UNITED STATES
FEDERAL AVIATION AGENCY

AIR VEHICLE PERFORMANCE CHARACTERISTICS

Volume II

TAKE-OFF

FOR

BUREAU OF RESEARCH & DEVELOPMENT
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BY

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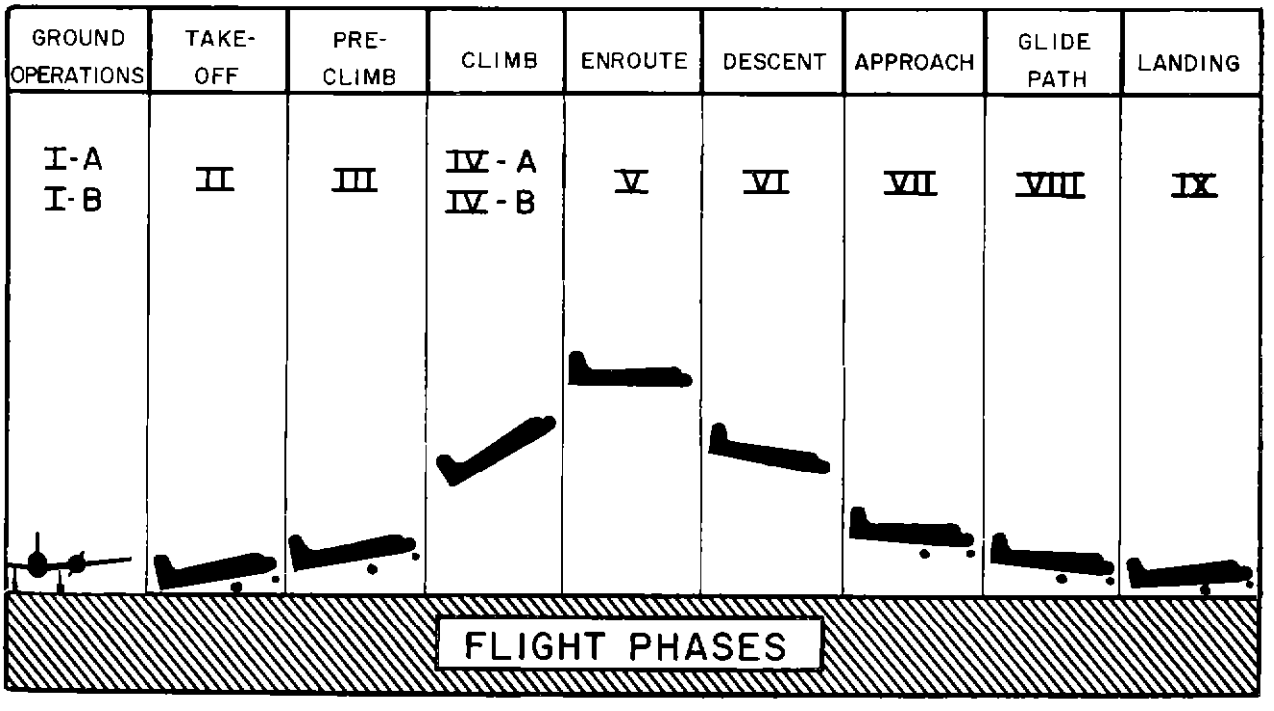
AIR VEHICLE PERFORMANCE CHARACTERISTICS

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	Classified Military Aircraft (S)
* Volume X-B	Classified Military Aircraft (S)
* Volume XI	Future Aircraft (S)

* 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.



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AIR VEHICLE PERFORMANCE CHARACTERISTICS

MASTER INDEX

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

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MASTER INDEX - (Cont'd)

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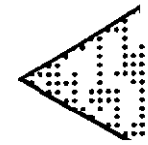

Section 1 - Military Aircraft

Section 2 - Commercial Aircraft

Section 3 - General Aviation

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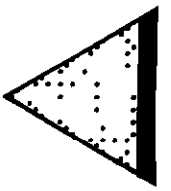
Volumes I-A through IX



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)

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NARRATIVE SUMMARY

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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A.S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
2,950 lbs.	67 kts.	1,100 ft.	0.3 min.	9 1%	9.1%

		Lift-Off Speed Deviation 100 Lbs Over MGW	100 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 100 Lbs. Over MGW	100 Lbs. Under MGW
2,950 lbs	67 kts.	Not applicable	1.5%	Not applicable	8.4%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,950 lbs.	67 kts	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)

NARRATIVE SUMMARY

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.

Time

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.

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day to Clear 50 Feet T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev.	1,000 Ft. Alt. Dev.
2,350 lbs.	15 kts.	400 ft.	*12 sec.	10%	10%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		100 Lbs. Over NGW	100 Lbs. Under NGW	100 Lbs. Over NGW	100 Lbs. Under NGW
2,350 lbs	15 kts.	none	none	10%	10%

* Speed at 50 feet altitude is 40 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)

NARRATIVE SUMMARY

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)

*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)	N A.S A. Sea Level Standard Day to Clear 50 Feet T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10°C Dev	1,000 Ft. Alt. Dev
5,800 lbs	30 kts	600 ft	*14 sec	5%	5%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		500 Lbs Over NGW	500 Lbs Under NGW	500 Lbs. Over NGW	500 Lbs. 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)

NARRATIVE SUMMARY

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.

Time

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.

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 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 Deviation 10,000 Lbs Over NGW	10,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs. Over NGW	10,000 Lbs. Under NGW
192,000 lbs.	175 kts.	2.5%	3.1%	14.0%	11.0%

		T/O Dist and Time Deviation w/ATO Dev. per 10,000 Lbs. Dist.	Time	Runway Gradient Deviation per 1% Slope
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.)

NARRATIVE SUMMARY

Sequence of Operations

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

Time

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 Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 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 10,000 Lbs Over MGW	10,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs Over MGW	10,000 Lbs. Under MGW
175,000 lbs	125 kts	Not applicable	5%	Not applicable	20%

		T/O Dist and Time Deviation w/ATO	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)

NARRATIVE SUMMARY

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

Time

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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	N.A.S.A. Sea Level Standard Day T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	T/O Dist. and Time Deviations per 1,000 Ft. Alt. Dev.
258,000 lbs	162 kts	7,100 ft.	0.9 min.	8.8%	8 9%

		Lift-Off Speed Deviation 10,000 Lbs Over NGW	Lift-Off Speed Deviation 10,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs. Over NGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs. 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 applicable	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.)

NARRATIVE SUMMARY

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

Time

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	per 1,000 Ft. Alt. Dev.
2,400 lbs.	38 kts	520 ft	0.3 min.	15 5%	14 5%

		Lift-Off Speed Deviation 300 Lbs Over MGW	300 Lbs. Under MGW	T/O Dist. and Time Deviation for Weight 300 Lbs. Over MGW	300 Lbs. Under MGW
2,400 lbs	38 kts	Not applicable	7 0%	Not applicable	26 0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,400 lbs.	38 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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are usually 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 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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 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 Deviation 100 Lbs Over MGW	100 Lbs. Under MGW	T/O Dist. and Time Deviation for Weight 100 Lbs Over MGW	100 Lbs Under MGW
2,400 lbs	54 kts	Not applicable	2 5%	Not applicable	12 5%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 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.)

NARRATIVE SUMMARY

Sequence of Operations

After taxiing 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.

Time

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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
6,400 lbs	88 kts.	1,610 ft	0 4 min	3.0%	6 8%

		Lift-Off Speed Deviation 400 Lbs Over MGW	400 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 400 Lbs. Over MGW	400 Lbs. Under MGW
6,400 lbs	88 kts	Not applicable	3 6%	Not applicable	Not available from operators

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
6,400 lbs.	88 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.)

NARRATIVE SUMMARY

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 taxiing onto the runway, there is no hesitation for any further check and power is applied for take-off

Time

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)

V1 (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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev		1,000 Ft. Alt Dev
40,000 lbs.	113 kts.	2,200 ft.	0.4 min.	Plus 3.6%	Minus 1.8%	6.2%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		2,000 Lbs Over NGW	2,000 Lbs Under NGW	2,000 Lbs Over NGW	2,000 Lbs. 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.)

NARRATIVE SUMMARY

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

Time

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10^{o} C Dev	1,000 Ft Alt Dev
48,550 lbs	112 kts	2,800 ft	0 5 min.	4 0%	3 6%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		2,000 Lbs Over MGW	2,000 Lbs Under MGW	2,000 Lbs. Over MGW	2,000 Lbs. Under MGW
48,550 lbs	112 kts	Not applicable	1 8%	Not applicable	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)

NARRATIVE SUMMARY

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
43,000 lbs	115 kts	2,750 ft	0 4 min.	9 1%	7.3%

		Lift-Off Speed Deviation 1,000 Lbs. Over NGW	1,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs Over NGW	1,000 Lbs. Under NGW
43,000 lbs	115 kts	1 3%	1 7%	5 5%	5.5%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
43,000 lbs	115 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)

NARRATIVE SUMMARY

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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
50,000 lbs	95 kts.	2,800 ft	0 6 min.	Not available from operator.	

		Lift-Off Speed Deviation 200 Lbs. Over MGW	200 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 200 Lbs. Over MGW	200 Lbs. Under MGW
50,000 lbs.	95 kts	Not applicable	None	Not applicable	4 6%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
50,000 lbs	95 kts	Not applicable	Not available from operator

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

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 20 degrees for take-off After taxiing 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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev
170,000 lbs	107 kts	3,100 ft.	0 6 min	8 1%	8 9%

		Lift-Off Speed Deviation 10,000 Lbs Over NGW	10,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs. Over NGW	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 applicable	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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is 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

Time

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
275,000 lbs.	119 kts	4,400 ft.	0.7 min	9.0%	9.0%

		Lift-Off Speed Deviation 10,000 Lbs Over MGW	10,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs Over MGW	10,000 Lbs. Under MGW
275,000 lbs.	119 kts	Not applicable	2.0%*	Not available from operator	8.0%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
275,000 lbs.	119 kts.	Not available from operator	8 0%

*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.)

NARRATIVE SUMMARY

Sequence of Operations

After taxiing 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

Time

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 Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
75,000 lbs.	150 kts.	5,800 ft	0.8 min	10.4%	9.1%

		Lift-Off Speed Deviation 5,000 Lbs Over NGW	5,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 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	Runway Gradient Deviation 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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are used as required for take-off. After taxiing 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.

Time

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev Plus	Minus	1,000 Ft Alt. Dev.
65,000 lbs	102 kts	2,350 ft	0 5 min	9%	6%	7%

		Lift-Off Speed Deviation 1,000 Lbs. Over NGW	1,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs Over NGW	1,000 Lbs. Under NGW
65,000 lbs.	102 kts	0 8%	0 9%	4.5%	4 0%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
65,000 lbs.	102 kts	Not applicable	6.4%

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

NARRATIVE SUMMARY

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.

Time

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)

TABLE I, TAKE-OFF
(Normal, Dry Power, No Flaps)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A.S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev	1,000 Ft Alt Dev
54,000 lbs	100 kts	2,500 ft	0 5 min	8%	8%

		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	5,000 Lbs. Under NGW
54,000 lbs	100 kts.	5%	5%	25%	20%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation 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)

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	N.A.S.A. Sea Level Standard Day T/O Time	T/O Dist and Time Deviations per 10° C Dev	T/O Dist and 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 5,000 Lbs Over NGW	Lift-Off Speed Deviation 5,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs. Over NGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs. Under NGW
54,000 lbs	76 kts.	5.0%	5.0%	26 0%	22.3%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
54,000 lbs.	76 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.)

NARRATIVE SUMMARY

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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	1,000 Ft. Alt. Dev.
66,800 lbs	44 kts.	1,800 ft	0 8 min.	10 0%	10 0%

		Lift-Off Speed Deviation 1,000 Lbs. Over NGW	1,000 Lbs. Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. 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.)

NARRATIVE SUMMARY

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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft. Alt Dev
90,000 lbs	45 kts.	2,000 ft.	0.9 min.	10%	10%

		Lift-Off Speed Deviation 1,000 Lbs Over MGW	1,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs Over MGW	1,000 Lbs Under MGW
90,000 lbs	45 kts	Not applicable	3.9%	Not applicable	5%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
90,000 lbs	45 kts.	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)

NARRATIVE SUMMARY

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

Time

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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
30,000 lbs	77 kts.	1,470 ft	0.4 min.	8.2%	11.2%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		1,000 Lbs Over NGW	1,000Lbs Under NGW	1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
30,000 lbs	77 kts	2%	2%	10.5%	7 5%

		T/O Dist and Time Deviation w/ATO Dev. 2,000 Lbs.		Runway Gradient Deviation per 1% Slope
30,000 lbs	77 kts.	25.2%	26.3%	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.)

NARRATIVE SUMMARY

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

Time

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
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)

TABLE I, TAKE-OFF

(6 engines, wet power)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev
170,000 lbs.	126 kts.	4,100 ft.	0.65 min.	Plus 12 2%	Minus Negligible 9.8%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		*3,000 Lbs Over NGW	10,000 Lbs Under NGW	*3,000 Lbs. Over NGW	10,000 Lbs. Under NGW
170,000 lbs	126 kts.	1.2%	3.2%	5.9%	12 2%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
170,000 lbs.	126 kts.	Not applicable	Not available 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)

NARRATIVE SUMMARY

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

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 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

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day to Clear 50 Feet T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev.
2,700 lbs	15 kts.	400 ft	*12 sec	10 0%	10 0%

		Lift-Off Speed Deviation 250 Lbs Over MGW	250 Lbs. Under MGW	T/O Dist. and Time Deviation for Weight 250 Lbs. Over MGW	250 Lbs. Under MGW
2,700 lbs	15 kts	Not applicable	none	Not applicable	10 0%

*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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 60 percent 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 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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
133,000 lbs	121 kts	3,650 ft	1 0 min	2 7%	2 7%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		10,000 Lbs Over NGW	10,000 Lbs Under NGW	10,000 Lbs. Over NGW	10,000 Lbs Under NGW
133,000 lbs	121 kts	3 3%	4 1%	22 0%	14 0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
133,000 lbs	121 kts	Not applicable	5.5%

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

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 18 degrees 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.

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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
120,000 lbs.	106 kts.	2,400 ft	0 5 min.	Plus 18 0% Minus 10 0%	10.0%

		Lift-Off Speed Deviation 4,000 Lbs Over NGW	10,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 4,000 Lbs. Over NGW	10,000 Lbs. Under NGW
120,000 lbs	106 kts	1 3%	5.4%	4.1%	13 5%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
120,000 lbs.	106 kts.	Not applicable	6 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.)

NARRATIVE SUMMARY

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

Time

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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S A Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev
16,650 lbs	130 kts	2,500 ft	0 4 min	10%	9.2%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		1,000 Lbs Over MGW	1,000 Lbs Under MGW	1,000 Lbs Over MGW	1,000 Lbs. Under MGW
16,650 lbs	130 kts	Not applicable	2.7%	Not applicable	13 8%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation 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)

NARRATIVE SUMMARY

Sequence of Operations

After taxiing 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

Time

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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
15,100 lbs.	120 kts.	3,000 ft.	0.5 min	13 4%	10 0%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		1,000 Lbs. Over NGW	1,000 Lbs Under NGW	1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
15,100 lbs	120 kts.	2 8%	2 8%	16 6%	14 0%

		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope
		Dist	Time	
15,100 lbs.	120 kts	38.0%	62 0%	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)

NARRATIVE SUMMARY

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	1,000 Ft. Alt. Dev.
55,000 lbs.	142 kts.	5,000 ft.	0.7 min.	18.6%	12 0%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		2,000 Lbs Over NGW	5,000 Lbs. Under NGW	2,000 Lbs. Over NGW	5,000 Lbs. Under NGW
55,000 lbs.	142 kts.	2.5%	6 2%	7.6%	19.0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
55,000 lbs.	142 kts	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.)

TABLE I, TAKE-OFF
(Maximum Power)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A.S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	1,000 Ft Alt. Dev
18,500 lbs.	125 kts	2,600 ft	0 5 min	7 0%	12.0%

		Lift-Off Speed Deviation 1,000 Lbs Over NGW	1,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
18,500 lbs	125 kts	2.4%	3.0%	13 5%	10 2%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
18,500 lbs	125 kts	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)

NARRATIVE SUMMARY

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

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 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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10^{o} C Dev	1,000 Ft Alt Dev
28,000 lbs	105 kts.	2,225 ft	0 4 min	5 5%	6 4%

		Lift-Off Speed Deviation		T/O Dist and Time Deviation for Weight	
		1,000 Lbs Over NGW	1,000 Lbs Under NGW	1,000 Lbs Over NGW	1,000 Lbs Under NGW
28,000 lbs.	105 kts.	1 8%	1.8%	11 0%	8 5%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
28,000 lbs	105 kts.	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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 9 degrees for take-off. After taxiing 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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev.	1,000 Ft Alt. Dev.
7,400 lbs	75 kts.	1,420 ft.	0.4 min	9.3%	9.9%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		90 Lbs. Over NGW	200 Lbs Under NGW	90 Lbs. Over NGW	200 Lbs. Under NGW
7,400 lbs	75 kts	None		2.9%	6.4%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
7,400 lbs	75 kts	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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 18 degrees for take-off After taxiing 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, 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 Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev.	1,000 Ft Alt Dev.
8,000 lbs	68 kts	645 ft	0 2 min	8 0%	8 7%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		500 Lbs Over NGW	500 Lbs Under NGW	500 Lbs Over NGW	500 Lbs. Under NGW
8,000 lbs	68 kts.	5 9%	4 8%	16 3%	13 8%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
8,000 lbs.	68 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)

NARRATIVE SUMMARY

Sequence of Operations

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

Time

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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	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 1,000 Lbs Over NGW	1,000 Lbs. Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
9,500 lbs	100 kts	5 0%	5 0%	9 0%	9 0%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
9,500 lbs	100 kts	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)

NARRATIVE SUMMARY

Sequence of Operations

After taxiing 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.

Time

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
43,200 lbs.	148 kts.	3,400 ft.	0 5 min	10.3%	9.9%

		Lift-Off Speed Deviation 1,000 Lbs Over NGW	1,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
43,200 lbs.	148 kts.	1.2%	1.2%	5 9%	4 8%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
43,200 lbs	148 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.)

NARRATIVE SUMMARY

Sequence of Operations

After taxiing 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

Time

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 20° Flaps)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
21,000 lbs.	152 kts	3,900 ft	0.5 min	10 3%	9 6%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		1,000 Lbs Over NGW	1,000 Lbs. Under NGW	1,000 Lbs Over NGW	1,000 Lbs. Under NGW
21,000 lbs	152 kts	2 2%	2 3%	11 6%	9%

		T/O Dist and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope
21,000 lbs	152 kts	18%	17%	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)

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
21,000 lbs	150 kts	4,300 ft	0 6 min	9 3%	9 9%

		Lift-Off Speed Deviation 1,000 Lbs Over NGW	1,000 Lbs. Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs Over NGW	1,000 Lbs. Under NGW
21,000 lbs	150 kts	2 2%	2 7%	12 8%	10 5%

		T/O Dist. and Time Deviation w/ATO		Runway Gradient Deviation per 1% Slope
21,000 lbs	150 kts	18%	15 5%	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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the take-off point After runup check is performed, the helicopter is air taxiied 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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	*N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
7,900 lbs.	30 kts	345 ft.	**14 sec.	20%	10%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		500 Lbs Over NGW	500 Lbs. Under NGW	500 Lbs Over NGW	500 Lbs. Under NGW
7,900 lbs.	30 kts.	none	none	15%	10%

* 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.)

NARRATIVE SUMMARY

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.

Time

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)	*N. A. S. A. Sea Level Standard Day to Clear 50 Feet T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10°C Dev	1,000 Ft. Alt Dev.
12,000 lbs.	30 kts.	500 ft	** 12 seconds	5%	25%

		Lift-Off Speed Deviation		T/O Dist and Time Deviation for Weight	
		1,000 Lbs Over NGW	1,000 Lbs Under NGW	1,000 Lbs Over NGW	1,000 Lbs. Under NGW
12,000 lbs.	30 kts.	none	none	25%	20%

* 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.

** 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.)

NARRATIVE SUMMARY

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.

Time

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 Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day to Clear 50 Feet T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev.	1,000 Ft. Alt. Dev.
29,431 lbs	30 kts.	500 ft.	*12 sec.	5%	10%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		1,000 Lbs Over NGW	1,000 Lbs Under NGW	1,000 Lbs. Over NGW	1,000 Lbs. 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.)

NARRATIVE SUMMARY

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.

Time

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 Weight	Lift-Off Speed (V2) (IAS)	*N A.S A Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
13,500 lbs.	30 kts.	700 ft.	** 17 sec.	15%	20%

		Lift-Off Speed Deviation 1,000 Lbs Over NGW	1,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. 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.)

AIR VEHICLE PERFORMANCE CHARACTERISTICS

Volumes I-A through IX

SECTION 2

COMMERCIAL AIRCRAFT

containing data on

Boeing B-377

Boeing 707-121

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Douglas DC-3 (C-47, R4D)

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Douglas DC-7

Douglas DC-7B

Douglas DC-7C

Fairchild F-27B

Lockheed Electra 188

Lockheed 1049G

Lockheed 1649A

Martin 404

Vickers Viscount 745D

Vickers Viscount 812

(date of latest revision September 1, 1959)

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

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 25 degrees for take-off After taxiing 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.

Time

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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (LAS)	N A S A. Sea Level Standard Day T/O Dist.	T/O Time	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 10,000 Lbs Over NGW	10,000 Lbs. Under NGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs. Over NGW	10,000 Lbs. Under NGW
120,000 lbs	102 kts	4 9%	3 9%	Not available from operators	

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
120,000 lbs	102 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)

NARRATIVE SUMMARY

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

Time

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev.
226,000 lbs	146 kts	4,500 ft	0 6 min.	Not available from operators	

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		10,000 Lbs Over NGW	10,000 Lbs Under NGW	10,000 Lbs 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 Deviation w/ATO	Runway Gradient Deviation per 1% Slope
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)

NARRATIVE SUMMARY

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 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 check	3 to 4 minutes
Taxi 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

Distance

Take-off	(see Table I)
Abort	1, 770 feet
Refusal distance	(see abort)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N. A. S. A. Sea Level Standard Day Over 50 Foot Obstacle T/O Dist	T/O Time	T/O Dist (Over 50 Foot Obstacle) and Time Deviation per 10^{o} C Dev	1,000 Ft. Alt. Dev
48,000 lbs	109 kts	4,960 ft.	0 9 min	Above 3 6% Below 1.8%	*4 9%

		Lift-Off Speed Deviation 1,000 Lbs Over MGW	1,000 Lbs. Under MGW	T/O Dist. (Over 50 Foot Obstacle) and Time Deviation for Weight 1,000 Lbs. Over MGW	1,000 Lbs. Under MGW
48,000 lbs.	109 kts.	Not applicable	1.4%	Not applicable	3.8%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
48,000 lbs.	109 kts	Not applicable	Uphill 16.0% Downhill 5 4%

* 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)

NARRATIVE SUMMARY

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.

Time

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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
140,000 lbs.	131 kts.	5,320 ft	0.8 min.	9.2%	6 3%

		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	5,000 Lbs. Under NGW
140,000 lbs	131 kts	1.9%	1.9%	8.5%	7 5%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
140,000 lbs.	131 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.)

NARRATIVE SUMMARY

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 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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev
25,346 lbs.	80 kts.	1,900 ft.	0 5 min.	10%	Not available from operator.

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		1,000 Lbs. Over MGW	1,000 Lbs. Under MGW	1,000 Lbs Over MGW	1,000 Lbs. Under MGW
25,346 lbs	80 kts.	Not applicable	Negligable	Not applicable	Not available from operator

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
25,346 lbs	80 kts.	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.)

NARRATIVE SUMMARY

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 a 10 to 20 second hesitation for a further power check and then 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 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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	1,000 Ft. Alt. Dev.
70,000 lbs	103 kts	3,850 ft.	0.8 min	Not available from operators.	

		Lift-Off Speed Deviation 1,000 Lbs Over NGW	1,000 Lbs. Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
70,000 lbs.	103 kts	0.7%	0.7%	4.6%	4.1%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
70,000 lbs.	103 kts	Not applicable	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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 20 degrees for take-off After taxiing 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 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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
90,000 lbs	107 kts	4,100 ft.	0 8 min	Not available from operator	6.7%

		Lift-Off Speed Deviation 5,000 Lbs Over NGW *	5,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs. Over NGW	5,000 Lbs. Under NGW
90,000 lbs	107 kts	2 8%	2.8%	17 0%	13.4%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
90,000 lbs	107 kts	Not applicable	Not available from operator

*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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 20 degrees for take-off After taxiing 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

Time

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 Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft. Alt Dev
100,000 lbs.	113 kts	3,180 ft.	0.6 min	6 3%	7.9%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		*7,000 Lbs. Over NGW	10,000 Lbs. Under NGW	*7,000 Lbs. Over NGW	10,000 Lbs 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)

NARRATIVE SUMMARY

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

Time

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

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
110,000 lbs	120 kts	3,500 ft	0 6 min	5.4%	5.7%

		Lift-Off Speed Deviation 10,000 Lbs Over NGW	10,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 10,000 Lbs Over NGW	10,000 Lbs. Under NGW
110,000 lbs.	120 kts	3 3%	4 2%	21 5%	21.5%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
110,000 lbs	120 kts	Not applicable	7 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)

NARRATIVE SUMMARY

Sequence of Operations

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

Time

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 Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
110,000 lbs	117 kts	3,500 ft	0 6 min	2 5%	4 2%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		10,000 Lbs Over NGW	10,000 Lbs Under NGW	10,000 Lbs Over NGW	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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 20 degrees for take-off. After taxiing 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 Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 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 Over NGW	8,000 Lbs Under NGW	10,000 Lbs Over NGW	8,000 Lbs. Under 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.)

NARRATIVE SUMMARY

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.

Time

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)

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev
34,000 lbs.	91 kts	2,300 ft.	0 5 min	7 0%	6 5%

		Lift-Off Speed Deviation 1,000 Lbs Over NGW	1,000 Lbs Under NGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over NGW	1,000 Lbs. Under NGW
34,000 lbs.	91 kts	2 0%	2 0%	6 5%	7 0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
34,000 lbs.	91 kts	Not applicable	7 0%

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

NARRATIVE SUMMARY

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.

Time

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

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N. A. S. A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev. 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 3,000 Lbs over NGW	10,000 Lbs. under NGW	T/O Dist. and Time Deviation for Weight 3,000 Lbs. over NGW	10,000 Lbs under NGW
110,000 lbs.	122 kts.	Negligible		8 0%	12 5%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation 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.)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 60 percent 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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev	1,000 Ft. Alt Dev.
137,500 lbs.	119 kts.	4,600 ft	0.8 min	Not available from operators	3.0%

		Lift-Off Speed Deviation 5,000 Lbs Over MGW	5,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs. Over MGW	5,000 Lbs. Under MGW
137,500 lbs	119 kts.	Not applicable	1.0%	Not applicable	8.4%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
137,500 lbs	119 kts.	Not applicable	15.0%

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

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway. The flaps are extended 80 percent 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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	N.A.S.A. Sea Level Standard Day T/O Time	T/O Dist. and Time Deviations per 10° C Dev	T/O Dist. and Time Deviations per 1,000 Ft Alt. Dev.
160,000 lbs.	123 kts.	5,100 ft.	0.8 min.	Not available from operator	3.0%

		Lift-Off Speed Deviation 5,000 Lbs Over MGW	Lift-Off Speed Deviation 5,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs Over MGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs. Under MGW
160,000 lbs.	123 kts.	Not applicable	1.0%	Not applicable	8.4%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
160,000 lbs	123 kts.	Not applicable	15.0%

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

NARRATIVE SUMMARY

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
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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	1,000 Ft Alt. Dev
44,900 lbs	106 kts	2,500 ft.	0 5 min.	4 0%	6.4%

		Lift-Off Speed Deviation 1,000 Lbs Over MGW	1,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 1,000 Lbs. Over MGW	1,000 Lbs. Under MGW
44,900 lbs.	106 kts.	Not applicable	1 1%	Not applicable	4 0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
44,900 lbs	106 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)

NARRATIVE SUMMARY

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.

Time

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev
64,500 lbs.	115 kts.	4,200 ft.	0 7 min.	7 3%	7.4%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		2,000 Lbs Over MGW	2,000 Lbs. Under MGW	2,000 Lbs Over MGW	2,000 Lbs. Under MGW
64,500 lbs.	115 kts	Not applicable	1.0%	Not applicable	7.3%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
64,500 lbs.	115 kts	Not applicable	7.3%

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

NARRATIVE SUMMARY

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.

Time

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 10° C Dev.	1,000 Ft Alt Dev
69,000 lbs	115 kts.	3,890 ft.	0 7 min	7 0%	8 0%

		Lift-Off Speed Deviation 5,000 Lbs Over MGW	5,000 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 5,000 Lbs Over MGW	5,000 Lbs Under MGW
69,000 lbs	115 kts	Not applicable	3 4%	Not applicable	15%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
69,000 lbs	115 kts.	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)

AIR VEHICLE PERFORMANCE CHARACTERISTICS

Volumes I-A through IX

SECTION 3

GENERAL AVIATION

containing data on

Aero Commander 500

Aero Commander 680 (L-26C)

Aero Commander 720

Beechcraft "Bonanza" K-35

Beechcraft "Twin Bonanza" (L-23D)

Beechcraft Model 95

Beechcraft Super 18

Cessna 150

Cessna 172

Cessna 175

Cessna 180 (Amphibian)

Cessna 182

Cessna 310A (L-27A)

Cessna 310C

de Havilland "Beaver" (L-20A)

de Havilland "Otter" (U-1A)

Mooney Mark 20A

Piper "Tri-Pacer" PA-22

Piper "Apache"" PA-23

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.

NARRATIVE SUMMARY

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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
6,000 lbs	83 kts	1,645 ft.	0 4 min	Not available from manufacturer	

		Lift-Off Speed Deviation 200 Lbs Over MGW	200 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 200 Lbs Over MGW	200 Lbs. Under MGW
6,000 lbs.	83 kts	Not applicable	Negligable	Not applicable	Not available from manufacturer

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
6,000 lbs	83 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.)

NARRATIVE SUMMARY

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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
7,000 lbs	78 kts	1,250 ft	0 3 min	8 0%	7 5%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		100 Lbs. Over MGW	100 Lbs Under MGW	100 Lbs. Over MGW	100 Lbs. Under MGW
7,000 lbs	78 kts	Not applicable	Not available from operators	Not applicable	Not available from operators

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
7,000 lbs	78 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)

NARRATIVE SUMMARY

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev.
7,500 lbs.	86 kts	1,190 ft.	0.3 min.	6%	9%

		Lift-Off Speed Deviation 500 Lbs Over MGW	500 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 500 Lbs. Over MGW	500 Lbs. Under MGW
7,500 lbs.	86 kts	Not applicable	Not available from manufacturer	Not applicable	Not available from manufacturer

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
7,500 lbs	86 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)

NARRATIVE SUMMARY

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 take-off

Time

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)

V1 (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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S A Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviation per 10° C Dev	1,000 Ft Alt. Dev.
2,950 lbs	56 kts	1,346 ft	0 5 min	2 7%	3 9%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		100 Lbs Over MGW	100 Lbs. Under MGW	100 Lbs Over MGW	100 Lbs Under MGW
2,950 lbs	56 kts	Not applicable	Not available from manufacturer	Not applicable	Not available from manufacturer

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,950 lbs	56 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)

NARRATIVE SUMMARY

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 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 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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev.
7,000 lbs	91 kts	1,270 ft	0 3 min	6%	6%

		Lift-Off Speed Deviation 500 Lbs Over MGW	500 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 500 Lbs Over MGW	500 Lbs. Under MGW
7,000 lbs	91 kts	Not applicable	Negligible	Not applicable	16%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 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.)

NARRATIVE SUMMARY

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 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev.
4,000 lbs.	74 kts	2,000 ft	0 5 minute	4%	10%

		Lift-Off Speed Deviation 100 Lbs Over MGW	100 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 100 Lbs. Over MGW	100 Lbs. Under MGW
4,000 lbs	74 kts.	Not applicable	Not available from manufacturer	Not applicable	Not available from manufacturer

		T/O Dist. and Time Deviation w/ATO Dev. per 100 lbs. Dist	Time	Runway Gradient Deviation per 1% Slope
4,000 lbs.	74 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)

NARRATIVE SUMMARY

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 Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev.	1,000 Ft. Alt. Dev
9,700 lbs	87 kts.	1,800 ft	0 4 min	6 0%	8 0%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		100 Lbs Over MGW	100 Lbs. Under MGW	100 Lbs. Over MGW	100 Lbs. Under MGW
9,700 lbs.	87 kts	Not applicable	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)

NARRATIVE SUMMARY

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft. Alt. Dev.
2,200 lbs	60 kts	725 ft	0 3 min	7 2%	1 0%

		Lift-Off Speed Deviation 300 Lbs. Over MGW	300 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 300 Lbs. Over MGW	300 Lbs. Under MGW
2,200 lbs.	60 kts	Not applicable	10.0%	Not applicable	29 0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,200 lbs	60 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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 20 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 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

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist. and Time Deviations per 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 Over MGW	100 Lbs Under MGW	100 Lbs. Over MGW	100 Lbs. 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)

NARRATIVE SUMMARY

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)

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
2,850 lbs.	60 kts	1,345 ft	0.4 min.	8.0%	9.0%

		Lift-Off Speed Deviation 250 Lbs Over MGW	250 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 250 Lbs. Over MGW	250 Lbs. 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
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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 20 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 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

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A S A Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev.	1,000 Ft Alt Dev.
2,650 lbs	61 kts	555 ft	0 3 min	10%	8%

		Lift-Off Speed Deviation 250 Lbs Over MGW	250 Lbs. Under MGW	T/O Dist. and Time Deviation for Weight 250 Lbs Over MGW	250 Lbs. Under MGW
2,650 lbs	61 kts	Not applicable	Negligable	Not applicable	20%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,650 lbs	61 kts	Not applicable	Not available from manufacturer

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

NARRATIVE SUMMARY

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.

Time

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

Maximum Gross Weight	Lift-Off Speed V2 (IAS)	N. A. S. A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev	1,000 Ft Alt. Dev.
4,830	97 kts.	720 ft	0 2 min.	0.6%	0.9%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		400 Lbs Over MGW	400 Lbs Under MGW	400 Lbs. Over MGW	400 Lbs. Under MGW
4,830	97 kts	Not applicable	None	Not applicable	22.0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
4,830	97 kts	Not applicable	Not available from manufacturer or 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)

NARRATIVE SUMMARY

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

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 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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt Dev
4,830 lbs	86 kts	800 ft	0 2 min.	10%	8%

		Lift-Off Speed Deviation 400 Lbs Over MGW	400 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 400 Lbs Over MGW	400 Lbs. Under MGW
4,830 lbs	86 kts	Not applicable	5%	Not applicable	11%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
4,830 lbs	86 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)

NARRATIVE SUMMARY

Sequence of Operations

The engine runup check is performed adjacent to the active runway The flaps are extended 35 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 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)

TABLE I, TAKE-OFF

Normal Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev.	1,000 Ft Alt. Dev
4,800 lbs.	56 kts	504 ft.	0 3 min.	7 0%	3 8%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		300 Lbs Over NGW	400 Lbs Under NGW	300 Lbs Over NGW	400 Lbs. Under NGW
4,800 lbs	56 kts	4 0%	7 0%	9 0%	16 0%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
4,800 lbs	56 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)

NARRATIVE SUMMARY

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

Time

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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N A S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist. and Time Deviations per 10^{o} C Dev.	1,000 Ft Alt. Dev.
8,000 lbs.	63 kts	655 ft	0 2 min.	2 5%	3 0%

		Lift-Off Speed Deviation 500 Lbs. Over MGW	500 Lbs. Under MGW	T/O Dist. and Time Deviation for Weight 500 Lbs. Over MGW	500 Lbs. Under MGW
8,000 lbs	63 kts	Not applicable	3 0%	Not applicable	12.0%

		T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
8,000 lbs.	63 kts	Not applicable	Negligable

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

NARRATIVE SUMMARY

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

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S A. Sea Level Standard Day T/O Dist	T/O Time	T/O Dist and Time Deviations per 10° C Dev.	1,000 Ft Alt. Dev
2,450 lbs.	60 kts.	600 ft.	0.3 min	Not available from manufacturer	

	Lift-Off Speed Deviation 50 Lbs Over MGW	50 Lbs Under MGW	T/O Dist. and Time Deviation for Weight 50 Lbs Over MGW	50 Lbs. Under MGW
2,450 lbs	60 kts	Not applicable	Not available from manufacturer	Not applicable	Not available from manufacturer

	T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,450 lbs.	60 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)

NARRATIVE SUMMARY

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.

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 2,000 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

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist	N.A.S.A. Sea Level Standard Day T/O Time	T/O Dist and Time Deviations per 10° C Dev	T/O Dist and Time Deviations per 1,000 Ft. Alt. Dev.
2,000 lbs	70 kts.	1,120 ft	0 3 min	Not available from manufacturer	

		Lift-Off Speed Deviation 100 Lbs. Over MGW	Lift-Off Speed Deviation 100 Lbs. Under MGW	T/O Dist. and Time Deviation for Weight 100 Lbs. Over MGW	T/O Dist. and Time Deviation for Weight 100 Lbs. Under MGW
2,000 lbs	70 kts.	Not Applicable	Not available from operator	Not Applicable	Not available from operator

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,000 lbs.	70 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.)

NARRATIVE SUMMARY

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

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A.S.A. Sea Level Standard Day T/O Dist.	T/O Time	T/O Dist and Time Deviations per 10° C Dev	1,000 Ft Alt. Dev
3,800 lbs	65 kts	1,190 ft.	0.4 min	Not available from manufacturer	25%

		Lift-Off Speed Deviation		T/O Dist. and Time Deviation for Weight	
		300 Lbs Over MGW	300 Lbs Under MGW	300 Lbs Over MGW	300 Lbs. Under MGW
3,800 lbs	65 kts	Not applicable	Not available from manufacturer	Not applicable	29%

T/O Dist. and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
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)

NARRATIVE SUMMARY

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 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, 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)

TABLE I, TAKE-OFF

Maximum Gross Weight	Lift-Off Speed (V2) (IAS)	N.A S A. Sea Level Standard Day T/O Dist	T/O Time	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	

		Lift-Off Speed Deviation Lbs Over MGW	Lbs Under MGW	T/O Dist. and Time Deviation for Weight Lbs. Over MGW	Lbs. Under MGW
2,550 lbs	70 kts	Not applicable	Not available from manufacturer.	Not applicable	8.5%

		T/O Dist and Time Deviation w/ATO	Runway Gradient Deviation per 1% Slope
2,550 lbs.	70 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.)