trim. This condition will be detected by the SAS/FPS computer, which will disengage trim and FPS functions in the yaw axis and light the FLT PATH STAB and TRIM FAIL caution lights.

If failure occurs:

POWER ON RESET switches - Simultaneously press and then release.

If failure returns, control affected axis manually.

9-71. TRIM ACTUATOR JAMMED.

Both yaw and roll trim actuators incorporate slip clutches to allow pilot and copilot inputs if either actuator should jam. The forces required to override the clutches are 80 pounds maximum in yaw and 13 pounds maximum in roll:

Land as soon as practicable.

9-72. STABILATOR MALFUNCTION - AUTO MODE FAILURE.

An Auto Mode Failure will normally result in the stabilator failing in place. The position of failure may vary from the ideal programmed position by 10° at 30 KIAS to 4° at 150 KIAS. If an approach is made with the stabilator fixed 0°, the pitch attitude may be 4° to 5° higher than normal in the 20 to 40 KIAS range.

WARNING

If acceleration is continued or collective is decreased with the stabilator in a trailing edge down position, longitudinal control will be lost. The stabilator shall be slewed to 0° above 40 KIAS and full-down when airspeed is less than 40 KIAS.

Pressing the auto control reset button after a failure occurs results in the automatic mode coming on for one second. If a hardover signal to one actuator is present, the stabilator could move approximately 4-5° in that one second before another auto mode failure occurs. Subsequent reset attempts could result in the stabilator moving to an unsafe position.

If the stabilator AUTO mode repeatedly disengages during a flight, flight above 70 KIAS is prohibited with the stabilator in AUTO mode.

If an Auto Mode Failure Occurs:

NOTE

Use of cyclic stabilator slew-up switch should be announced to the crew to minimize cockpit confusion.

1. <u>Cyclic Slew Switch - Adjust if necessary</u> to arrest nose down pitch rate.

2. Auto Control Switch - Press ON once.

If automatic control is not regained:

3. Manually slew stabilator - Adjust to 0° for flight above 40 KIAS or full down when airspeed is below 40 KIAS. The preferred method of manually slewing the stabilator up is to use the cyclic slew-up switch.

4. Land as soon as practicable.

If manual control is not possible:

5. STAB POS Indicator - Check and fly at or below KIAS LIMITS shown on placard.

6. Land as soon as practicable.

9-73. UNCOMMANDED NOSE DOWN/UP PITCH ATTITUDE CHANGE.

An uncommanded nose down/up pitch attitude change could be the result of a stabilator or other AFCS malfunction (SAS, FPS, or PBA). There is a remote possibility that a stabilator malfunction could occur in the automatic or manual mode without audio warning or caution light illumination.

If an uncommanded nose down pitch attitude change is detected, the pilot should initially attempt to stop the rate with aft cyclic. Maintaining or increasing collective position may assist in correcting for a nose down pitch attitude. If the nose down pitch rate continues, and/or inappropriate stabilator movement is observed, activate the cyclic slew-up switch to adjust the stabilator to control pitch attitude. Continue to monitor the stabilator position when the slew-up switch is released to insure movement stops.

Uncommanded nose up pitch attitude changes at airspeeds of 140 KIAS and less should not become severe even if caused by full up slew of the stabilator and can be corrected with forward cyclic. If the nose up pitch attitude is caused by full up stabilator slew at airspeeds above 140 KIAS, full forward cyclic may not arrest the nose up pitch rate.

If an uncommanded nose up pitch attitude change is detected, the pilot should initially attempt to stop the rate with forward cyclic. At airspeeds above 140 KIAS, a collective reduction of approximately 3 inches, simultaneously with forward cyclic will arrest the nose up pitch rate. If these control corrections are delayed and/or a large nose up attitude results, a moderate roll to the nearest horizon will assist in returning the aircraft to level flight. After the nose returns to the horizon, roll to a level attitude. After coordination with the pilot, the copilot should adjust the stabilator to 0° at airspeeds above 40 KIAS and full down at airspeeds below 40 KIAS.

If an uncommanded nose down pitch attitude occurs:

1. Cyclic - Adjust as required.

2. Collective - Maintain or increase.

3. Cyclic slew-up switch - Adjust as required to arrest nose down pitch rate.

4. MAN SLEW switch - Adjust to 0° at airspeeds above 40 KIAS and full down at airspeeds below 40 KIAS.

5. Land as soon as practicable.

If an uncommanded nose up pitch attitude occurs:

1. Cyclic - Adjust as required.

2. Collective - Reduce as required.

3. MAN SLEW switch - Adjust to 0° at airspeeds above 40 KIAS and full down at airspeeds below 40 KIAS.

4. Land as soon as practicable.

9-74. EMERGENCY JETTISONING.

When conditions exist which require the jettisoning of external loads to ensure continued flight or execution of emergency procedures, the crew should jettison the load as follows:

CARGO REL or EMER HOOK REL button - Press.

Section II MISSION EQUIPMENT

9-75. EMERGENCY RELEASE OF RESCUE HOIST LOAD.

If the rescue hoist becomes jammed, inoperative, or the cable is entangled and emergency release is required:

1. CABLE SHEAR switch - FIRE.

If release from rescue hoist position is required:

2. CABLE CUT switch - FIRE.

9-76. BLADE DE-ICE SYSTEM MALFUNCTIONS.

9-77. MR DE-ICE FAULT OR MR DE-ICE FAIL, OR TR DE-ICE FAIL CAUTION LIGHT ON.

If the MR DE-ICE FAULT caution light goes on, the system will continue to function in a degraded mode. The pilot must be aware of vibration levels and % TRQ requirements, which could be a result of ice buildup.

If the MR DE-ICE FAIL caution light goes on, the main rotor deice will automatically turn off. Tail rotor deice will remain on.

If the TR DE-ICE FAIL caution lights goes on, tail rotor deice will automatically turn off. Main rotor de-ice will remain on.

1. Icing conditions - Exit.

2. BLADE DE-ICE POWER switch - OFF, when out of icing conditions.

If vibrations increase.

3. Land as soon as possible.

9-78. PWR MAIN RTR AND/OR TAIL RTR MONITOR LIGHT ON.

If a PWR monitor light is on with BLADE DE-ICE POWER switch ON to stop power from being applied to blades:

1. Icing conditions - EXIT.

2. BLADE DE-ICE POWER switch - OFF.

If a PWR monitor light is still on with BLADE DE-ICE POWER switch OFF:

3. GENERATORS NO. 1 or NO. 2 switch - OFF.

4. GENERATORS APU switch - OFF (if in use).

5. Land as soon as practicable.

9-79. ICE RATE METER FAIL OR INACCURATE.

Failure of the ice rate meter should be indicated by appearance of the FAIL flag on the meter face. Inaccuracy of the meter will be indicated by increased torque required and/or increase of vibration levels due to ice buildup. If failure or inaccuracy is suspected, with no other indicated failures, the system can be manually controlled.

1. BLADE DE-ICE MODE switch MANUAL as required.

If vibration levels increase or % TORQUE required increases:

2. Higher icing MODE - Select as required.

If ice buildup continues:

3. Land as soon as practicable.

9-80. LOSS OF NO. 1 OR NO. 2 GENERATOR DURING BLADE DE-ICE OPERATION.

Loss of one generator during blade de-ice operation will result in loss of power to the system. To restore system operation, the APU must be started and the APU generator switch on. The APU GEN ON advisory light will not go on because one main generator is still operating. The APU generator will supply power only for blade de-ice operation.

EMER APU START.

APPENDIX A
REFERENCES

AR 70-50	Designating and Naming Military Aircraft, Rockets and Guided Missiles
AR 95-1	Army Aviation General Provisions and Flight Regulations
AR 95-3	General Provisioning, Training, Standization, and Resource Management
AR 385-40	Accident Reporting and Records
DA PAM 738-751	Functional Users Manual for the Army Maintenance Management System Aviation (TAMMS-A)
DOD FLIP	Flight Information Publication
FAR Part 91	Federal Air Regulation, General Operating and Flight Rules
FM 1-202	Environmental Flight
FM 1-203	Fundamentals of Flight
FM 1-204	Night Flight Techniques and Procedures
FM 1-230	Meteorology for Army Aviators
FM 1-240	Instrument Flying and Navigation for Army Aviators
FM 10-68	Aircraft Refueling
FM 55-450-1	Army Helicopter External Load Operations
FM 55-450-2	Army Helicopter Internal Load Operations
TB MED 501	Noise and Conservation of Hearing
TB 55-9150-200-25	Engine and Transmission Oils, Fuels, and Additives for Army Aircraft
TM 1-1520-250-23-1	General Tie-down and Mooring Technical Manual Aviation Unit and Intermediate Maintenance. All Series Army Models AH-64, UH-60, CH-47, UH-1, AH-1, OH-58 Helicopters.
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APPENDIX B
ABBREVIATIONS AND TERMS

ALT	-	altitude
ATF	-	aircraft torque factor
°C	-	degree Celsius
CDU	-	central display unit
CG	-	center of gravity
CL	-	center line
CRT	-	cathode ray tube
DEC	-	digital electronic control (for engine)
DEG	-	degree
ΔF	-	change in flat plate drag area
ΔTRQ	-	change in torque
ECU	-	electrical control unit
ENG	-	engine
EOT	-	element-on-time
ESU	-	electronic sequence unit
ESSS	-	external stores support system
ETF	-	engine torque factor
ETL	-	effective translational lift
°F	-	degree Fahrenheit
FAT	-	free-air temperature
FPM	-	feet-per-minute
ft	-	feet
GW	-	gross weight
HAT	-	height above terrain
HMU	-	hydromechanical unit (fuel control)
hr	-	hour
HSP	-	hot start preventor
HSS	-	horizontal stores support
IAS	-	indicated airspeed
IGE	-	in ground effect
IN	-	inch
IN HG	-	inch of mercury
IPS	-	inlet particle separator
	-	inches per second
IR	-	infrared
KCAS	-	knots calibrated airspeed
KIAS	-	knots indicated airspeed
KN	-	knot
KTAS	-	knots true airspeed
lb	-	pound(s)
lb/gal	-	pounds-per-gallon
lb/hr	-	pounds-per-hour
LDI	-	leak detection isolation
LDS	-	load-demand spindle
LIM	-	limit
LLL	-	low light level
LRU	-	line replaceable unit
LWC	-	liquid water content

APPENDIX B (Cont)

MAX	-	maximum
MIN	-	minimum
min	-	minutes
N_g SPEED 1 or 2	-	No. 1 or No. 2 engine compressor speed % rpm
NM	-	nautical miles
NVG	-	night vision goggles
°	-	degree
% RPM R	-	rotor rpm, percent
% RPM 1 or 2	-	No. 1 or No. 2 engine Np % rpm
ODV	-	overspeed and drain valve
OEI	-	one engine inoperative
OGE	-	out of ground effect
PA	-	pressure altitude
PDU	-	pilot display unit
PAS	-	power-available spindle
POU	-	pressurizing and overspeed unit
PRESS	-	pressure
PPM	-	pounds-per-minute
PSI	-	pounds per square inch
PSID	-	pounds per square inch differential
R/C	-	rate of climb
R/D	-	rate of descent
RPM	-	revolutions-per-minute
SDC	-	signal data converter
SL	-	sea level
SPEC	-	specification
STA	-	station
STD TEMP	-	15°C at sea level
SQ FT	-	square feet
TAS	-	true airspeed
TGT	-	turbine gas temperature
% TRQ	-	torque, percent
TRQ	-	torque
VDC	-	volts direct current
Vh	-	maximum level flight speed using torque available - 30 minutes
VIDS	-	vertical instrument display systems
VSP	-	vertical support pylon
Vne	-	velocity never exceed (airspeed limitation)
WOW	-	weight-on-wheels
XMSN	-	transmission

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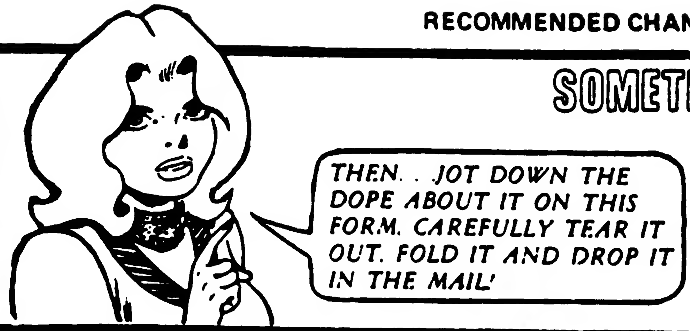

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