UNITED STATES FEDERAL AVIATION AGENCY

AIR VEHICLE PERFORMANCE CHARACTERISTICS

Volume II TAKE-OFF

FOR

BUREAU OF RESEARCH & DEVELOPMENT U S FEDERAL AVIATION AGENCY Washington 25, D C

BY

APPLIED SCIENCE DIVISION FAIRCHILD ENGINE & AIRPLANE CORP Alexandria, Virginia

AIR VEHICLE PERFORMANCE CHARACTERISTICS This is a fourteen volume study, containing the following

Volume I-A Ground Operations	
Volume I-B Ground Operations	
Volume II Take-Off	
Volume III Pre-Climb	
Volume IV-A Climb	
Volume IV-B Climb	
Volume V Enroute	
Volume VI Descent	
Volume VII Approach	
Volume VIII Glide Path	
Volume IX Landing	

* Volume X-A . . .

* Volume XI

* Volume X-B . .

* Volumes I-A through IX contain flight phase data on current aircraft, except those classified by the military. The latter are in Volumes X-A and X-B, and future aircraft in Volume XI. These three volumes have a security classification of secret.

Classified Military Aircraft (S)

Classified Military Aircraft (S)

Future Aircraft (S)

GROUND OPERATIONS	TAKE- OFF	PRE- CLIMB	CLIMB	ENROUTE	DESCENT	APPROACH	GLIDE PATH	LANDING
I-A I-B	ш	ш	1☑ - A	¥	VI	ΔΙΙ	AIII	13C
		-						
			mmml	HT PHA	mmm			

UNITED STATES FEDERAL AVIATION AGENCY
Bureau of Research & Development Washington 25, D.C

MASTER INDEX

The following is a complete listing of the 122 aircraft reported and their location by volume

Aircraft	Vol.	Aircraft	Vol.
Aero Commander 500	I-IX	Convair C-131A	I-IX
Aero Commander 680 (L-26C)		Convair F-102A	X
Aero Commander 720		Convair F-106A	X
Avro CF-100 MK5	X	Convair R4Y-I	I-IX
Beechcraft "Bonanza" K-35		Convair T-29C	I-IX
Beechcraft "Twin Bonanza"		Convair YB/RB-58	X
(L-23D)	I-IX	Curtiss C-46R	$I \neg IX$
Beechcraft Model 95	I-IX	de Havilland "Beaver"	
Beechcraft MS 760	ΧI	(L-20A)	$I \neg IX$
Beechcraft Super 18	I-IX	de Havilland Comet 4	I-IX
Beechcraft T-34A	I-IX	de Havilland "Otter"	
Bell H-13H (47G-2)	I-IX	(U-1A)	I-IX
Bell H-40	I-IX	Douglas AD-6	X
Bell XV-3	ΧI	Douglas A3D-2	X
Boeing 707-121	I-IX	Douglas A4D-1	X
Boeing 707-320	ΧI	Douglas C-124C	I-IX
Boeing B-377	I-IX	Douglas C-133A	I-IX
Boeing B-47B/B-47E	I-IX	Douglas DC-3 (C-47, R4D)	I-IX
Boeing B-52F	\mathbf{x}	Douglas DC-4 (C-54)	I-IX
Boeing KC-97G	$I \neg I X$	Douglas DC-6	I-IX
Boeing KC-135A	I-IX	Douglas DC-6B	I - IX
Canadair CP-107	X	Douglas DC-7	I-IX
Canadaır Sabre MK 6	X	Douglas DC-7B	I-IX
Canadair T-33A MK3	X	Douglas DC-7C	I-IX
Cessna 150	I-IX	Douglas DC-8	XI
Cessna 172	$I \neg IX$	Douglas DC-9	XI
Cessna 175	I-IX	Douglas F4D-1	X
Cessna 180 (Amphibian)	I-IX	Douglas RB/WB-66B	$I \rightarrow IX$
Cessna 182	I-IX	Fairchild C-119G	I-IX
Cessna 310A (L-27A)	I-IX	Fairchild C-123B	I-IX
Cessna 310C	I-IX	Fairchild F-27B	I-IX
Cessna L-19 A/E (OE-1)	$I \neg IX$	Goodyear ZPG-2	I-IX
Cessna T-37A	$I \rightarrow IX$	Goodyear ZPG-3W	I-IX
Cessna TL-19D	I - IX	Grumman F9F-8T	X
Chance-Vought F8U-1	X	Grumman F11F-1	X
Convair 340/440	I-IX	Grumman SA-16A GR (UF-1)	$I \neg IX$
Convair 600	XI	Grumman S2F-1	X
Convair 880-22	XI	Hayes-Boeing KB-50J/KB-50K	I-IX

AGENCY UNITED STATES FEDERAL AVIATION Bureau of Research & Development Washington 25, D.C.

MASTER INDEX - (Cont'd)

Aircraft	<u>Vol</u>	Aircraft	<u>Vol</u> .
Hiller H-23D	I∽IX	North American F-100D	x
Hiller XH-18	XI	North American F-108	$\mathbf{X}\mathbf{I}$
Lockheed 1049G	I-IX	North American FJ-3B	X
Lockheed 1649A	I-IX	North American FJ-4/FJ-4B	X
Lockheed C-121 C/G	I-IX	North American TB-25M	I– IX
Lockheed C-130A	I - IX	North American T-28A	$I \sim IX$
Lockheed F-104A	\mathbf{X}	North American T-28B	I-IX
Lockheed P2V-5	X	North American T-39A	$\mathbf{x}_{\mathbf{I}}$
Lockheed T2V-1	I-IX	North American T2J-1	I– IX
Lockheed T-33A-1	I-IX	Northrop F-89H	I-IX
Lockheed WV-2	X	Northrop T-38A	X
Lockheed Electra 188	I-IX	Piper "Tri-Pacer" PA-22	I-IX
Lockheed Jetstar	XI	Piper "Apache" PA-23	I-IX
MACH 3 Transport	ΧI	Piper "Comanche" PA-24-180	I-IX
Martın 404	I-IX	Republic F-84F Series	I-IX
Martin B-57B	I-IX	Republic F-105B	X
Martın P5M-2	X	Sikorsky H-19D	I-IX
McDonnell 119A (UCX)	XI	Sikorsky H-34A (S-58)	
McDonnell F-101B	X	(HSS-1)	I-IX
McDonnell F3H-2	X	Sıkorsky H-37A	$I \neg IX$
McDonnell F4H-1	X	Vertol 107	XI
Mooney Mark 20A	I-IX	Vertol H-21C (44-B)	I-IX
North American A3J-1	X	Very Large Subsonic Jet	
North American B-70	XΙ	Cargo	ΧI
North American F-86L	I-IX	Vickers Viscount 745D	I– IX
		Vickers Viscount 812	I-IX

Table of Contents for Volumes I-A through IX

Section 1 - Military Aircraft

Beechcraft T-34A Douglas C-124C Lockheed T2V-1 Lockheed T-33A-1 Douglas C-133A Bell H-13H (47G-2) Martin B-57B Bell H-40 Douglas RB/WB-66B Boeing B-47B/B-47E Fairchild C-119G North American F-86L North American TB-25M Boeing KC-97G Fairchild C-123B Goodyear ZPG-2 North American T-28A Boeing KC-135A Cessna L-19 A/E Goodyear ZPG-3W North American T-28B Grumman SA-16A-North American T2J-1 (OE-1) Cessna TL-19D GR (UF-1) Northrop F-89H Republic F-84F Series Cessna T-37A Haves-Boeing KB-50J Convair C-131A and KB-50K Sikorsky H-19D Sikorsky H-34A (S-58) (HSS-1) Convair R4Y-1 Hiller H-23D Convair T-29C Sikorsky H-37A Lockheed C-121 C/G Vertol H-21C (44-B) Curtiss C-46R Lockheed C-130A

Section 2 - Commercial Aircraft

Boeing B-377 Douglas DC-6 Lockheed 1049G Boeing 707-121 Douglas DC-6B Lockheed 1649A Convair 340/440 Douglas DC-7 Martin 404 Vickers Viscount 745D de Havilland Comet 4 Douglas DC-7B Douglas DC-3 Douglas DC-7C Vickers Viscount 812 (C-47, R4D)Fairchild F-27B Douglas DC-4 (C-54) Lockheed Electra 188

Section 3 - General Aviation

Aero Commander 500 Cessna 180 (Amphibian) Aero Commander 680 (L-26C) Cessna 182 Cessna 310A (L-27A) Aero Commander 720 Beechcraft "Bonanza" K-35 Cessna 310C Beechcraft "Twin Bonanza" (L-23D) de Havilland "Beaver" (L-20A) Beechcraft Model 95 de Havilland "Otter" (U-1A) Beechcraft Super 18 Mooney Mark 20A Cessna 150 Piper "Tri-Pacer" PA-22 Cessna 172 Piper "Apache" PA-23 Cessna 175 Piper "Comanche" PA-24-180

(date of latest revision September 1, 1959)

UNITED STATES FEDERAL AVIATION AGENCY
Bureau of Research & Development Washington 25, D.C.

Volumes I-A through IX

SECTION 1

MILITARY AIRCRAFT

containing data on

Beechcraft T-34A Bell H-13H (47G-2)

Bell H-40

Boeing B-47B/B-47E

Boeing KC-97G Boeing KC-135A

Cessna L-19 A/E (OE-1)

Cessna TL-19D Cessna T-37A Convair C-131A Convair R4Y-1 Convair T-29C

Curtiss C-46R

Douglas C-124C

Douglas C-133A

Douglas RB/WB-66B

Fairchild C-119G

Fairchild C-123B

Goodyear ZPG-2

Goodyear ZPG-3W

Grumman SA-16A-GR (UF-1) Hayes-Boeing KB-50J/KB-50K

Hiller H-23D

Lockheed C-121 C/G

Lockheed C-130A

Lockheed T2V-1

Lockheed T-33A-1

Martin B-57B

North American F-86L North American TB-25M

North American T-28A

North American T-28B

North American T2J-1

Northrop F-89H

Republic F-84F Series

Sikorsky H-19D

Sikorsky H-34A (S-58) (HSS-1)

Sikorsky H-37A

Vertol H-21C (44-B)

(date of latest revision September 1, 1959)

UNITED STATES FEDERAL
Bureau of Research & Development

AVIATION AGENCY Washington 25, D C.

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for normal take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 2 0 to 5 0 minutes

Taxi onto runway, and apply take-off power 5 to 10
seconds

Take-off (see Table I)

Speed (knots IAS)

V1 Not applicable V2 (at normal gross weight of 2, 950 pounds) 67

Distance

Take-off (see Table I)
Abort 600 feet
Refusal distance (see abort)

$ m T/O~Dist~$ and Time Deviations per $ m 10^{\circ}~C~Dev~$ 1,000 Ft Alt Dev	9 1% 9.1%	T/O Dist, and Time Deviation for Weight 100 Lbs. 100 Lbs. Over MGW Under MGW Not applicable 8.4% Runway Gradient Deviation per 1% Slope	Not available from operator
N A.S A. Sea Level Standard Day T/O Dist	1, 100 ft. 0.3 min.	Lift-Off Speed Deviation 100 Lbs 100 Lbs Over MGW Under MGW Not applicable 1.5% T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	67 kts.	67 kts.	67 kts
Lift-Off Maximum Gross Speed (V2) Weight (IAS)	2, 950 lbs.	2, 950 lbs	2, 950 lbs.

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After the runup check is performed, the helicopter is air taxied to the take-off point. There is no further hesitation and power is applied for take-off. Maximum rpm (3, 100) and manifold pressure as required is used for take-off. The helicopter is lifted to a hovering position, and a forward movement is initiated, while increasing airspeed throughout the translational phase. At 15 knots IAS a climb attitude is attained, and airspeed is increased to 40 knots IAS and a 500 fpm rate of climb is established.

Alternate Take-Off Procedure

Rolling Take-Off

At the take-off point, throttle is advanced to maximum rpm (3, 100), forward movement is initiated and ground speed is gradually increased throughout the translational phase. As ground speed increases, sufficient lift will be developed to accomplish lift-off. From lift-off, a shallow rate of climb is maintained, while increasing airspeed to the desired climb airspeed. This method of take-off is utilized under adverse conditions of overloading or at high altitudes where vertical or hovering take-off cannot be accomplished.

Tıme

Engine runup check 0.5 to 1.0 minute
Taxi and apply take-off power 1 to 5 seconds
Take-off (see Table I)

Speed

*V2 (at normal gross weight of 2, 350 pounds) 15

Distance

Take-off (see Table I)
Abort 100 feet
Refusal distance (see abort)

^{*} Effective translational lift gained at 15 knots IAS is equivalent to V2 speed.

T/O Dist. and Time Deviations per

N.A.S.A. Sea Level Standard Day

to Clear 50 Feet

L1ft-Off

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

^{*} Speed at 50 feet altitude is 40 knots IAS

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After the runup check is performed, the helicopter is air taxied to the take-off point. There is no further hesitation and power is applied for take-off. Maximum rpm (6, 400) and torque pressure as required are used for lift-off. The helicopter is lifted to a hovering position and a forward movement is initiated, gradually increasing airspeed throughout the translational phase. At 30 knots IAS, a climb attitude is attained, airspeed is increased gradually to 50 knots IAS and a 500 fpm rate of climb is established.

Time

Engine runup check 1 0 to 2 0 minutes
Taxi and apply take-off power 1 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

*V2 (at normal gross weight of 5,800 pounds) 30

Distance

Take-off (see Table I)
Abort 150 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Normal Gross	Lift-Off Speed (V2)	N A.S A. Sea I to Clear	Level Standard Day 50 Feet	T/O Dist and T	Fime Deviations per	
Weight	(IAS)	T/O Dist.	T/O Time	10°C Dev 1	,000 Ft. Alt. Dev	
5,800 lbs	30 kts	600 ft	*14 sec	5%	5%	
		Lift-Off Speed		T/O Dist. and Time		
		Deviati	on	Deviation for Weight		
		500 Lbs	500 Lbs	500 Lbs.	500 Lbs.	
		Over NGW	Under NGW	Over NGW	Under NGW	
5,800 lbs.	30 kts	none	none	5%	5%	

*Speed at 50 feet altitude is 50 knots IAS

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are fully extended for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

When Assisted Take-Off (ATO) is employed, the recommended normal procedure is to fire ATO approximately ten seconds before lift-off. For minimum take-off, the rockets are fired approximately 15 seconds before lift-off.

Tıme

Engine runup check 2 0 to 4.0 minutes
Taxi onto runway, and apply take-off power. 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at a normal gross weight of 192,000 pounds) 159 V2 (at a normal gross weight of 192,000 pounds) 175

Distance

Take-off (see Table I)

Abort Not available from operators

Refusal distance At normal gross weight of 192,000 pounds wet power - 3,000 feet, utilizing 11,000 foot runway. If ATO malfunctions at 3,000 foot marker, the aircraft aborts.

	L1ft-Off					
Normal Gross	Speed (V2)	N.A S.A. Sea	Level Standard Day	T/O Dist and	Time Deviations per	
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft. Alt. Dev.	
192,000 lbs.	175 kts.	7,600 ft.	0.8 min.	9.0%	11.0%	
	Lift-Off Speed			T/O Dist. and Time		
		Deviat		Deviation for Weight		
		10,000 Lbs	10,000 Lbs	10,000 Lbs.	10,000 Lbs.	
		Over NGW	Under NGW	Over NGW	Under NGW	
192,000 lbs.	175 kts.	2.5%	3.1%	14.0%	11.0%	
		T/O Dist and Time		Runway Gradient		
		Deviation	w/ATO	Deviation I	per 1% Slope	
		Dev. per 10	,000 Lbs.			
		Dıst.	Time			
192,000 lbs.	175 kts.	12.0%	8.0%		7.5%	

(The values above are to be substituted directly in the Take-Off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 33 degrees for take-off. After taxing onto the runway, there is a 10 to 15 second delay after aligning to prevent fuel vent overflow.

Tıme

Engine runup check 5 0 to 10 0 minutes
Taxi onto runway, and apply take-off power 0 2 to 0 4 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 175,000 pounds) 113 V2 (at maximum gross weight of 175,000 pounds) 125

Distance

Take-off (see Table I)
Abort 2,800 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Maximum Gross		N A S.A. Sea Level S		•	Time Deviations per	
Weight	(IAS)	T/O Dist.	T/O Time	10° C Dev	1,000 Ft Alt Dev	
175,000 lbs	125 kts	7,750 ft	1 2 min.	2%	7%	
		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight		
	10,000 Lbs 10,000 Lbs		0 Lbs	10,000 Lbs	10,000 Lbs.	
		Over MGW Und		Over MGW	•	
175,000 lbs	125 kts	Not applicable	5%	Not applicable	20%	
	T/O Dist and Deviation w/A			Runway Gradient Deviation per 1% Slope		
175,000 lbs	125 kts.	Not applicable		4	%	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway Flaps are extended 30 degrees for take-off. Upon taxiing onto the runway and aligning, the brakes are set for holding and take-off thrust (wet) is applied. When engines have attained take-off thrust, the brakes are released and take-off is initiated.

$T_{1}me$

Engine runup check: 0 5 to 2 0 minutes
Taxi onto runway, align and set brakes. 0.5 minute
Take-off. (see Table I)

Speed (knots IAS)

VI (at normal gross weight of 258,000 pounds) Not applicable V2 (at normal gross weight of 258,000 pounds) 162

Distance

Take-off: (see Table I)
Abort (see Refusal Distance)
Refusal Distance At a normal gross weight of 258,000 pounds,
6,100 feet when utilizing a 12,000 foot runway

	L1ft-Off				
Normal Gross	Speed (V2)	N.A.S.A. Sea	Level Standard Day	T/O Dist. and	Time Deviations per
Weight	(IAS)	T/O Dist.	T/O Time	10° C Dev.	1,000 Ft. Alt. Dev.
258, 000 1bв	162 kts	7,100 ft.	0.9 min.	8.8%	8 9%
	Lift-Off Speed		T/O Dist. and Time		
		Deviat		Deviation for Weight	
		10,000 Lbs	10,000 Lbs	10,000 Lbs.	10,000 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
258,000 lbs.	162 kts.	1 9%	2.1%	9 4%	7.5%
		T/O Dist. and Time Deviation w/ATO		Runway Gradient	
				Deviation per 1% Slope	
258, 000 lbs	162 kts	Not applı	cable	8.5%	,

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 30 degrees for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

T_1me

Engine runup check 0 5 to 1 0 minute

Taxi onto runway and apply take-off power 3 to 5 seconds

Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2, 400 pounds) Not applicable V2 (at maximum gross weight of 2, 400 pounds) 38

Distance

Take-off (see Table I)
Abort 345 feet
Refusal distance (see abort)

	Lift-Off				
Maxımım Gross	Speed (V2)	N A.S.A. Sea Le	ev el St andard Day	T/O Dist and T	ıme Deviations per
Weight	(IAS)	T/O Dist.	T/O Time	10° C Dev	,000 Ft. Alt. Dev.
2,400 lbs.	38 kts	520 ft	0.3 min.	15 5%	14 5%
		Lıft-Off S		T/O Dist.	
		Deviatio		Deviation f	_
		300 Lbs	300 Lbs.	300 Lbs.	300 Lbs.
		Over MGW	Under MGW	Over MGW	Under MGW
2,400 lbs	38 kts	Not applicable	7 0%	Not applicable	26 0%
		T/O Dist. and Time		Runway Gradient	
		Deviation w	/ATO	Deviation pe	r 1% Slope
2,400 lbs.	38 kts.	Not applica	able	Not availal	

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are usually fully retracted for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

T_1me

Engine runup check 0 5 to 1 0 minute
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2, 400 pounds) 49 V2 (at maximum gross weight of 2, 400 pounds) 54

Distance

Take-off (see Table I)

Abort Not available from operators

Refusal distance Not available from operators

TABLE I, TAKE-OFF

	L1ft-Off					
Maximum Gross	Speed (V2)	N.A.S.A. Sea Level	Standard Day	T/O Dist and	Fime Deviations per	
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft Alt Dev	
2, 400 lbs	54 kts	570 ft	0 2 min	5 3%	Not available from operators	
		Lift-Off Speed		T/O Dist. and Time		
		Deviation		Deviation for Weight		
		100 Lbs 10	00 Lbs.	100 Lbs	100 Lbs	
		Over MGW Und	der MGW	Over MGW	Under MGW	
2,400 lbs	54 kts	Not applicable	2 5%	Not applicable	12 5%	
		T/O Dist. and T	O Dist. and Time		Gradient	
		Deviation w/AT	0	Deviation p	er 1% Slope	
2,400 lbs	54 kts	Not applicable		Not available from operators		

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100.)

Sequence of Operations

After taxing onto the runway, the brakes are set and the engine runup check is performed. The flaps are extended 20 degrees for take-off Throttles are advanced to 90 percent power and brakes are released. Throttles are then advanced to 100 percent take-off power.

Tıme

```
Taxi onto runway, engine runup check, and apply take-off
    power 1.0 to 2 0 minutes
Take-off (see Table I)
```

Speed (knots IAS)

```
V1 (at maximum gross weight of 6, 400 pounds) 78
V2 (at maximum gross weight of 6, 400 pounds) 88
```

Distance

```
Take-off (see Table I)
Abort 1,500 feet
Refusal distance (see abort)
```

T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt Dev	%8 9	T/O Dist, and Time Deviation for Weight	400 Lbs. 400 Lbs.	Not applicable Not available from operators	Runway Gradient Deviation per 1% Slope	Not available from operators
T/O Dist 10° C Dev	3.0%	, Ç	400 Lbs. Over MGW	Not apj	Dev	Not
N.A.S.A. Sea Level Standard Day T/O Dist.	1,610 ft 0 4 min	Lift-Off Speed Deviation	400 Lbs 400 Lbs Over MGW Under MGW	Not applicable 3 6%	T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	88 kts.			88 kts		88 kts
Normal Gross Weight	6, 400 lbs			6,400 lbs		6,400 lbs.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway with the brakes set for holding. The flaps are extended 12 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off

Tıme

Engine runup check 3.0 to 4.0 minutes
Taxi onto runway, and apply take-off power 3 to 10 seconds
Take-off (see Table I)

Speed (knots IAS)

VI (at normal gross weight of 40,000 pounds) 110 V2 (at normal gross weight of 40,000 pounds) 113

Distance

Take-off (see Table I)

Abort 1,650 feet (brakes and prop reversal)

Refusal distance (see abort)

TABLE I, TAKE-OFF

	L1ft-Off				
Normal Gross	Speed (V2)	N A S.A. Sea I	Level Standard Day	T/O Dist and	Time Deviations per
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft. Alt Dev
40,000 lbs.	113 kts.	2,200 ft.	0.4 min.	Plus Minus 3.6% 1.8%	6.2%
		Lift-Off Speed Deviation		T/O Dist. and Time	
				Deviation for Weight	
		2,000 Lbs	2,000 Lbs	2,000 Lbs	2,000 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
40,000 lbs.	113 kts.	1.8%	1.8%	13 7%	10.6%
		T/O Dist. and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
40,000 lbs.	113 kts.	Not applicable		3.6%	

(The above values are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 11 degrees for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

$T_{1}me$

Engine runup check 1 0 to 2 0 minutes
Taxi onto runway and apply take-off power 5 to 10 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 48,550 pounds) 109 V2 (at maximum gross weight of 48,550 pounds) 112

Distance

Take-off (see Table I)
Abort 1,600 feet (using reverse thrust)
Refusal distance (see abort)

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Le T/O Dist.	vel Standard Day T/O Time	_	Fime Deviations per 1,000 Ft Alt Dev
48,550 lbs	112 kts	2,800 ft	0 5 min.	4 0%	3 6%
		Lift-Off Sp Deviation 2,000 Lbs	n 2,000 Lbs	Deviation 2,000 Lbs.	
48,550 lbs	112 kts	Over MGW Not applicable	Under MGW	Over MGW Not applicable	Under MGW 4 1%
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
48,550 lbs	112 kts	Not applicable		2 1%	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 12 degrees for take-off. After taxiing onto the runway, there is no further hesitation for any check and power is applied for take-off.

Time

Engine runup check 1 0 to 3.0 minutes
Taxi onto runway, and apply take-off power 5 to 10 seconds
Take-off (see Table I)

Speed (knots IAS)

```
V1 (at normal gross weight of 43,000 pounds) 113
V2 (at normal gross weight of 43,000 pounds) 115
```

Distance

Take-off (see Table I) Abort 2,500 feet Refusal distance (see abort)

TABLE I, TAKE-OFF

•	$_{ m 1ft-Off}$				
Normal Gross	Speed (V2)	N A S A. Sea L	Level Standard Day	T/O Dist and	Time Deviations per
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft Alt. Dev
43,000 lbs	ll5 kts	2,750 ft	0 4 min,	9 1%	7.3%
		Lıft-Off Speed		T/O Dist. and Time	
		Deviation		Deviation for Weight	
		l,000 Lbs.	1,000 Lbs	1,000 Lbs	1,000 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
43, 000 lbs	ll5 kts	1 3%	1 7%	5 5%	5,5%
		T/O Dist and Time		Runway Gradient	
		Deviation w/ATO		Deviation per 1% Slope	
43,000 lbs	ll5 kts	Not applicable		3.6%	

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 1 0 to 2 0 minutes

Taxi onto runway and apply take-off power 3 to 5 seconds

Take-off (see Table I)

Speed (knots IAS)

```
V1 (at maximum gross weight of 50,000 pounds) 95
V2 (at maximum gross weight of 50,000 pounds) 95
```

Distance

```
Take-off (see Table I)
Abort 4,460 feet
Refusal distance (see abort)
```

hay T/O Dist and Time Deviations perme $10^{ m o}$ C Dev 1,000 Ft Alt Dev	. Not available from operator.	T/O Dist, and Time Deviation for Weight 200 Lbs. 200 Lbs. Over MGW Under MGW Not applicable 4 6% Runway Gradient Deviation per 1% Slope	Not available from operator
evel Standard Day T/O Tıme	0 6 min.	peed 200 Lbs Under MGW None nd Time	ıble
N A S.A. Sea Level Standard Day T/O Dist.	2,800 ft	Lift-Off Speed Deviation 200 Lbs. 200 Over MGW Under Not applicable Nor T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	95 kts.	95 kts	95 kts
Maxımum Gross Weight	50, 000 lbs	50, 000 lbs.	50,000 lbs

(The values are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off. Wet power (water-alcohol injection) is normally used for take-off.

Time

Engine runup check 5.0 to 8 0 minutes
Taxi onto runway and apply take-off power 0 5 to 1 0 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 170,000 pounds) 104 V2 (at normal gross weight of 170,000 pounds). 107

Distance

Take-off (see Table I)

Abort: (see Refusal distance)

Refusal distance At a normal gross weight of 170,000 pounds and a speed of 104 knots IAS, 3,000 feet of runway are required to stop the aircraft using brakes and reverse thrust on two engines

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea I T/O Dist.	Level Standard Day T/O Time		Time Deviations per 1,000 Ft. Alt. Dev
170,000 lbs	107 kts	3,100 ft.	0 6 min	8 1%	8 9%
		Lift-Off : Deviat 10,000 Lbs Over NGW	ion	•	. and Time for Weight 10,000 Lbs. Under NGW
170,000 lbs	107 kts.	3 2%	3.2%	16 0%	13 0%
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
170,000 lbs	107 kts	Not appl	ıcable	11	. 0%

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 25 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

$T_{1}me$

Engine runup check 1 0 to 4 0 minutes

Taxi onto runway, and apply take-off power 0 5 to 1 0 minute

Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 275, 000 pounds) 104 V2 (at maximum gross weight of 275, 000 pounds) 119

Distance

Take-off (see Table I)
Abort 2,600 feet
Refusal distance (see abort)

fime Eeviations per 1, 000 Ft Alt Dev	%0.6	ind Time or Weight 10,000 Lbs. Under MGW 8.0% radient radient	
T/O Dist and 7 10° C Dev	%0.6	T/O Dist. and Time Deviation for Weight 10,000 Lbs 10,000 Lb Over MGW Under Mi Not available from 8.0% operator Runway Gradient Deviation per 1% Slope	%0 8
A S A. Sea Level Standard Day O Dist	0.7 mm	peed on 10,000 Lbs Under MGW 2.0%*	Not avaılable from operator
N A S A. Sea I T/O Dist	4, 400 ft.	Lift-Off Speed Deviation 10,000 Lbs 10,000 Over MGW Under Not applicable 2.0% T/O Dist and Time Deviation w/ATO	Not avaılable
Lift-Off Speed (V2) (IAS)	119 kts	119 kts	119 kts.
Maxımum Gross Weıght	275,000 lbs.	275, 000 lbs.	275,000 lbs.

*Lift-off speed (V2) is 110 knots at gross weights less than 235,000 pounds

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

After taxing onto the active runway, the brakes are set for holding and the engine runup check is performed. The flaps are extended 60 percent for take-off. Power is applied until take-off thrust is obtained. Brakes are then released and take-off is initiated.

Tıme

Taxi onto runway, perform engine runup check, and apply take-off power 2 0 to 3.0 minutes
Take-off (see Table 1)

Speed (knots IAS)

V1 Not available from operator.
V2 (at normal gross weight of 75,000 pounds) 150

Distance

Take-off (see Table 1)
Abort 4,600 feet, using brakes and drag chute
Refusal distance (see abort)

TABLE I, TAKE-OFF (Using 60% flaps)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A S A. Sea I T/O Dist	Level Standard Day T/O Time	T/O Dist and 10° C Dev	Time Deviations per 1,000 Ft Alt. Dev
75,000 lbs.	150 kts.	5, 800 ft	0.8 min	10.4%	9.1%
		Lift-Off S Deviati	-	·	. and Time for Weight
		5,000 Lbs Over NGW	.,	5,000 Lbs Over NGW	5,000 Lbs. Under NGW
75, 000 lbs	150 kts	3 3%	4 0%	15 5%	13 8%
		T/O Dist. and Time Deviation w/ATO Deviation per 4,000 Pounds Dist Time		•	Gradient per 1% Slope
75,000 lbs.	150 kts.	10.3%	9 2%	5	.6%

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are used as required for take-off. After taxing onto the runway, there is no further hesitation and power is applied for take-off. Maximum (water injection) power is normally used for take-off.

Tıme

Engine runup check 3 to 5 minutes
Taxi onto runway, and apply take-off power 0.5 to 1 minute
Take-off (see Table 1)

Speed (knots IAS)

V1 (at normal gross weight of 65,000 pounds) 92 V2 (at normal gross weight of 65,000 pounds) 102

Distance

Take-off (see Table 1)
Abort 3,000 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

T/O Dist and Time Deviations per $10^{ m O}$ C Dev 1,000 Ft Alt. Dev.	0/0 L	T/O Dist. and Time Deviation for Weight 000 Lbs 1,000 Lbs. rer NGW Under NGW % 4 0% . Runway Gradient Deviation per 1% Slope	6.4%
T/O Dist and 10° C Dev	Plus Minus 9% 6%	T/O Dist Deviation 1,000 Lbs Over NGW 4.5% Runway Deviation I	9
A S A. Sea Level Standard Day O Dist T/O Time	ntm 5 0	peed on 1,000 Lbs Under NGW 0 9% und Time	cable
N A S A, Sea L T/O Dist	2,350 ft	Lift-Off Speed Deviation 1,000 Lbs. 1,000 Over NGW Under 0 8% T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	102 kts	102 kts	102 kts
formal Gross Weight	65,000 lbs	65, 000 lbs.	65,000 lbs.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway For normal take-off the flaps are fully retracted. Flaps may be extended 20 degrees, or as required for short field operations. After taxiing onto the runway, there is a short hesitation to prevent fuel overflow, then power is applied for take-off.

Tıme

Engine runup check 2 0 to 5.0 minutes

Taxi onto runway, and apply take-off power 0.5 to 1.0 minute

Take-off (see Tables I and II)

Speed (knots IAS)

```
Normal take-off

V1 (at normal gross weight of 54,000 pounds) 100

V2 (at normal gross weight of 54,000 pounds) 100

Maximum performance take-off

V1 (at normal gross weight of 54,000 pounds) 76

V2 (at normal gross weight of 54,000 pounds) 76
```

Distance

```
Take-off (see Tables I and II)
Abort 1,450 feet
Refusal distance (see abort)
```

	L1ft-Off				
Normal Gross	Speed (V2)	N A.S A. Sea L	Level Standard Day		Time Deviations per
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	l,000 Ft Alt Dev
54, 000 lbs	100 kts	2,500 ft	0 5 min	8%	8%
		L1ft-Off S	Speed	T/O Dıst	. and Time
		Deviation		Deviation for Weight	
		5,000 Lbs	$5,000\mathrm{Lbs}$	$5,000~\mathrm{Lbs}$	5,000 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
54,000 lbs	100 kts.	5%	5%	25%	20%
		T/O Dist a Deviation		-	Gradient per 1% Slope
54,000 lbs	100 kts	Not applicable		;	3%

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Fairchild C-123E

TABLE II, TAKE-OFF
(Maximum Performance, Wet Power, 20° Flaps)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea I T/O Dist	Level Standard Day T/O Time		Time Deviations per 1,000 Ft Alt. Dev
54,000 lbs.	76 kts.	1,350 ft.	0.4 min.	11.0%	4.6%
		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		5,000 Lbs Over NGW	5,000 Lbs Under NGW	5,000 Lbs. Over NGW	
54,000 lbs	76 kts.	5.0%	5.0%	26 0%	22.3%
		T/O Dist a Deviation		•	Gradient er 1% Slope
54,000 lbs.	76 kts.	Not applicable			vailable perators

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

Adjacent to the active runway, the mooring mast tractor brakes are set for holding and the engine runup check is performed. After taxiing onto the runway and aligning, the bow handling lines are tended and the lugs attaching the bow cone of the airship to the mast are pulled, the mooring pendant is tripped, and the mast pulled free of the airship by the tractor. When the mast is clear, power is applied for take-off and bow-lines released.

Time

Engine runup check. 2.0 minutes

Taxi onto runway, unmast, and apply take-off power 5 0 to
10 0 minutes

Take-off (see Table I)

Speed (knots IAS)

V1 (at any gross weight). 25 V2 (at normal gross weight of 66, 800 pounds). 44

Distance

Take-off (see Table I)

Abort. At runway speeds greater than 25 knots, fuel, water or other ballast is jettisoned, and a single engine take-off is accomplished. At speeds less than 25 knots, the take-off is aborted.

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.ASA Seal T/O Dist.	Level Standard Day T/O Time		Time Deviations per 1,000 Ft. Alt. Dev.
66,800 lbs	44 kts.	1,800 ft	0 8 min.	10 0%	10 0%
		Lift-Off S Deviati	-		and Time
		1,000 Lbs.			1,000 Lbs.
		Over NGW		Over NGW	Under NGW
66,800 lbs	44 kts	3 4%	3.4%	30.5%	15.3%
		T/O Dist. and Time Deviation w/ATO		Runway Gradient	
				Deviation per 1% Slope	
		Not applicable		Not available from operator	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100.)

Sequence of Operations

Adjacent to the active runway, the mooring mast tractor brakes are set for holding and the engine runup check is performed. After taxiing onto the runway and aligning, the bow handling lines are tended and the lugs attaching the bow cone of the airship to the mast are pulled, the mooring pendent is tripped, and the mast is pulled free of the airship by the tractor. When the mast is clear, power is applied for take-off and bow lines are released.

Time

Engine runup check 2 to 4 minutes

Taxi onto runway, unmast, and apply take-off power 10 to
15 minutes

Take-off (see Table I)

Speed (knots IAS)

V1 (at any gross weight) 25 V2 (at maximum gross weight of 90,000 pounds) 45

Distance

Take-off (see Table I)

Abort At speeds greater than 25 knots, fuel, water, or other ballast is jettisoned, and a single engine take-off is made. At speeds less than 25 knots, the take-off is aborted

TABLE I, TAKE-OFF

Maxımum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Le T/O Dist	evel Standard Day T/O Time	•	Γιme Deviations per 1,000 Ft. Alt Dev
90,000 lbs	45 kts.	2,000 ft.	0.9 min.	10%	10%
90, 000 lbs	45 kts	Lift-Off S _I Deviation 1,000 Lbs Over MGW Not applicable		•	and Time for Weight 1,000 Lbs Under MGW 5%
90,000 lbs	45 kts.	T/O Dist an Deviation w Not applic	//ATO	Deviation p	Gradient er 1% Slope e from operator

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The pre-take-off functional check and the engine runup check are performed adjacent to the active runway. After taxiing onto the runway, flaps are extended 15 degrees, and power is applied for take-off

Tıme

Pre-take-off functional check and engine runup check 5 0 to 15 0 minutes

Taxi onto runway and apply take-off power 0.8 to 1.0 minute Take-off (see Table I)

Speed (knots IAS during taxi)

V1 (at normal gross weight of 30,000 pounds) Not available from operator

V2 (at normal gross weight of 30,000 pounds) 77

Distance (see Table I)

Take-Off (see Table I)
Abort Not available from operator

Refusal distance Not available from operator

$ m T/O~Dist~$ and Time Deviations per $ m 10^{O}~C~Dev~$	8.2%	T/O Dist. and Time Deviation for Weight 1,000 Lbs. 1,000 Lbs. Over NGW Under NGW 10.5% 75% Runway Gradient Deviation per 1% Slope	Not available from operator
N A S A, Sea Level Standard Day T/O Dıst T/O Tıme	470 ft 0.4 min.	Lift-Off Speed Deviation 1,000 Lbs 1,000Lbs Over NGW Under NGW 2% 2% T/O Dist and Time Deviation w/ATO Dev. 2,000 Lbs.	25.2% 26.3%
Lift-Off Speed (V2) N (IAS) T	77 kts. 1,	77 kts	77 kts.
Normal Gross Weight	30,000 lbs	30, 000 lbs	30,000 lbs

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The jet engines are started, and the pre-take-off functional check and engine runup check are performed adjacent to the active runway. The flaps are extended 25 degrees for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off. The application of power requires from 30 to 45 seconds due to the complexity of the power plant. Wet power (water-alcohol injection) is normally used for take-off.

$T_{1}me$

Engine run-up check 6 to 8 minutes (included in pre-take-off functional check)

Taxi onto runway, and apply take-off power 1 0 to 1.5 minutes

Taxi onto runway, and apply take-off power 1.0 to 1.5 minutes Take-off (see Table 1)

Speed (knots IAS)

V1 (at normal gross weight of 170,000 pounds) 105 V2 (at normal gross weight of 170,000 pounds) 126

Distance

Take-off (see Table 1)
Abort 2,100 feet
Refusal distance (see abort)

(6 engines, wet power)

	Lift-Off					
Normal Gross	Speed (V2)	N A.S.A. Sea	Level Standard Day	T/O Dist. and	Time Deviations per	
Weight	(IAS)	T/O D ₁ st.	T/O Time	10° C Dev	1,000 Ft. Alt. Dev	
170,000 lbs.	126 kts.	4,100 ft.	0.65 min.	Plus Minu 12 2% Neglig	- ,	
		Lift-Off	Speed	T/O Dist	t. and Time	
		Deviat	10n	Deviation for Weight		
		*3,000 Lbs	10,000 Lbs	*3,000 Lbs.	10,000 Lbs.	
		Over NGW	Under NGW	Over NGW	Under NGW	
170,000 lbs	126 kts.	1.2%	3.2%	5.9%	12 2%	
		T/O Dist Deviation			y Gradient per 1% Slope	
170,000 lbs.	126 kts.	Not applicable		Not availab	le from operator	

*Normal gross weight plus 3,000 lbs. equals maximum gross weight

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After the runup check is performed, the helicopter is air taxied to the take-off point. There is no further hesitation and power is applied for take-off. Maximum rpm (3, 200) and manifold pressure as required are used for lift-off. The helicopter is lifted to a hovering position, and a forward movement is initiated while gradually increasing airspeed throughout the translational phase. At 15 knots IAS, a climb attitude is attained, and airspeed is increased to 40 knots IAS and a 500 fpm rate of climb is established.

Alternate Take-Off Procedure

Running Take-Off

At the take-off point, the throttle is advanced to maximum rpm (3, 200), forward movement is initiated, and ground speed is gradually increased throughout the translational phase. As ground speed increases, sufficient lift will be developed to accomplish lift-off. From lift-off, a shallow rate of climb is maintained, while increasing airspeed to the desired climb airspeed. This method of take-off is utilized under adverse conditions of overloading or at high altitudes where vertical or hovering take-off cannot be accomplished.

Tıme

Engine runup check 1 0 to 2 0 minutes
Taxi and apply take-off power 1 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

*V2 (at maximum gross weight of 2,700 pounds) 15

Distance

Take-off (see Table I) Abort 100 feet Refusal distance Not applicable

^{*} Effective translational lift gained at 15 knots IAS is equivalent to V2 speed

$ m T/O~Dist~$ and Time Deviations per $10^{ m O}$ C Dev $1,000$ Ft Alt Dev.	10 0%	T/O Dist. and Time Deviation for Weight 0 Lbs. 250 Lbs. r MGW Under MGW	e 10 0%
T/O Dist and 10° C Dev	10 0%	T/O Dis Deviatio 250 Lbs. Over MGW	Not applicable
A.S.A. Sea Level Standard Day to Clear 50 Feet O Dist. T/O Time	*12 sec	n 250 Lbs. Under MGW	none
N.A.S.A. Sea Level Stan to Clear 50 Feet T/O Dist.	400 ft	Lift-Off Speed Deviation 250 Lbs 250 Over MGW Und	Not applicable
Lift-Off Speed (V2) (IAS)	15 kts.		15 kts
Lift-Off Maximum Gross Speed (V2) Weight (IAS)	2, 700 lbs		2, 700 lbs

*Speed at 50 feet altitude 18 50 knots IAS

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 60 percent for take-off. After taxing onto the run-way, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 8 0 to 15.0 minutes

Taxi onto runway and apply take-off power 1 0 to 3.0 minutes

Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 133,000 pounds) 115 V2 (at normal gross weight of 133,000 pounds) 121

Distance

Take-off (see Table I)
Abort (see Refusal distance)
Refusal distance At a normal gross weight of 133,000 pounds,
2,700 feet

ions per lt. Dev		ω X7	
l Time Deviations per 1,000 Ft Alt. Dev	2 7%	T/O Dist. and Time Deviation for Weight 300 Lbs. 10,000 Lbs rer NGW Under NGW 22 0% 14 0% Runway Gradient Deviation per 1% Slope	5, 5%
T/O Dist and Time Deviations per 10° C Dev	2 7%	T/O Dis Deviatio 10,000 Lbs. Over NGW 22 0% Runwa Deviation	-,
A S.A, Sea Level Standard Day O Dıst	1 0 min	Speed 10,000 Lbs Under NGW 4 1% and Time w/ATO	ıcable
N.A S.A. Sea. T/O Dist	3, 650 ft	Lift-Off Speed Deviation 10,000 Lbs 10,000 Over NGW Under 3 3% 4 1% T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	121 kts	121 kts	121 kts
Normal Gross Weight	133,000 lbs	133, 000 lbs	133, 000 lbs

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 18 degrees for take-off. After taxing onto the runway and aligning, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 2 0 to 4.0 minutes
Taxi onto runway and apply take-off power 0.5 to 1 0 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 120,000 pounds). 86 V2 (at normal gross weight of 120,000 pounds). 106

Distance

Take-off (see Table I)
Abort 3,200 feet
Refusal distance (see abort)

T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt, Dev	Plus 18 0% 10.0% Minus 10 0%	T/O Dist. and Time Deviation for Weight 4,000 Lbs. 10,000 Lbs. Over NGW Under NGW 4.1% 13 5%	Runway Gradient Deviation per 1% Slope	6 5%
N A S A. Sea Level Standard Day T/O Dist T/O Time	2, 400 ft 0 5 min.	Lift-Off Speed Deviation 4,000 Lbs 10,000 Lbs Over NGW Under NGW 1 3% 5.4%	T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (LAS)	106 kts.	106 kts		106 kts.
Normal Gross Weight	120,000 lbs.	120,000 lbs		120,000 lbs.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are fully extended for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

$T_{1}me$

Engine runup check 1 5 to 3 5 minutes

Taxi onto runway, and apply take-off power 0 2 to 0 3 minute

Take-off (see Table I)

Speed (knots IAS)

V1 Not applicable V2 (at maximum gross weight of 16,650 pounds) 130

Distance

Take-off (see Table I) Abort 2,000 feet Refusal distance (see abort)

TABLE I, TAKE-OFF

	L1ft-Off				
Maximum Gross Weight	Speed (V2) (IAS)	N.A.S A Sea I T/O Dist	Level Standard Day T/O Time		Time Deviations per 1,000 Ft. Alt. Dev
16,650 lbs	130 kts	2,500 ft	0 4 min	10%	9.2%
		Lift-Off S Deviati	_		. and Time for Weight
		1,000 Lbs	1,000 Lbs	1,000 Lbs	1,000 Lbs.
		Over MGW	Under MGW	Over MGW	Under MGW
16,650 lbs	130 kts	Not applicable	2.7%	Not applicable	13 8%
		T/O Dist a Deviation			Gradient per 1% Slope
16,650 lbs	130 kts.	Not applicable		5,0	%

(The value above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

After taxing onto the runway, the brakes are set for holding and the engine runup check is performed. The flaps are extended 30 degrees for take-off. Throttles are advanced to 90 percent power, and brakes released. Throttles are then advanced to 100 percent power. When ATO is employed, the recommended normal take-off is to fire ATO at 30 knots IAS.

Tıme

Taxi onto runway, engine runup check, and apply take-off power 0.5 to 1 0 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 15, 100 pounds) 110 V2 (at normal gross weight of 15, 100 pounds) 120

Distance

Take-off (see Table I)
Abort 3,500 feet
Refusal distance At a normal gross weight of 15,100 pounds,
2,300 feet, when utilizing 6,000-foot runway

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 0 3 to 0 5 minute
Taxi onto runway and apply take-off power. 0 2 to 0.6 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 55,000 pounds) 138 V2 (at normal gross weight of 55,000 pounds) 142

Distance

Take-off (see Table I)
Abort (see refusal distance)
Refusal distance. At a normal gross weight of 55,000 pounds,
4,000 feet utilizing a 10,000 foot runway

TABLE I, TAKE-OFF

T/O Dist. and Time Deviations per 10° C Dev. 1,000 Ft. Alt. Dev.	12 0%	T/O Dist. and Time	Deviation for Weight 10 Lbs. 5,000 Lbs. 11 NGW Under NGW	19.0%	Runway Gradient Deviation per 1% Slope	Not available from operator
T/O Dist. an	18.6%	T/O D1	Deviation 2,000 Lbs. Over NGW	7.6%	Runw Deviatio	Not availab
A S.A. Sea Level Standard Day O Dıst.	0.7 mm.	Speed	ton 5, 000 Lbs. Under NGW	6 2%	and Time w/ATO	cable
N A S.A. Sea I T/O Dist.	5, 000 ft.	Lift-Off Speed	Deviation 2,000 Lbs Over NGW	2.5%	T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (LAS)	142 kts.			142 kts.		142 kts
Normal Gross Weight	55, 000 lbs.			55, 000 lbs.		55,000 lbs.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

TABLE I, TAKE-OFF (Maximum Power)

T/O Dist. and Time Deviations per 10° C Dev. 1,000 Ft Alt. Dev	7 0% 12.0%	T/O Dist, and Time Deviation for Weight 1,000 Lbs. 1,000 Lbs. Over NGW Under NGW 13 5% 10 2% Runway Gradient Deviation per 1% Slope	Not available from operator
N A.S A. Sea Level Standard Day T/O Dist	2, 600 ft 0 5 min	Lift-Off Speed Deviation 1,000 Lbs Over NGW 2.4% 3.0% T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	125 kts	125 kts	125 kts
Normal Gross Weight	18, 500 lbs.	18, 500 lbs	18, 500 lbs

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100 }

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 11 degrees for take-off. After taxiing onto the runway there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check. 1 to 3 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 28,000 pounds) 95 V2 (at normal gross weight of 28,000 pounds) 105

Distance

Take-off (see Table I) Abort 1,400 feet Refusal distance (see abort)

TABLE I, TAKE-OFF

	$_{\text{lnft-Off}}$				
Normal Gross Weight	Speed (V2) (IAS)	N.A.S.A Sea I T/O Dist	Level Standard Day T/O Time	_	Time Deviations per 1,000 Ft Alt Dev
28,000 lbs	105 kts.	2, 225 ft	0 4 min	5 5%	6 4%
		Lift-Off S		•	and Time
		Deviation			for Weight
		$1,000~\mathrm{Lbs}$	1,000 Lbs	1,000 Lbs	1,000 Lbs
		Over NGW	Under NGW	Over NGW	Under NGW
28,000 lbs.	105 kts.	1 8%	1.8%	11 0%	8 5%
		T/O Dist		•	Gradient
		Deviation	w/ATO	Deviation]	per 1% Slope
28,000 lbs	105 kts.	Not appli	cable	Not availa	ble from operator

(The values above are to be substituted directly in the take-off equations in the appendix \ln substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 9 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and maximum power is applied for take-off.

Time

```
Engine runup check 1.0 to 3 0 minutes

Taxi onto runway, align ship, and apply take-off power: 0.1
to 0.3 minute

Take-off (see Table 1)
```

Speed (knots IAS)

```
V1 (at any gross weight). Not available from operator. V2 (at any gross weight) 75
```

Distance

```
Take-off (see Table 1)
Abort 1,100 feet
Refusal distance (see abort)
```

	L1ft-Off				_
Normal Gross Weight	Speed (V2) (IAS)	N A S A. Sea I T/O Dist.	Level Standard Day T/O Time		Time Deviations per 1,000 Ft Alt. Dev.
7, 400 lbs	75 kts.	1, 420 ft.	0.4 min	9.3%	9.9%
		Lift-Off S	Speed	T/O Dıst	. and Time
		Deviati	.on	Deviation	n for Weight
		90 Lbs.	200 Lbs	90 Lbs.	200 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
7, 400 lbs	75 kts	Nor	ne	2.9%	6.4%
		T/O Dist. a			/ Gradient per 1% Slope
		Deviation	W/AIO	Deviation	her 1 % probe
7, 400 lbs	75 kts	Not appla	cable	Not avaılable	from operator.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 18 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and maximum power is applied for take-off.

Tıme

Engine runup check 1 0 to 3 0 minutes
Taxi onto runway, and apply take-off power 0 1 to 0 3 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 8,000 pounds) Not available from manufacturer
V2 (at normal gross weight of 8,000 pounds) 68

Distance

Take-off (see Table I)

Abort Not available from manufacturer

Refusal distance Not available from manufacturer

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea I T/O Dist	Level Standard Day T/O Time	•	Time Deviations per 1,000 Ft Alt Dev.
8,000 lbs	68 kts	645 ft	0 2 min	8 0%	8 7%
		Lift-Off S Deviati 500 Lbs Over NGW	on 500 Lbs	·	. and Time for Weight 500 Lbs. Under NGW
8,000 lbs	68 kts.	5 9%	4 8%	16 3%	13 8%
		T/O Dist a		•	Gradient per 1% Slope
8,000 lbs.	68 kts	Not appl	ıcable	Not available	e from manufacturer

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway Flaps are used as required for take-off. After taxing onto the runway there is a 10 second hesitation for a further power check and power is then applied for take-off.

Tıme

Engine runup check 1.5 to 3.0 minutes
Taxi onto runway and apply take-off power 0.4 to 0.5 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at a normal gross weight of 9,500 pounds) not applicable V2 (at a normal gross weight of 9,500 pounds) 100

Distance

Take-off (see Table I) Abort 2,500 feet Refusal distance (see abort)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea I T/O Dist	A.S.A. Sea Level Standard Day O Dist	T/O Dist and 10° C Dev	T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt Dev.	
9, 500 lbs	100 kts	4, 900 ft	0 9 min	8 2%	9 7 %	
		Lift-Off Speed Deviation	Speed 10n	T/O Dist Deviation	T/O Dist. and Time Deviation for Weight	
		l, 000 Lbs Over NGW	l, 000 Lbs. Under NGW	1,000 Lbs. Over NGW	l, 000 Lbs. Under NGW	
9, 500 lbs	100 kts	2 0%	5 0%	%0 6	%0 6	
		T/O Dist and Time Deviation w/ATO	and Tıme w/ATO	Runway Deviation J	Runway Gradient Deviation per 1% Slope	
9, 500 lbs	100 kts	Not applicable	cable	Not available	Not avaılable from operator	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by $100\)$

Sequence of Operations

After taxing onto the active runway, the brakes are set for holding and the engine runup check is performed. The flaps are extended 30 degrees for take-off. Afterburners are then ignited, when stabilization of rpm and exhaust gas temperature occurs, brakes are released and take-off is initiated.

Tıme

Engine runup check, taxi onto runway and apply take-off power 2 to 3 minutes

Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 43, 200 pounds) 137 V2 (at normal gross weight of 43, 200 pounds) 148

Distance

Take-off (see Table I)

Abort See Refusal Distance

Refusal Distance At a normal gross weight of 43, 200 pounds at maximum power, 3,600 feet when utilizing a 9,000 foot runway

TABLE I, TAKE-OFF

and Time Deviations per 1,000 Ft Alt Dev	9.6.6	T/O Dist. and Time Deviation for Weight 000 Lbs. 1,000 Lbs. rer NGW Under NGW 5 9% 4 8% Runway Gradient Deviation per 1% Slope	ible from tors
T/O Dist and 10° C Dev	10.3%	T/O Dis Deviatio 1,000 Lbs. Over NGW 5 9% Runwa Deviation	Not available from operators
A S A Sea Level Standard Day O Dıst T/O Tıme	0 5 mm	Speed lon 1,000 Lbs Under NGW 1.2% and Time w/ATO	ble
N A S A Sea I T/O Dist	3, 400 ft.	Lift-Off Speed Deviation 1,000 Lbs 1,000 Over NGW Under 1.2% 1.2% T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	148 kts.	148 kts.	148 kts.
Normal Gross Weight	43, 200 lbs.	43, 200 lbs.	43, 200 lbs

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

After taxing onto the runway, the engine runup and pre-take-off functional checks are performed. Flaps are extended 20 degrees and power is applied for take-off.

Tıme

Taxi onto runway, perform engine runup and pre-take-off functional checks, extend flaps, and apply take-off power 1 0 to 3.0 minutes

Take-off (see Tables I and II)

Speed (knots IAS)

V1 (at normal gross weight of 21,000 pounds) not applicable
V2 (at normal gross weight of 21,000 pounds) 152
(J65-W-7 engine)
V2 (at normal gross weight of 21,000 pounds) 150
(J65-B-3 engine)

Distance

Take-off (see Tables I and II)
Abort (see refusal distance)
Refusal distance At a normal gross weight of 21,000 pounds,
3,000 feet when utilizing an 8,000 foot runway

TABLE I, TAKE-OFF J65-W-7 ENGINE (Using 20º Flans)

	T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt. Dev	10 3% 9 6%	T/O Dist. and Time Deviation for Weight 1,000 Lbs 1,000 Lbs. Over NGW Under NGW 11 6% 9% Runway Gradient Deviation per 1% Slope	Not available from operator
(Using 20° Flaps)	N A S A. Sea Level Standard Day T/O Dıst	0.5 min	Speed lon l,000 Lbs. Under NGW 2 3% and Time w/ATO	17%
(Usin N A S A, Sea Le T/O Dist	3, 900 ft	Lift-Off Speed Deviation 1,000 Lbs 1,000 Over NGW Under 2 2% 2 3 T/O Dist and Time Deviation w/ATO	18%	
<i>35</i> € 1	Speed (V2) (IAS)	152 kts	152 kts	152 kts
	Normal Gross Weight	21,000 lbs.	21,000 lbs	21,000 lbs

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

	TABLE I, TAKE-OFF J65-B-3 ENGINE (Using 20º Flaps)
--	--

Dist and Time Deviations per C Dev 1,000 Ft Alt Dev % 9 9% 9 9% T/O Dist. and Time Deviation for Weight 000 Lbs 1,000 Lbs. 12 8% 10 5% 10 5% Runway Gradient Deviation per 1% Slope	T/O Dist and 10° C Dev 9 3% T/O Dist Deviation 1,000 Lbs Over NGW 12 8% Deviation Deviation	N A S A. Sea Level Standard Day T/O Dist. Lift-Off Speed Deviation 1,000 Lbs 1,000 Lbs. Over NGW Under NGW 2 2% 2 7% T/O Dist. and Time Deviation w/ATO	N A S A. Sea Level Star T/O Dist. Lift-Off Speed Deviation 1,000 Lbs 1,000 Over NGW Under 2 2% 2 7 T/O Dist. and Time Deviation w/ATO	Lift-Off Speed (V2) (IAS) 150 kts	Normal Gross Weight 21,000 lbs
Not available from operator	Not availabl	15 5%	18%	150 kts	21.000 lbs
ty Gradient per 1% Slope	Kunwa Deviation	ınd Tıme w/ATO	T/O Dist. a Deviation		
10 5%	12 8%	2 7%	2 2%	150 kts	,000 lbs
1,000 Lbs. Under NGW	1,000 Lbs Over NGW	1,000 Lbs. Under NGW	1,000 Lbs Over NGW		
on for Weight	Deviatio	no.	Deviati		
it, and Time	$_{ m T/O~D_{18}}$	Speed	Lift-Off S		
%6 6	% 3%	0 6 min	4,300 ft	150 kts	, 000 lbs
1,000 Ft Alt Dev	10° C Dev	T/O Tıme	T/O Dist.	(IAS)	Weight
d Time Deviations per	T/O Dist and	evel Standard Day	N A S A. Sea L	Speed (V2)	rmal Gross
		ing co riaps)	1180	\$\$C *\$* 1	

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After runup check is performed, the helicopter is air taxiled to the take-off point. There is no further hesitation and power is applied for take-off. Maximum rpm (2, 400) and manifold pressure as required are used for lift-off to a hover position. From the hover position forward movement is initiated, and airspeed is increased through the translational phase. At 30 knots IAS, a climb attitude is attained, and airspeed is increased to 50 knots IAS and a rate of climb of 500 fpm is established.

Alternate Take-Off Procedure

Rolling Take-Off

At the take-off point, the throttle is advanced to maximum rpm (2,400), forward roll is initiated and ground speed is increased through the translational phase. As ground speed increases, sufficient lift will be developed to accomplish lift-off. From the lift-off, a shallow rate of climb is maintained, and airspeed is increased to the desired climb airspeed.

Time

Engine runup check 1 0 to 3 0 minutes
Taxi and apply take-off power 1 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

*V2 (at normal gross weight of 7,900 pounds) 30

Distance

Take-off (see Table I)
Abort 150 feet
Refusal distance Not applicable

^{*} Effective translational lift gained at 30 knots IAS is equivalent to V2 speed

- * At or above 6,000 feet elevation, at a gross weight of 7,900 pounds, a rolling take-off must be utilized. Normal operations under these conditions require a ground run of 225 feet to accelerate to 30 knots IAS, plus 720 feet air distance to clear 50 foot obstacle. For each 10 knots head wind, decrease distance 20 per cent.
- ** Speed at 50 feet altitude is 50 knots IAS

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After the runup check is performed the helicopter is air taxied to the take-off point. There is no further hesitation and power is applied for take-off. Maximum rpm (2, 800) and manifold pressure as required are used for lift-off. The helicopter is lifted to a hovering position, and a forward movement is initiated, gradually increasing airspeed throughout the translational phase At 30 knots IAS, a climb attitude is attained and airspeed is then increased to 50 knots IAS with an established rate of climb of 500 fpm.

Alternate Take-Off Procedure

Rolling Take-Off

At the take-off point, the throttle is advanced to maximum rpm (2,800), forward roll is initiated and ground speed is increased through the translational phase. As ground speed increases, sufficient lift will be developed to accomplish lift-off. From lift-off, a shallow rate of climb is maintained, and airspeed is increased to the desired climb airspeed.

Tıme

Engine runup check 2 0 to 3.0 minutes
Taxi and apply take-off power 1 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

*V2 (at normal gross weight of 12,000 pounds) 30

Distance

Take-off (see Table I) Abort 150 feet Refusal distance Not applicable

^{*} Effective translational lift gained at 30 knots IAS is equivalent to V2 speed

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)		Sea Level Standard Day Clear 50 Feet T/O Time	T/O Dist. and 10°C Dev	d Time Deviations per 1,000 Ft. Alt Dev.
12,000 lbs.	30 kts.	500 ft	** 12 seconds	5%	25%
		Lift-Off Speed Deviation 1,000 Lbs 1,000 Lbs		T/O Dist and Time	
				Deviation for Weight	
				1,000 Lbs	1,000 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
12,000 lbs.	30 kts.	none	none	25%	20%

** Speed at 50 feet altitude is 50 knots IAS.

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100.)

^{*} At 6,000 feet elevation and above at a gross weight of 13,300 pounds, a rolling take-off must be utilized. Normal operations under these conditions require a ground run of 635 feet to accelerate to 50 knots IAS plus 825 feet air distance to clear a 50 foot obstacle. For each 10 knots of head wind, decrease the distance 20 percent.

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After the runup check is performed, the helicopter is air taxied to the take-off point. There is no further hesitation and power is applied for take-off Maximum rpm (2, 700) and manifold pressure as required are used for lift-off. The helicopter is lifted to a hovering position, and a forward movement is initiated while gradually increasing airspeed throughout the translational phase. At 30 knots IAS, a climb attitude is attained, and airspeed is increased to 70 knots IAS and a 500 fpm rate of climb is established. Gear is retracted after attaining an airspeed of 65 knots IAS.

Tıme

Engine runup check 3.0 to 5.0 minutes
Taxi and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

```
* V1 (at normal gross weight of 29, 431 pounds) 65
** V2 (at normal gross weight of 29, 431 pounds) 30
```

Distance

Take-off (see Table I)
Abort 280 feet
Refusal distance not applicable

^{*} Safe single engine speed

^{**} Effective translational lift gained at 30 knots IAS is equivalent to V2 speed.

TABLE I, TAKE-OFF

Normal Gross	Lift-Off N.A.S.A. Sea Level Standard Day to Clear 50 Feet		T/O Dist. and Time Deviations per			
Weight	(IAS)	T/O Dist.	T/O Time	10° C Dev.	1,000 Ft. Alt. Dev.	
29, 431 lbs	30 kts.	500 ft.	*12 sec.	5%	10%	
		Lift-Off	-	·	and Time	
			Deviation		Deviation for Weight	
		$1,000~\mathrm{Lbs}$	1,000 Lbs	1,000 Lbs.	1,000 Lbs.	
		Over NGW	Under NGW	Over NGW	Under NGW	
29, 431 lbs	30 kts	none	none	10%	10%	

* Speed at 50 feet altitude is 50 knots IAS

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the take-off point. After runup check is performed, the helicopter is air taxied to the take-off point. There is no further hesitation and power is applied for take-off. Maximum rpm (2,700) and manifold pressure as required are used for lift-off. The helicopter is lifted to a hovering position, and a forward movement is initiated, while gradually increasing airspeed throughout the translational phase. At 30 knots IAS, a climb attitude is attained, and airspeed is increased to 50 knots IAS and a 500 fpm rate of climb is established.

Alternate Take-off Procedure

Rolling take-off

At the take-off point, throttles are advanced to maximum rpm (2,700), forward roll is initiated, and ground speed is gradually increased through the translational phase. As ground speed increases, sufficient lift will be developed to accomplish lift-off. From the lift-off, a shallow rate of climb is maintained, while increasing airspeed to 50 knots IAS.

Tıme

Engine runup check 2.0 to 3 0 minutes
Taxi and apply take-off power 1 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

*V2 (at maximum gross weight of 13,500 pounds). 30

Distance

Take-off (see Table I)
Abort 150 feet
Refusal distance not applicable

^{*} Effective translational lift gained at 30 knots IAS is equivalent to V2 speed

TABLE I, TAKE-OFF

Normal Gross	Lift-Off Speed (V2)	*N A.S A Sea Le	evel Standard Day	T/O Dist. and	Time Deviations per	
Weight	(IAS)	T/O Dist.	T/O Time	10° C Dev	1,000 Ft Alt Dev	
13,500 lbs.	30 kts.	700 ft.	** 17 sec,	15%	20%	
		Lift-Off Sp	peed	· ·	and Time	
		Deviation		Deviation for Weight		
		1,000 Lbs	1,000 Lbs	1,000 Lbs.	1,000 Lbs.	
		Over NGW	Under NGW	Over NGW	Under NGW	
13,500 lbs	30 kts.	Not applicable	None	Not applicable	25%	

*At 6,000 feet elevation and above at a gross weight of 13,500 pounds, a rolling take-off must be utilized. Normal operations under these conditions require a ground run of 240 feet to accelerate to 50 knots IAS plus 800 feet air distance to clear a 50-foot obstacle. For each 10 knots of wind, decrease the distance 20 percent

**Includes 5 seconds to ascend to hover altitude (10 ft)

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Volumes I-A through IX

SECTION 2

COMMERCIAL AIRCRAFT

Douglas DC-7B

containing data on

Boeing B-377

Boeing 707-121 Douglas DC-7C

Convair 340/440 Fairchild F-27B

de Havilland Comet 4 Lockheed Electra 188

Douglas DC-3 (C-47, R4D) Lockheed 1049G

Douglas DC-4 (C-54) Lockheed 1649A

Douglas DC-6 Martin 404

Douglas DC-6B Vickers Viscount 745D

Douglas DC-7 Vickers Viscount 812

(date of latest revision September 1, 1959)

UNITED STATES FEDERAL AVIATION AGENCY Bureau of Research & Development Washington 25, D.C.

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 25 degrees for take-off. After taxing onto the runway, a further hesitation of 10 to 15 seconds is required to avoid fuel vent overflow. Power is then applied for take-off.

Tıme

Engine runup check 2.0 to 3 0 minutes
Taxi onto runway and apply take-off power 0.3 to 0 4 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 120,000 pounds). 94 V2 (at normal gross weight of 120,000 pounds). 102

Distance

Take-off (see Table I)
Abort 2,800 feet
Refusal distance (see abort)

Take-Off - 2/2

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea L T/O Dist.	A S A. Sea Level Standard Day O Dıst. T/O Tıme	T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt. Dev
120, 000 lbs	102 kts	2, 800 ft	0 6 min	Not available from operators
		Lift-Off Speed Deviation	peed	T/O Dist, and Time Deviation for Weight
		10,000 Lbs Over NGW	10,000 Lbs. Under NGW	10,000 Lbs. 10,000 Lbs. Over NGW Under NGW
120,000 lbs	102 kts	4 9%	3 9%	Not available from operators
		T/O Dist and Time Deviation w/ATO	und Time w/ATO	Runway Gradient Deviation per 1% Slope
120,000 lbs	102 kts	Not applicable	able	Not available from operators

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100

Sequence of Operations

The engine runup check is performed adjacent to the active runway. Flaps are extended 30 degrees for take-off. Upon taxiing onto runway and aligning, brakes are set for holding and take-off thrust (wet) is applied. When engines have attained take-off thrust, the brakes are released and take-off is initiated.

Alternate Take-Off Procedure

The engines may be rapidly accelerated to take-off thrust (wet) as the airplane is turned onto the runway. There is no hesitation and take-off is initiated immediately

Runway distance and time do not differ materially with either method of starting the take-off run

Tıme

Engine runup check 0 5 to 2 0 minutes

Taxi onto runway, align and set brakes 0 5 minute

Alternate take-off (no hesitation) 3 to 5 seconds

Speed (knots IAS)

V1 (at a normal gross weight of 226,000 pounds) 140 V2 (at a normal gross weight of 226,000 pounds) 146

Distance

Take-off (see Table I)

Abort (see refusal distance)

Refusal Distance At a gross weight of 226,000 pounds, wet power - 2,500 feet when utilizing a 8,200 foot runway

TABLE I, TAKE-OFF

L1ft-Off						
Normal Gross Weight	Speed (V2) (IAS)	N A S A Sea I T/O Dist	Level Standard Day T/O Time	T/O Dist and 10° C Dev	Time Deviations per 1,000 Ft Alt. Dev.	
226,000 lbs	146 kts	4, 500 ft	0 6 min.	Not avaılab	le from operators	
		Lıft-Off	-	•	. and Time i for Weight	
			Deviation , 000 Lbs 10,000 Lbs		_	
		10,000 Lbs Over NGW	Under NGW	Over NGW	10,000 Lbs. Under NGW	
226,000 lbs	146 kts	2 9%	2.9%	18 0%	18 0%	
		T/O Dist and Time		Runway Gradient Deviation per 1% Slope		
	Deviation v		w/ATO			
226, 000 lbs	146 kts	Not applicable		Not available from operators		

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The pre-take-off functional check and the engine runup check are performed adjacent to the active runway. The flaps are extended 11 degrees. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup and pre-take-off functional check 3 to 4 minutes

Tax1 onto runway, and apply take-off power 3 to 10 seconds Take-off (see Table I)

Speed (knots IAS)

V1 (at minimum gross weight of 48,000 pounds) 108 V2 (at maximum gross weight of 48,000 pounds) 109

D₁stance

Take-off (see Table I)

Abort 1,770 feet

Refusal distance (see abort)

TABLE I, TAKE-OFF

Maximum Gross	Lift-Off Speed (V2)	N. A.S. A. Sea Level Standard Day Over 50 Foot Obstacle		T/O Dist (Over 50 Foot Obstacle) and Time Deviation per		
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft. Alt. Dev	
48,000 lbs	109 kts	4,960 ft.	0 9 min	Above 3 6%	*4 9%	
				Below 1.8%		
		Lift-Off Speed		-	Over 50 Foot Obstacle)	
		Deviation			eviation for Weight	
		1,000 Lbs 1,000		1,000 Lbs.	l,000 Lbs.	
		Over MGW Under	MGW	Over MGW	Under MGW	
48,000 lbs.	109 kts.	Not applicable 1.4%	6	Not applicable	3.8%	
		T/O Dist. and Time Deviation w/ATO	ie.	Runway Grad Deviation per 1%		
48,000 lbs.	109 kts	Not applicable		Uphill 16.0 Downhill 5		

^{*} Applicable to 4,000 foot pressure altitude provided take-off gross weight limit at altitude is not exceeded.

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended to the 20 degree plain and 20 degree split position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 0.5 to 1.0 minute
Taxi onto runway and apply take-off power 5 to 10 seconds
Take-off (see Table 1)

Speed (knots IAS)

```
V1 (at normal gross weight of 140,000 pounds) 109
V2 (at normal gross weight of 140,000 pounds) 131
```

Distance

```
Take-off (see Table I)
Abort 2,550 feet
Refusal distance (see abort)
```

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are fully retracted for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 3 to 5 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 25, 346 pounds) 73 V2 (at maximum gross weight of 25, 346 pounds) 80

Distance

Take-off (see Table I)
Abort 1,125 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Maxımum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea L T/O Dist.	evel Standard Day T/O Time	•	ime Deviations per l,000 Ft. Alt. Dev
25, 346 lbs.	80 kts.	1,900 ft.	0 5 min.	10%	Not available from operator.
25, 346 lbs	80 kts.	Lift-Off S Deviation 1,000 Lbs. Over MGW Not applicable	on 1,000 Lbs. Under MGW	T/O Dist. Deviation for the second se	
		T/O Dist. a Deviation v		Runway (Deviation pe	
25, 346 lbs	80 kts.	Not applic	able	Not available	from operator

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 15 degrees for take-off. After taxing onto the run-way, there is a 10 to 20 second hesitation for a further power check and then power is applied for take-off.

Tıme

Engine runup check 2 0 to 4.0 minutes
Taxi onto runway, and apply take-off power 0.3 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 70,000 pounds) 97 V2 (at normal gross weight of 70,000 pounds) 103

Distance

Take-off (see Table I)

Abort Not available from operators

Refusal distance Not available from operators

TABLE I, TAKE-OFF

	L1ft-Off				
Normal Gross	Speed (V2)	N A S.A. Sea	Level Standard Day	T/O Dist. and T	Time Deviations per
Weight	(IAS)	T/O Dist.	$T/O T_{1}me$	10° C Dev.	l,000 Ft. Alt. Dev.
70,000 lbs	103 kts	3,850 ft.	0.8 min	Not available fr	om operators.
		L1ft-Off	Speed	T/O D ₁ st.	and Time
		Deviat	ion	Deviation:	for Weight
		1,000 Lbs	1,000 Lbs.	1,000 Lbs.	1,000 Lbs.
		Over NGW	Under NGW	Over NGW	Under NGW
70,000 lbs.	103 kts	0.7%	0.7%	4.6%	4.1%
			and Time n w/ATO	Runway (Deviation pe	
70,000 lbs.	103 kts	Not app	olicable	9 0	%

(The values above are to be substituted directly in the take-off equation in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off. Wet power (water-alcoholinjection) is normally used for take-off.

Time

Engine runup check 4.0 to 5.0 minutes
Taxi onto runway, and apply take-off power 0.3 to 0.5 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 90,000 pounds) 95 V2 (at normal gross weight of 90,000 pounds) 107

Distance

Take-off (see Table I)
Abort Not available from operator
Refusal distance Not available from operator

TABLE 1, TAKE-OFF

$ m T/O~Dist~$ and Time Deviations per $ m 10^{0}~C~Dev$	6.7%	T/O Dist. and Time Deviation for Weight 000 Lbs. 5,000 Lbs. ver NGW Under NGW 17 0% 13.4% Runway Gradient Deviation per 1% Slope	Not available from operator
T/O Dist an 10° C Dev	Not available from operator	T/O Dis Deviation 5,000 Lbs. Over NGW 17 0% Runwa Deviation	Not avaılable
N A S A, Sea Level Standard Day T/O Dist T/O Time	0 8 min	Speed on 5,000 Lbs Under NGW 2.8% and Time w/ATO	cable
N A S A, Sea I T/O Dist	4, 100 ft.	Lift-Off Speed Deviation 5,000 Lbs 5,000 Over NGW* Under 2 8% 2. T/O Dist, and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	107 kts	107 kts	107 kts
Normal Gross Weight	90, 000 lbs	90, 000 lbs	90, 000 lbs

*Normal gross weight plus 5, 200 pounds equals maximum gross weight.

(The values above are to be substituted directly in the take-off equations in the appendix, In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off. Wet power is normally used for take-off.

Tıme

Engine runup check 2 to 3 minutes

Taxi onto runway, and apply take-off power 5 to 10 seconds

Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 100,000 pounds) 101 V2 (at normal gross weight of 100,000 pounds) 113

Distance

Take-off (see Table I)

Abort 1,525 feet

Refusal distance (see abort)

TABLE I, TAKE-OFF (Wet Power)

Normal Gross Weight	Lift-Off Speed (V2) (IAS	N A.S.A Sea Level T/O Dist.	Standard Day T/O Time	· _	Time Deviations per 1,000 Ft. Alt Dev
100,000 lbs.	113 kts	3,180 ft.	0.6 min	6 3%	7.9%
		Lift-Off Speed Deviation *7,000 Lbs. 10,000 Lbs. Over NGW Under NGW		T/O Dist. and Time Deviation for Weight *7,000 Lbs. 10,000 Lbs Over NGW Under NGW	
100,000 lbs	113 kts.	3.7% 5.	. 3%	17.6%	20.4%
		T/O Dist. and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
100,000 lbs.	113 kts.	Not applicable		6.3%	

*Normal gross weight plus 7,000 pounds equals maximum gross weight.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway and flaps are extended 20 degrees for take-off. After taxiing on to the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 2 0 to 3 0 minutes

Taxi onto runway, and apply take-off power 0 2 to
0 3 minute

Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 110,000 pounds) 104 V2 (at normal gross weight of 110,000 pounds) 120

Distance

Take-off (see Table I)
Abort 2,500 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

s per Dev				
$ m T/O~Dist~$ and Time Deviations per $ m 10^{\circ}~C~Dev$	5.7%	T/O Dist, and Time Deviation for Weight 00 Lbs 10,000 Lbs. ir NGW Under NGW 5% 21.5%	Runway Gradient Deviation per 1% Slope	%0 L
T/O Dıst and 10° C Dev	5, 4%	T/O Dis Deviatio 10,000 Lbs Over NGW 21 5%	Runway Deviation	2
A S A Sea Level Standard Day O Dist.	0 6 mm	Speed 10, 000 Lbs Under NGW 4 2%	and Time w/ATO	ble
N A S A Sea T/O Dist.	3, 500 ft	Lift-Off Speed Deviation 10,000 Lbs 10,0 Over NGW Un	T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (LAS)	120 kts	120 kts		120 kts
Normal Gross Weight	110,000 lbs	110, 000 lbs.		110,000 lbs

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is a 10 to 20 second hesitation for a further check and then power is applied for take-off.

$T_{1}me$

Engine runup check 2 0 to 3 0 minutes

Taxi onto runway, check engines and apply take-off power
0 2 to 0 4 minute

Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 110,000 pounds) 99 V2 (at normal gross weight of 110,000 pounds) 117

Distance

Take-off (see Table I)
Abort 3,000 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea Le T/O Dist.	evel Standard Day T/O Time		Time Deviations per 1,000 Ft Alt Dev
110,000 lbs	ll7 kts	3, 500 ft	0 6 min	2 5%	4 2%
		Lift-Off S _I Deviation 10,000 Lbs Over NGW	-		. and Time for Weight 10,000 Lbs. Under NGW
110,000 lbs	117 kts	4 5%	4 3%	22 0%	21 0%
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
110,000 lbs	117 kts	Not applicable		5 7%	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is a 10 to 30 second hesitation for a further check, and then power is applied for take-off

Time

Engine runup check: 1.0 to 3.0 minutes

Taxi onto runway, perform check and apply take-off power

0 2 to 0 5 minute

Take-off: (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 130,000 pounds): 105 V2 (at normal gross weight of 130,000 pounds): 118

Distance

Take-off (see Table I)
Abort 3,000 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Normal Gross	Lift-Off Speed (V2)		evel Standard Day		Time Deviations per	
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft. Alt Dev	
130,000 lbs.	118 kts.	3,850 ft	0.6 min	Not available from operators	4.6%	
		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight		
		10,000 Lbs		10,000 Lbs	_	
		Over NGW	•	Over NGW	· ·	
130,000 lbs.	118 kts.	3.4%	2 5%	18.9%	15.1%	
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope		
130,000 lbs.	118 kts.	Not applicable		Not available from operators		

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

After taxiing onto the runway, the brakes are set for holding and the engine runup check is performed to assure maximum turbine rpm and ADI operation. Flaps are set at 16.5 degrees and brakes are released as take-off (wet) power is applied.

Tıme

```
Taxi onto runway, perform engine runup check 0 3 minute to 0 4 minute
Take-off (see Table I)
```

Speed (knots IAS)

```
V1 (at normal gross weight of 34,000 pounds) 91 V2 (at normal gross weight of 34,000 pounds) 91
```

Distance

```
Take-off (see Table I)
Abort 1,775 feet
Refusal distance 2,300 feet utilizing a 4,500 foot runway
(wet power) at a gross weight of 34,000 pounds
```

TABLE I, TAKE-OFF (Wet Power)

ons per lt, Dev		<u>,</u> ≽		
Time Deviations per 1,000 Ft. Alt. Dev	6 5%	T/O Dist, and Time Deviation for Weight 00 Lbs. 1,000 Lbs. r NGW Under NGW 5 5% 7 0%	Runway Gradient Deviation per 1% Slope	
T/O Dist and Time Deviations per 10° C Dev 1,000 Ft. Alt. Dev	0/20 2	T/O Distribition 1,000 Lbs. Over NGW	Runway Deviation	%0 L
N A S A Sea Level Standard Day T/O Dıst	0 5 min	peed on 1,000 Lbs Under NGW 2 0%	nd Time w/ATO	ole
N A S A Sea L T/O Dıst	2,300 ft.	Lift-Off Speed Deviation 1,000 Lbs 1,0 Over NGW Un 2 0%	T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	91 kts	91 kts		91 kts
Normal Gross Weight	34,000 lbs.	34, 000 lbs.		34,000 lbs.

(The values above are to be substituted directly in the take-off equations In substituting, divide all percentage figures by 100) in the appendix

Sequence of Operations

The aircraft is taxied to the active runway and aligned. The brakes are set and the engine runup check is performed. The flaps are then extended 78 percent, the brakes released and full take-off power is applied.

$T_{1}me$

Taxi onto runway, engine runup check, and apply take-off power 0 2 to 0.5 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at normal gross weight of 110,000 pounds) 110 V2 (at normal gross weight of 110,000 pounds) 122

Distance

Take-off (see Table I)
Abort Not available from operators
Refusal distance Not available from operators

Normal Gross	Lift-Off Speed (V2)						e Deviations per
Weight	(IAS)	T/O Dist. T/O Time	Increase	Decrease	1,000 Ft. Alt Dev		
110,000 lbs.	122 kts.	4,400 ft. 0.7 min.	17 0%	9 2%	6 3%		
		Lift-Off Speed Deviation			and Time for Weight		
		3,000 Lbs 10,000 over NGW under N			. 10,000 Lbs		
110,000 lbs.	122 kts.	Negligible		8 0%	12 5%		
		T/O Dist. and Time Deviation w/ATO					
		•			ay Gradient		
				Deviation	on per 1% Slope		
110,000 lbs.	122 kts.	Not applicable]	10 3%		

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 60 percent for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 3 to 4 minutes
Taxi onto runway and apply take-off power 5 to 7 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 137, 500 pounds) 113 V2 (at maximum gross weight of 137, 500 pounds) 119

Distance

Take-off (see Table I)
Abort 1,800 feet
Refusal distance (see abort)

	T/O Dist. and Time Deviations per 10° C Dev 1,000 Ft. Alt Dev.	3.0%	T/O Dist. and Time Deviation for Weight 00 Lbs. 5,000 Lbs.	8. 4%	Runway Gradient Deviation per 1% Slope	
	$T/O~Dist.$ and $10^{ m o}$ C ${ m Dev}$	Not available from operators	T/O Dist Deviation 5,000 Lbs. Over MGW	Not applicable	Runway Deviation p	15.0%
	N.A S A. Sea Level Standard Day T/O Dist. T/O Time	4,600 ft 0.8 min f	Lift-Off Speed Deviation 5,000 Lbs 5,000 Lbs Over MGW Under MGW	Not applicable 1.0%	T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off	Speed (V2) (LAS)	119 kts.		119 kts.		119 kts.
į	Maximum Gross Speed (V2) Weight (IAS)	137, 500 lbs.		137, 500 lbs		137, 500 lbs

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 80 percent for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 3 to 4 minutes
Taxi onto runway, and apply take-off power 5 to 7 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 160,000 pounds) 112 V2 (at maximum gross weight of 160,000 pounds) 123

Distance

Take-off (see Table I) Abort 1,900 feet Refusal distance (see abort)

T/O Dist. and Time Deviations per $10^{ m O}$ C Dev	3,0%	T/O Dist. and Time Deviation for Weight 000 Lbs 5,000 Lbs. ver MGW Under MGW applicable 8.4% Runway Gradient Deviation per 1% Slope	%0
T/O Dist. and 10° C Dev	0.8 min. Not available from operator	T/O Dist. Deviation 5, 000 Lbs Over MGW Not applicable Runway Deviation F	15,0%
A.S.A. Sea Level Standard Day O Dist.	0.8 min.	Speed ton 5,000 Lbs Under MGW 1.0% and Time w/ATO	cable
N.A.S.A. Sea I T/O Dist.	5, 100 ft.	Lift-Off Speed Deviation 5,000 Lbs 5,000 Over MGW Under Not applicable 1.C T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	123 kts.	123 kts.	123 kts.
Maxımum Gross Weight	160,000 lbs.	160, 000 lbs.	160,000 lbs

(The values are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The pre-take-off functional check and the engine runup check are performed adjacent to the active runway. The flaps are extended 12.5 degrees. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup and pre-take-off functional checks 2 0 to 4 0 minutes

Tax1 onto runway, and apply take-off power 5 to 10 seconds Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 44, 900 pounds) 104 V2 (at maximum gross weight of 44, 900 pounds) 106

Distance

Take-off (see Table I)
Abort 1,950 feet
Refusal distance (see abort)

T/O Dist. and Time Deviations per $10^{ m o}$ C Dev. 1,000 Ft Alt. Dev	6.4%	nd Time: Weight 1,000 Lbs. Under MGW 4 0% adient 1% Slope	perators
nd Time D 1,000 l	9	for for	ie from o
T/O Dist. ar 10° C Dev.	4 0%	T/O Dist. Deviation: 1,000 Lbs. Over MGW Not applicable Runway of the control of	Not available from operators
A.S.A. Sea Level Standard Day O Dist.	0 5 min.	peed on 1,000 Lbs Under MGW : 1 1% nd Time v/ATO	able
N A.S.A. Sea I T/O Dist.	2, 500 ft.	Lift-Off Speed Deviation 1,000 Lbs 1,000 Over MGW Under Not applicable 1 10 T/O Dist, and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	106 kts	106 kts.	106 kts.
Maxımum Gross Weight	44, 900 lbs	44, 900 lbs.	44, 900 lbs

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

F

Sequence of Operations

The aircraft is taxied onto the active runway, brakes are set for holding and flaps are extended 20 degrees. After the runup check is performed with the engines at take-off rpm, the brakes are released for take-off.

Tıme

Taxi onto runway, engine runup check, and apply take-off power 0 3 to 0.5 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 64, 500 pounds) 100 V2 (at maximum gross weight of 64, 500 pounds) 115

Distance

Take-off (see Table I)
Abort 2,820 feet
Refusal distance (see abort)

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The aircraft is taxied onto the active runway, brakes are set for holding and flaps are extended 20 degrees. The engines are runup to take-off rpm, and brakes are released for take-off.

Tıme

Engine runup check 0 1 to 0 2 minute
Taxi onto runway, and apply take-off power 0 2 to 0 6 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 69,000 pounds) 102 V2 (at maximum gross weight of 69,000 pounds) 115

Distance

Take-off (see Table I)
Abort 1,810 feet
Refusal distance (see abort)

T/O Dist, and Time Deviations per 10° C Dev, 1,000 Ft Alt Dev	7 0% 8 0%	T/O Dist, and Time Deviation for Weight 5,000 Lbs 5,000 Lbs Over MGW Under MGW	applicable Runway Gradient Deviation per 1% Slope Not available from operator
N A S.A. Sea Level Standard Day T/O Dist	0 7 min	n 5,000 Lbs Under MGW 3 4%	nd Time //ATO cable
N A S.A. Sea Le T/O Dist	3,890 ft.	Lift-Off Speed Deviation 5,000 Lbs 5,0 Over MGW Uno	applicable T/O Dist and Time Deviation w/ATO Not applicable
Lift-Off Speed (V2) (IAS)	115 kts.	115 kts	115 kts.
Lift-Off Maximum Gross Speed (V2) Weight (LAS)	69,000 lbs	69, 000 lbs	69,000 lbs

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by $100\,$)

Volumes I-A through IX

SECTION 3

GENERAL AVIATION

containing data on

Aero Commander 500 Cessna 180 (Amphibian)

Aero Commander 680 (L-26C) Cessna 182

Aero Commander 720 Cessna 310A (L-27A)

Beechcraft "Bonanza" K-35 Cessna 310C

Beechcraft "Twin Bonanza" (L-23D) de Havilland "Beaver" (L-20A)

Beechcraft Model 95 de Havilland "Otter" (U-1A)

Beechcraft Super 18 Mooney Mark 20A

Cessna 150 Piper "Tri-Pacer" PA-22

Cessna 172 Piper "Apache" PA-23

Cessna 175 Piper "Comanche" PA-24-180

(date of latest revision September 1, 1959)

UNITED STATES FEDERAL AVIATION AGENCY
Bureau of Research & Development Washington 25, D.C.

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 10 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

$T_{1}me$

Engine runup check 2 to 4 minutes
Taxi onto runway, and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 6,000 pounds) 69 V2 (at maximum gross weight of 6,000 pounds) 83

Distance

Take-off (see Table I)
Abort 1,100 feet
Refusal distance (see abort)

Maxımum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S A. Sea Le T/O Dist.	vel Standard Day T/O Time	•	me Deviations per ,000 Ft Alt. Dev
6,000 lbs	83 kts	1,645 ft.	0 4 min	Not available fi	rom manufacturer
6,000 lbs.	83 kts	Lift-Off Sp Deviatio 200 Lbs Over MGW Not applicable		T/O Dist. a Deviation for 200 Lbs Over MGW Not applicable	or Weight 200 Lbs. Under MGW
6,000 lbs	83 kts	T/O Dist. ar Deviation w Not applica	/ATO	Runway C Deviation pe	

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are usually extended 10 degrees for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check, 1 0 to 3 0 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 7,000 pounds) Not available from manufacturer
V2 (at maximum gross weight of 7,000 pounds) 78

Distance

Take-off (see Table I)
Abort Not available from operator
Refusal distance Not available from operator

TABLE I, TAKE-OFF

Maxımum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A S A. Sea Le T/O Dist.	vel Standard Day T/O Time	·	ime Deviations per ,000 Ft Alt Dev
7,000 lbs	78 kts	1,250 ft	0 3 min	8 0%	7 5 %
7,000 lbs	78 kts	Lift-Off Sp Deviation 100 Lbs. Over MGW Not applicable	n 100 Lbs Under MGW Not available from operators		or Weight 100 Lbs. Under MGW Not available from operators
		T/O Dist an Deviation w		Runway C Deviation pe	
7,000 lbs	78 kts	Not applicable Not available from op		from operators	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 10 degrees for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check. 1.0 to 3 0 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at a maximum gross weight of 7, 500 pounds) 81 V2 (at a maximum gross weight of 7, 500 pounds). 86

Distance

Take-off (see Table I)
Abort 510 feet
Refusal distance. (see abort)

T/O Dist and Time Deviations per 10° C Dev 1,000 Ft. Alt. Dev.	9%6	T/O Dist, and Time Deviation for Weight 500 Lbs. 500 Lbs. er MGW Under MGW applicable Not available from manufacturer Runway Gradient Deviation per 1% Slope	Not avaılable from manufacturer
T/O Dist and T 10° C Dev	6%	T/O Dist. Deviation 500 Lbs. Over MGW Not applicable Runway Deviation po	Not available fr
A S.A. Sea Level Standard Day O Dist.	0.3 mm.	beed 500 Lbs Under MGW Not available from manufacturer ATO	able
N.A S.A. Sea Le T/O Dist.	1, 190 ft.	Lift-Off Speed Deviation 500 Lbs 500 Over MGW Under Not applicable Not av fro manufa T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	86 kts	86 kts	86 kts.
Lift-Off Maximum Gross Speed (V2) Weight (IAS)	7, 500 lbs.	7, 500 lbs.	7, 500 lbs

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are retracted for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for takeoff.

T_{1} me

Engine runup check 1 0 to 2 0 minutes

Taxi onto runway and apply take-off power 15 to 20
seconds

Take-Off (see Table I)

Speed (knots IAS)

VI (at maximum gross weight of 2, 950 pounds) 52 V2 (at maximum gross weight of 2, 950 pounds) 56

Distance

Take-off (see Table I)
Abort 1,000 feet
Refusal Distance (see abort)

TABLE I, TAKE-OFF

	L1ft-Off				
$\operatorname{Maximum} Gross$	Speed (V2)	N.A.S A Sea Le	evel Standard Day	T/O Dist and T	Ime Deviation per
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev	1,000 Ft Alt. Dev.
2,950 lbs	56 kts	1,346 ft	0 5 min	2 7%	3 9%
		Lıft-Off Sp		T/O Dist.	
		Deviatio			for Weight
		100 Lbs	100 Lbs.	$100~{ m Lbs}$	100 Lbs
		Over MGW	Under MGW	Over MGW	Under MGW
2,950 lbs	56 kts	Not applicable	Not available from manufacturer	Not applicable	Not available from manufacturer
		T/O Dist ar	nd Time	Runway	Gradient
		Deviation w	/ATO	Deviation po	er 1% Slope
2,950 lbs	56 kts	Not applic	Not applicable Not available from manufactur		om manufacturer

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended as required. After taxiing onto the runway, there is no hesitation for any further check and power is applied for takeoff.

Tıme

```
Engine runup check 1 0 to 3 0 minutes
Taxi onto runway and apply take-off power 3 to 5
seconds
Take-off (see Table I)
```

Speed (knots IAS)

```
V1 (at any gross weight) 81
V2 (at any gross weight) 91
```

Distance

```
Take-off (see Table I)
Abort 1,320 feet
Refusal distance (see abort)
```

TABLE I, TAKE-OFF

	L1ft-Off				
Maximum Gross	Speed (V2)	N A.S.A. Sea L	evel Standard Day	T/O Dist and T	Time Deviations per
Weight	(IAS)	T/O Dist	T/O Time	10° ¢ Dev	1,000 Ft Alt Dev.
7,000 lbs	91 kts	1,270 ft	0 3 min	6%	6%
		Lift-Off S	=	T/O Dist.	
		Deviation			for Weight
		500 Lbs	500 Lbs	$500 \mathrm{Lbs}$	·
		Over MGW	Under MGW	Over MGW	Under MGW
7,000 lbs	91 kts	Not applicable	e Negligible	Not applicable	16%
		T/O Dist a Deviation v		Runway Deviation pe	Gradient er 1% Slope
7,000 lbs	91 kts	Not applicable		Not available	from operators

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 2 0 to 4 0 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-Off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 4,000 pounds) 61 V2 (at maximum gross weight of 4,000 pounds) 74

Distance

Take-Off (see Table I) Abort 2,265 feet Refusal Distance (See Abort)

T/O Dist and Time Deviations per $10^{\rm o}$ C Dev	10%	T/O Dist, and Time Deviation for Weight 100 Lbs. Over MGW Under MGW Not applicable Not available from manufacturer Runway Gradient Deviation per 1% Slope	Not available from manufacturer
T/O Dıst 10° C Dev	4%	Not.	No
N.A.S.A. Sea Level Standard Day T/O Dist	2,000 ft 0 5 minute	Lift-Off Speed Deviation 100 Lbs 100 Lbs Over MGW Under MGW Not applicable Not available from manufacturer T/O Dist, and Time Deviation w/ATO Dev. per 100 lbs. Dist Time	Not applicable
Luft-Off Speed (V2) (LAS)	74 kts	74 kts.	74 kts
Lift-Off Maximum Gross Speed (V2) Weight (LAS)	4,000 lbs.	4,000 lbs	4,000 lbs.

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting divide all percentage values by 100)

)

1 ``

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are fully retracted for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 2 0 to 4.0 minutes
Taxi onto runway, and apply take-off power 0 3 to 0 5 minute
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 9, 700 pounds) 78 V2 (at maximum gross weight of 9, 700 pounds) 87

Distance

Take-off (see Table I)
Abort 1,580 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A Sea I T/O Dist	Level Standard Day T/O Time	· _	Time Deviations per 1,000 Ft. Alt. Dev
9,700 lbs	87 kts.	1,800 ft	0 4 min	6 0%	8 0%
		Lift-Off S Deviati 100 Lbs Over MGW	on 100 Lbs.	•	•
9,700 lbs.	87 kts		Not available from manufacturer	Not applicable	Not available from manufacturer
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
9,700 lbs	87 kts	Not applicable		Not available from manufacturer	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 1 0 to 2.0 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2, 200 pounds) 50 V2 (at maximum gross weight of 2, 200 pounds) 60

Distance

Take-off (see Table I)
Abort 1,115 feet
Refusal distance (see abort)

fime Deviations per 1, 000 Ft. Alt. Dev.)%	d Time Weight 300 Lbs. Under MGW 29 0% adient	facturer
d Time Dev 1, 000 Ft	1 0%	for Gr	from manu
T/O Dist and Time Deviations per 10° C Dev	7 2%	T/O Dist Deviation 300 Lbs. Over MGW Not applicable Runway Deviation I	Not available from manufacturer
N.A.S.A. Sea Level Standard Day T/O Dist.	0 3 min	peed 300Lbs Under MGW 10.0% nd Time	cable
N.A.S.A. Sea Le T/O Dist.	725 ft	Lift-Off Speed Deviation 300 Lbs. 300 Over MGW Under Not applicable 10.C T/O Dist, and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	60 kts	60 kts	60 kts
Maxımum Gross Weight	2, 200 lbs	2, 200 lbs.	2, 200 lbs

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 1 0 to 2 0 minutes
Taxi onto runway, and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2, 350 pounds) 49 V2 (at maximum gross weight of 2, 350 pounds) 52

Distance

Take-off (see Table I)

Abort Not available from manufacturer

Refusal distance Not available from manufacturer

	Lift-Off				
Maxımum Gross Speed (V2)		N A S A. Sea Level Standard Day		T/O Dist. and Time Deviations per	
Weight	(IAS)	T/O Dist	T/O Time	10° C Dev 1	,000 Ft Alt Dev
2,350 lbs	52 kts	735 ft	0 3 min	7.5%	8 1%
		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		100 Lbs		100 Lbs.	100 Lbs.
		Over MGW	Under MGW	Over MGW	Under MGW
2,350 lbs	52 kts	Not applicable	2 2%	Not applicable	9 4%
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
2, 350 lbs	52 kts.	Not applicable		Not available from manufacturer	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed at the mooring point. The flaps are extended 20 degrees for take-off. After taxiing to the take-off position, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 1 to 2 minutes

Taxi to take-off position, and apply take-off power 3 to 5 seconds

Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2, 850 pounds) not applicable V2 (at maximum gross weight of 2, 850 pounds) 60

Distance

Take-off (see Table I)
Abort not applicable
Refusal distance not applicable

TABLE I, TAKE-OFF (Water Take-Off)

	L1ft-Off				
Maximum Gross Speed (V2)		N.A.S.A. Sea Level Standard Day		T/O Dist and Time Deviations per	
Weight	(IAS)	T/O Dist	T/O Tıme	10° C Dev	1,000 Ft Alt. Dev
2,850 lbs.	60 kts	1,345 ft	0.4 min.	8.0%	9.0%
		Lıft-Off Speed		T/O Dist. and Time	
		Deviation		Deviation for Weight	
		250 Lbs	250 Lbs	250 Lbs.	250 Lbs.
		Over MGW	Under MGW	Over MGW	Under MGW
2,850 lbs	60 kts	Not applicable	Negligible	Not applicable	19.0%
		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope	
		ECVIEUTOTI W	,111	Deviation per 1/0 blope	
2,850 lbs	60 kts.	Not applicable		Not applicable	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

$T_{1}me$

Engine runup check 1 to 2 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2,650 pounds) 61 V2 (at maximum gross weight of 2,650 pounds). 61

Distance

Take-off (see Table I)

Abort not available from manufacturer

Refusal distance not available from manufacturer

T/O Dist and Time Deviations per 10° C Dev. 1,000 Ft Alt Dev.	10%	T/O Dist. and Time Deviation for Weight 250 Lbs 250 Lbs. Over MGW Under MGW Not applicable 20%	Runway Gradient Deviation per 1% Slope	Not available from manufacturer
	uıı	z		No
evel Standard Day T/O Tıme	0 3 mm	peed nn 250 Lbs. Under MGW Negligable	nd Time /ATO	able
N.A S A Sea Level Standard Day T/O Dist. T/O Lime	555 ft	Lift-Off Speed Deviation 250 Lbs 2 Over MGW Und	T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	61 kts	61 kts		61 kts
Maxımum Gross Weıght	2, 650 lbs	2, 650 lbs		2, 650 lbs

(The values above are to be substituted in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 15 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 1 to 3 minutes

Taxi onto runway and apply take-off power 3 to 5 seconds

Speed (knots IAS)

```
V1 (at maximum gross weight of 4,830 pounds) 85
V2 (at maximum gross weight of 4,830 pounds) 97
```

Distance

```
Take-off (see Table I)
Abort. 1,850 feet
Refusal distance (see abort)
```

TABLE I, TAKE-OFF

ons per Alt, Dev.	70	, An	.0		
Ime Deviations per 1,000 Ft Alt. Dev.	0.9%	T/O Dist. and Time Deviation for Weight 0 Lbs. 400 Lbs. r MGW Under MGW	22.0%	Runway Gradient Deviation per 1% Slope	ıble fr o m ırer or tors
$ m T/O~Dist.$ and Time Deviations per $10^{ m O}~C~Dev$	0.6%	T/O Dist. Deviation 400 Lbs. Over MGW	Not applicable	Runway Deviation p	Not available from manufacturer or operators
N. A. S. A. Sea Level Standard Day T/O Dist. T/O Time	0 2 min,	Speed tion 400 Lbs Under MGW	None	T/O Dist. and Time Deviation w/ATO	Not applıcable
N. A. S. A. Sea] T/O Dist.	720 ft	Laft-Off Speed Deviation 400 Lbs 400 Over MGW Under	Not applicable	T/O Dıst Devatıc	Not ap
Laft-Off Speed V2 (IAS)	97 kts.		97 kts		97 kts
Maxımum Gross Weıght	4,830		4, 830		4,830

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 15 degrees for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

$T_{1}me$

Engine runup check 2 0 to 4 0 minutes

Taxi onto runway and apply take-off power 0 3 to 0 5 minute

Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 4, 830 pounds) 77 V2 (at maximum gross weight of 4, 830 pounds) 86

Distance

Take-off (see Table I)
Abort 2,390 feet
Refusal distance (see abort)

TABLE I, TAKE-OFF

Maxımum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Le T/O Dist	evel Standard Day T/O Time		Time Deviations per 1,000 Ft Alt Dev
4,830 lbs	86 kts	800 ft	0 2 min.	10%	8%
		Lift-Off Sp Deviatio 400 Lbs Over MGW	n 400 Lbs	T/O Dist. Deviation : 400 Lbs Over MGW	
4,830 lbs	86 kts	Not applicable	5%	Not applicable	11%
		T/O Dist ar Deviation w		Runway (Deviation pe	
4,830 lbs	86 kts.	Not applica	able	Not avaılable manufactu	

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 35 degrees for take-off. After taxing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 0 5 to 1 5 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

```
V1 (at normal gross weight of 4, 800 pounds) 53
V2 (at normal gross weight of 4, 800 pounds) 56
```

Distance

Take-off (see Table I)
Abort 500 feet
Refusal distance (see abort)

e v						
$ m T/O~Dist~$ and Time Deviations per $10^{\rm O}$ C Dev. 1,000 Ft Alt. Dev	3 8%	T/O Dist, and Time Deviation for Weight	400 Lbs. Under NGW	16 0%	Runway Gradient Deviation per 1% Slope	Not available from operators
T/O Dist and 10° C Dev.	0%0 2	T/O Dis	300 Lbs Over NGW	%0 6	Runway	Not available operators
.A S A. Sea Level Standard Day /O Dist	0 3 min.	ipeed on	400 Lbs Under NGW	7 0%	nd Tıme #/ATO	.ble
N.A S A. Sea I T/O Dist	504 ft.	Lift-Off Speed Deviation	300 Lbs Over NGW	4 0%	T/O Dist and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (LAS)	56 kts			56 kts		56 kts
rmal Gross Weight	800 lbs.			800 lbs		800 lbs

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended to "take-off" position for take-off. After taxiing onto the runway and aligning, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 2.0 to 3.0 minutes
Taxi onto runway and apply take-off power 5 to 10 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 8,000 pounds) not applicable V2 (at maximum gross weight of 8,000 pounds) 63

Distance

Take-off (see Table I)
Abort 655 feet
Refusal distance (see abort)

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea L T/O Dist.	evel Standard Day T/O Time	=	Time Deviations per 1,000 Ft Alt. Dev.
8,000 lbs.	63 kts	655 ft	0 2 min.	2 5%	3 0%
		Lift-Off S Deviation 500 Lbs. Over MGW	-	•	and Time for Weight 500 Lbs. Under MGW
8,000 lbs	63 kts	Not applicable	3 0%	Not applicable	12.0%
		T/O Dist. a Deviation v			Gradient er 1% Slope
8,000 lbs.	63 kts	Not applica	able	Negl	ıgable

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for normal take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 1 to 3 minutes
Taxi onto runway, and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2, 450 pounds) 50 V2 (at maximum gross weight of 2, 450 pounds) 60

Distance

Take-off (see Table I)

Abort Not available from manufacturer.

Refusal distance Not available from manufacturer

Maxımum G ross Weıght	Lift-Off Speed (V2) (IAS)	N.A.S A. Sea Level Standard Day T/O Dist	rel Standard Day T/O Tıme	T/O Dist and Time Deviations per $10^{\rm o}$ C Dev. 1,000 Ft Alt. Dev
2, 450 lbs.	60 kts.	600 ft.	0.3 min	Not available from manufacturer
2, 450 lbs	60 kts	Lift-Off Speed Deviation 50 Lbs Over MGW Under Not applicable T/O Dist and Time Deviation w/ATO	Speed 10n 50 Lbs Under MGW Not available from manufacturer and Time w/ATO	T/O Dist. and Time Deviation for Weight 50 Lbs 50 Lbs. Over MGW Under MGW Not applicable Not available from manufacturer Runway Gradient Deviation per 1% Slope
2, 450 lbs.	60 kts	Not applicable	ole	Not available from manufacturer

Ę (The values above are to be substituted directly in the take-off equations in the appendix. substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. Flaps are fully retracted for normal take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off. Flaps may be extended before take-off speed is reached for maximum performance take-off.

Tıme

Engine runup check 1.0 to 2.0 minutes

Taxi onto runway and apply take-off power: 3 to 5 seconds

Take-off. (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 2,000 pounds) Not applicable V2 (at maximum gross weight of 2,000 pounds) 70

Distance

Take-off: (see Table I)

Abort. Not available from manufacturer.

Refusal distance. Not available from manufacturer.

TABLE I, TAKE-OFF

	Lift-Off	N A C A C I	1 Chaudand Day	T/O D -4 - 3 5	n D
Maxımum Gross Weight	(IAS)	T/O Dist	Level Standard Day T/O Time		Time Deviations per 1,000 Ft. Alt. Dev.
2,000 lbs	70 kts.	1,120 ft	0 3 min	Not available	from manufacturer
		Lıft-Off S Devıatı	•	•	and Time for Weight
		100 Lbs.	100 Lbs.	100 Lbs.	100 Lbs.
		Over MGW	Under MGW	Over MGW	Under MGW
		Not	Not avaılable	Not	Not available
2,000 lbs	70 kts.	Applicable	from operator	Applicable	from operator
		T/O Dist a		•	Gradient
		Deviation v	w/ATO	Deviation p	er 1% Slope
2,000 lbs.	70 kts.	Not applica	able	Not available fro	om manufacturer

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100.)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Time

Engine runup check 2 0 to 4 0 minutes
Taxi onto runway, apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

V1 (at maximum gross weight of 3,800 pounds) 57 V2 (at maximum gross weight of 3,800 pounds) 65

Distance

Take-off: (see Table I)

Abort Not available from manufacturer

Refusal distance Not available from manufacturer

T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt. Dev	25%	T/O Dist, and Time Deviation for Weight 10 Lbs 300 Lbs. rr MGW Under MGW	29%	Runway Gradient Deviation per 1% Slope	Not available from manufacturer
T/O Dist and 10° C Dev	Not avaılable from manufacturer	T/O Dist. Deviation 300 Lbs Over MGW	Not applicable	Runway Deviation p	Not a from ma
A.S.A. Sea Level Standard Day O Dist. T/O Time	0.4 mm fr	Speed non 300 Lbs Under MGW	Not applicable Not available from manufacturer	and Time w/ATO	sable
N.A.S.A. Sea T/O Dist.	1, 190 ft.	Lift-Off Speed Deviation 300 Lbs 3 Over MGW Un	Not applicabl	T/O Dist. and Time Deviation w/ATO	Not applicable
Lift-Off Speed (V2) (IAS)	65 kts		65 kts		
Maxımum Gross Weıght	3, 800 lbs		3,800 lbs		

(The values above are to be substituted directly in the take-off equations in the appendix In substituting, divide all percentage values by 100)

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are in the retracted position for take-off. After taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off.

Tıme

Engine runup check 1 to 3 minutes
Taxi onto runway and apply take-off power 3 to 5 seconds
Take-off (see Table I)

Speed (knots IAS)

VI (at maximum gross weight of 2,550 pounds) 60 V2 (at maximum gross weight of 2,550 pounds) 70

Distance

Take-off (see Table I)
Abort 600 feet
Refusal distance (see abort)

Maxımum Gross Weıght	Lift-Off Speed (V2) (IAS)	N,A S A, Sea Le T/O Dıst	N.A S A. Sea Level Standard Day T/O Dıst	T/O Dist and Time Deviations per 10° C Dev 1,000 Ft Alt Dev.
2, 550 lbs.	70 kts.	750 ft.	0.2 min.	Not available from manufacturer
2, 550 lbs	70 kts	Lift-Off Speed Deviation Lbs Over MGW Under Not applicable Not av from ma	peed on Lbs Under MGW Not available from manufacturer.	T/O Dist. and Time Deviation for Weight Lbs. Over MGW Under MGW Not applicable 8.5% Runway Gradient
2, 550 lbs.	70 kts.	Deviation w/ATO Not applicable	/ATO cable	Deviation per 1% Slope Not available from manufacturer

(The values above are to be substituted directly in the take-off equations in the appendix. In substituting, divide all percentage values by 100.)