CHAPTER 7: HELICOPTER LOAD CALCULATIONS AND MANIFESTS.

I. Introduction.

Helicopter load calculations shall be completed for all flights to ensure that the helicopter will perform within the limitations established by the helicopter manufacturer, without exceeding the gross weight for the environmental conditions where the helicopter is to be operated. When utilizing military helicopters, a similar load calculation system such as the Performance Planning Card (PPC) method is authorized.

See Appendix A, Helicopter Management Forms and Checklists, for examples of standard load calculation and manifest forms, along with instructions for completion. The user also needs to become familiar with a number of terms in this section. Refer to the Glossary for definitions. These terms include:

- Pressure altitude
- Weight and balance
- Hover-In-Ground Effect
- Maximum certificated gross weight
- Maximum computed gross weight
- Gross weight limitations
- Operating weight
- Useful load
- Fuel consumption
- Density altitude
- Center of gravity
- Hover-Out-Of-Ground Effect
- Hover ceiling
- Weight reduction
- Equipped weight
- Allowable payload
- Cruise speed
- Fuel capacity

For a basic explanation of the principles of helicopter flight, capabilities, and limitations, the user may want to refer to FAA Advisory Circular AC 61-13B, Basic Helicopter Handbook.

Important points to remember include:

- Environmental conditions aside from those of temperature and altitude may affect allowable payload (an example is the effect of wind on the Bell Jet Ranger model); some performance charts are designed for no-wind conditions.

- Performance charts are predicated on the helicopter engine(s) meeting the engine manufacturers specific torque values as determined by periodic power assurance checks.

- Errors, high or low, may result when plotting the maximum computed gross weight on the helicopter performance chart (use of copier-enlarged copies of charts is recommended to reduce error).

- Structural limitations (takeoff and landing limitations) such as maximum skid weight, as opposed to performance limitations, may cause confusion; ensure that personnel are trained in the difference between these two limitations.

A. Agencies Not Utilizing the Load Calculation.

When aircraft from agencies which do not use the form are operating on an incident or project managed by an agency for which the form is required, then the load calculation shall be used for all helicopters operating on the incident or project.

Conversely, when helicopters from an agency requiring its use are operating on incidents managed by an agency which does not require the load calculation, the load calculation form shall be used for all helicopters operated by or under the control of agencies requiring its use.

Furthermore, agency personnel for whom use of the load calculation is required may not ride aboard helicopters managed or controlled by agencies not utilizing the load calculation.

B. Cooperator (Civil) and Other-Government-Agency Helicopters.
When employees from agencies that do mandate use of the load calculation form are riding on civil, corporate or other-government agency aircraft in non-revenue status, the form shall be used.

C. Military Helicopters.
➔ Standard military methods for determining performance such as the Performance Planning Card (PPC) may be used. For aviation operations utilizing Active Duty/Reserve Military helicopters, and National Guard units officially "federalized" by DoD, refer to Chapter 70 of the Military Use Handbook for specific policy and procedural information.

➔ The use of National Guard units for federal firefighting purposes within their state must be outlined in national, regional, state or local agreements and Memorandums of Understanding (MOUs) between federal agencies and the specific National Guard units.

D. Restricted Category (Limited Use) Helicopters.
A load calculation must be completed. The same rules apply as those for standard category helicopters regarding omitting the weight reduction for external, jettisonable loads, provided the Pilot concurs. See Chapter 11, Cargo Transport, for further information.

II. Responsibility for Completion of Load Calculations.

A. Pilot.

- It is the Pilot's responsibility to complete the load calculation form correctly, using proper performance charts.
- The Pilot is responsible for computing the allowable payload.
- In addition, the Pilot shall check, or be informed of any subsequent passenger/cargo manifested weights completed under the initial load calculation to ensure allowable payloads are not exceeded.

IMPORTANT NOTE: The government representative MAY participate in the completion of load calculations. However, the pilot is ultimately responsible for content accuracy.

B. Government Representative.
➔ The government representative (for example, the Helicopter Manager, Project Flight Manager, Loadmaster, etc.) is responsible for providing an accurate passenger/cargo manifest weight that does not exceed the allowable payload based on real time, on site

conditions. The government representative is responsible for checking the load calculation to ensure accuracy and completeness. or may be reflected on the Passenger/Cargo Manifest Book

C. Mutual Responsibility.
After completion of the form, the Pilot and government representative shall sign the form.

III. Determining Load Capability Using Appropriate HIGE and/or HOGE Aircraft Performance Charts.

A. General Requirement.
With the exceptions mentioned for military helicopters, all helicopter flights require a load calculation/performance determination prior to takeoff. Appendix A, Helicopter Management Forms and Checklists, provides specific instructions for completion of the load calculation and passenger/cargo manifest forms.

If the electronic format is used, the form must be printed out in black and white, then signed by the pilot and helicopter manager, and retained.

Appendix A also provides instructions for completion of Form HCM-10, Helicopter Load Capability Planning Summary - Multiple Helispots and Fuel Loads. Use of this format significantly reduces the need for repetitive load calculation completion, provided an original load calculation for the temperature, elevation, and fuel load has been accurately completed and is readily available.

B. Specific Requirements.

1. **Frequency of Completion.** A new load calculation may be completed for each flight or flight leg to determine performance. However, one calculation is valid between points of similar elevation, temperature, and fuel load, provided the load for each flight leg is manifested.

2. **Requirement for a New Calculation.** A new load calculation is required when there is a change of:

   - +/- 5 degrees Celcius. in temperature, or
   - +/- 1,000 feet change of altitude, or
   - ➔ When the Helicopter Operating Weight changes (such as changes to the helicopter equipped weight, changes in flight crew weight or a change in fuel load). (A decrease in fuel load at the same temperature and elevation will, of course, increase allowable payload; a new calculation may be completed to reflect increased capability or may be reflected on the Passenger/Cargo Manifest Book.)

3. **Determining Pressure Altitude. Pressure altitude can be determined by:**

   - Aircraft altimeter Kolsman Window; adjust to 29.92 inches of Hg (mercury) and then read pressure altitude directly off the altimeter; or,

- For locations where the helicopter or an altimeter setting is not available, altitude can be estimated by using a map, bench mark, signs, etc.

4. **Determining Temperature. Temperature can be determined by:**
   - On-site thermometer
   - Weather stations
   - Fixed-base operators (FBO's) or Flight Service Stations (FSS's)
   - Aircraft Outside Air Temperature (OAT) Gauge
   - Using the standard lapse rate of 2° C. (or 3½° F.) per 1,000 feet from a known temperature and elevation

CAUTION: The OAT gauge may show a higher than actual temperature due to direct sunlight and radiant heat on a helicopter that has been sitting.

CAUTION: When an atmospheric inversion exists, temperatures may actually increase at higher elevations.

5. **Determining Helicopter Equipped Weight.** The helicopter equipped weight is obtained from the Pilot by checking the aircraft weight and balance form in the flight manual.

6. **Determining Flight Crew Weight.** This is the weight of Pilot(s), plus personal gear and flight gear.

7. **Determining Fuel Weight.** The actual weight of a gallon of aircraft fuel may vary slightly. For computation purposes, the following weights should be used.

   - AvGas = 6.0 pounds/gallon
   - JetFuel = 7.0 pounds/gallon

8. **Utilizing Fuel Burn-off.** Utilizing the weight of fuel burned off en route to the landing or hover site is an acceptable method of calculating a helicopter's ability to hover or land at the destination.

   If the helicopter is within limits at the takeoff site, the weight of fuel consumed during the flight can be "added" to the allowable payload by determining the weight of fuel aboard the aircraft when it arrives at the landing/hovering site.

CAUTION: Pilots and managers must ensure that the estimate of fuel burned off is accurate prior to arrival at the destination.

9. **Operating Weight.** This is the sum of the helicopter's equipped weight, flight crew weight, and fuel weight.

10. **Maximum Computed Gross Weight.** In order to safely operate a helicopter at varying altitudes and temperatures, the helicopter's performance capability must be

determined. This is done by referring to the performance charts provided with most helicopter flight manuals. The Maximum Computed Gross Weight is obtained from the appropriate performance charts (HIGE, HOGE).

A listing of the appropriate charts can be obtained from agency aircraft inspectors for all helicopters utilized by the agency. Some items to remember regarding maximum computed gross weight include:

- Helicopter flight manuals often contain many different performance charts. These charts provide Hover Ceiling In Ground Effect (HIGE) and Hover Ceiling Out Of Ground Effect (HOGE) information. Care should be taken to ensure Pilot utilization of the proper chart(s). Charts differ for:

- The specific equipment configuration of the helicopter, such as skid height, particle separators on/off, with/without cargo hook or floats, and other equipment configurations; and,

- Conditions such as anti-ice on/off, critical wind azimuth, etc., and,

- Environmental temperature ranges

- Current aircraft configuration and temperature range must match with the correct performance chart.

- Operators with computer programs approved by the FAA in the company's operating specifications may be used in lieu of flight manual performance charts.

IMPORTANT NOTE: Performance enhancement charts (also known as"wind charts") that attempt to take advantage of prevailing winds **are not** authorized.

SAFETY ALERT: DURING SOME HOT TEMPERATURE AND HIGH ALTITUDE CONDITIONS, SOME HELICOPTER FLIGHT MANUAL PERFORMANCE CHARTS MAY NOT PROVIDE ADEQUATE PERFORMANCE INFORMATION. For the vast majority of our operations, the manufacturer's performance charts provide the needed information. However, in some unusual circumstances such as hot and high conditions, this may not be the case. **IT IS IMPORTANT TO UNDERSTAND THAT AN ALTITUDE LINE MAY NOT BE EXTENDED (THAT IS, EXTRAPOLATED OUT) TO INTERSECT A TEMPERATURE LINE IN ORDER TO COMPLETE THE CALCULATION**. Such a practice would allow the helicopter to be operated in an area for which the manufacturer has not provided performance information. **IF PERFORMANCE CAPABILITY CANNOT BE DETERMINED UTILIZING MANUFACTURER DATA, THEN THE MISSION MUST NOT BE FLOWN.**

➔ **SAFETY ALERT:** The HOGE allowable weight calculation should be utilized on a routine basis for internal loads when the destination is unknown, or is known to be or has been designated as a HOGE site. Ground effect will dissipate over rough, sloped, or vegetated ground. Since there is nothing precise about ground effect, power requirements (load capability estimates) should always be conservative.

Remember, if the helicopter is inadvertently loaded for HIGE and the landing site requires an HOGE capability, the aircraft may settle and possibly crash if the pilot attempts the landing. See Chapter 7, Section III.B.13 f or additional information and requirements.

CAUTION: Pilots and managers must ensure that helicopter can take off from the departure point as well as land at the destination. This is most critical in areas which experience extremely high summer temperatures, such as the desert Southwest.

11. ➔ **Weight Reduction**. The Government Weight Reduction is required for all "non-jettisonable" loads. The Weight Reduction is optional (mutual agreement between Pilot and Helicopter Manager) when carrying jettisonable loads (HOGE-J) where the pilot has total jettisonable control. The appropriate Weight Reduction value, for make and model, can be found in the current helicopter procurement document.

NOTE: All internal loads will be downloaded in accordance with the weight reduction chart. For external, jettisonable loads, the government representative may suggest the omission of the fixed-weight reduction. However, the final decision shall be made by the Pilot if he or she decides it would be prudent to do so.

If the weight reduction is omitted for external, jettisonable loads, a load calculation reflecting this shall be completed.

12. ➔ **Gross Weight Limitations.** Enter applicable gross weight limit from Limitations Section of the basic Flight Manual or the appropriate Flight Manual Supplement. This may be Maximum Gross Weight Limit for Take-off and Landing, a Weight/Altitude/Temperature (WAT) limitation or a Maximum Gross Weight Limit for External Load (jettisonable). Limitations may vary for HIGE, HOGE and HOGE-J.

IMPORTANT NOTE: Do not use a limitation (for example, maximum skid weight) when determining the Computed Gross Weight.

13. ➔ **Alternatives When Conditions At Destination Landing Site Are Unknown Or Found To Be Different**. Although HOGE should be used to calculate allowable weight the first time flying into an unknown landing site, in certain instances, particularly on initial attack where fuel and allow able load are pre-calculated each day, environmental conditions at the landing site may be more severe than were estimated on the load calculation.

Examples include a higher altitude or temperature than was anticipated, or a HOGE instead of a HIGE landing site. Another example is where an inversion exists, and the

temperature actually increases instead of decreases at higher elevations. This often results in an over gross weight condition for the intended landing site. Wind speed and direction may also have a detrimental effect on aircraft controllability.

Takeoffs and landings, as well as external load operations, must never be attempted when the aircraft is not operating within its performance capabilities.

If an over gross condition is anticipated prior to takeoff at the departure base or at an intermediate stop, personnel and/or cargo must be offloaded to bring the aircraft to within its performance capabilities.

There are occasions (for example, fire initial attack dispatches) when a possible over gross condition cannot be determined due to unknown winds and/or site conditions. After it is determined that conditions are such that performance limitations are exceeded, then a more suitable landing site, usually at a lower elevation, must be selected. A portion of the personnel and/or cargo are offloaded at the lower site, with the remaining load then taken to the original destination.

If a HOGE site is encountered at destination, and if the aircraft would be in an over gross condition if a landing were attempted at the HOGE site, then either the alternative outlined in the paragraphs above must be chosen, or a HIGE landing site must be found.

The HOGE allowable weight calculation should be utilized on a routine basis for internal loads when the destination is known to be, or has been designated, as a HOGE landing site, or when experience has proven that landing sites in certain areas are usually HOGE sites.

14. **Managing Helicopter Bucket Payloads**. Helicopter bucket operations require attention to ensure that allowable payloads are not exceeded. Allowable bucket payloads must be calculated for current fuel loads and local environmental conditions. Actual bucket payloads can only be accurately determined if the bucket is filled to adjusted capacity or an on-board load meter is used.

    The following procedures **shall be used for all bucket operations:**

    - Determine allowable payload using the Interagency Load Calculation method, appropriate HOGE helicopter performance charts and current local temperature and pressure altitude. Performance enhancement charts (also known as "wind charts") that attempt to take advantage of prevailing winds **are not** authorized. Since buckets are external jettisonable loads, the weight reduction may be omitted from the load calculation process with pilot approval.

    The following procedures shall be used for all bucket operations except helicopters equipped with electronic helicopter hook load measuring systems (load cells) that provide a cockpit readout of the actual external load and a bucket that is equipped with a gating system that allows part of the load to be dispensed while retaining the remainder of the load:

- At the beginning of the fuel cycle, adjust the bucket capacity so that the actual payload, when the bucket is filled to the adjusted capacity, does not exceed the allowable payload. Use **8.3 pounds per gallon of water**. If mixed fire retardants are being delivered by bucket use the appropriate weight per gallon for that mixture. The weight of the empty bucket and any associated suspension hardware (lines, cables, connectors, etc.) must also be included in calculating the actual payload. The calculation of the actual bucket payload must be documented on the load calculation form or separate load manifest.

SAFETY ALERT: IF THE HELICOPTER BUCKET PROVIDED BY THE CONTRACTOR CANNOT BE ADJUSTED TO THE ALLOWABLE PAYLOAD FOR CURRENT, LOCAL ENVIRONMENTAL CONDITIONS, BUCKET OPERATIONS MUST NOT BE CONDUCTED. If this situation occurs, consult with the appropriate Contracting Officer to determine contractual ramifications and necessary actions.

CAUTION: There are many different manufacturers and designs of helicopter buckets. Capacity adjustments are made in various ways: removing plugs, opening zippers or cinching collapsible/foldable buckets (see Ch 9. Section VII, paragraph K). Capacity at each position or adjustment level should be marked on the bucket. Collapsible buckets with cinch straps should only be adjusted to the marked graduations (as an example 90%, 80%, 70%). Attempts to establish intermediate graduations or capacities below the manufacturer's minimum graduation (tying knots, etc.) is prohibited as this results in estimated capacities and may interfere with the release mechanism.

- After the bucket has been adjusted so that the actual payload will be within the allowable payload, bucket operations may begin. The pilot will be directed to fill the bucket to the adjusted capacity each time **(no partial dips for performance planning purposes)**. Thus, the same payload will be carried on each trip. As fuel is burned, the allowable payload will increase but the actual payload will remain constant. If so desired, after a period of time (for example, 30 minutes), the bucket may be readjusted to the new allowable created by fuel burn-off.

IV. Manifests.

➔ A listing of all passengers and cargo being transported is required. This listing of passengers and cargo may be accomplished on the load calculation form, on the Interagency Helicopter Passenger/Cargo Manifest, or; handcrews may provide a pre-completed crew manifest utilizing their own format, this practice is acceptable as long as the information on the form is accurate and verified.

The listing of passengers must include:

- Full name of each passenger;
- Clothed weight of each passenger and personal gear;

- Weight of additional cargo;

- Destination.

➔ A copy of the passenger list must remain at the departure base; if there are no personnel to receive manifests at the departure base and no verbal relay exists, a copy of the manifest must be left in a visible, easily accessible place.

See Appendix A for an example and instructions for completion of the standard manifest.