CHAPTER 17

LIMITATIONS

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ILLUSTRATIONS

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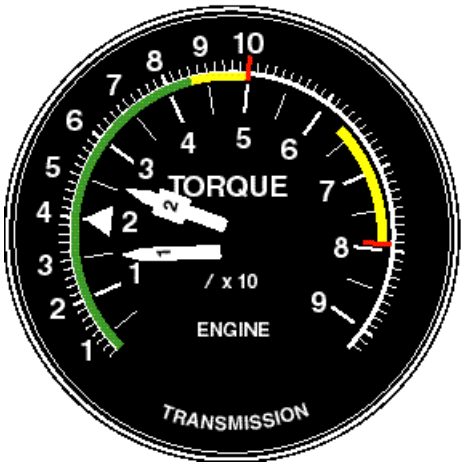
CHAPTER 17

Limitations



TRANSMISSION TORQUE (△)
(TWIN ENGINE OPERATION)

0 to 87.5%	Continuous Operation
87.5 to 100%	5 Minute Takeoff Range
100%	Maximum

ENGINE 1 OR ENGINE 2 TORQUE
(One engine inoperative)

63.9 to 79.4%	30 Minute OEI Range
79.4%	Maximum OEI

INTRODUCTION

The complete operating limitations for the Bell 212 aircraft are described in detail in the RFM and the appropriate supplements. Remember that there are two different models of the 212. The IFR version and the VFR version as pointed out in Chapter 3. Bell initially certificated the 212VFR model on October 29, 1970. A little over two and a half years later they received initial certification on the 212IFR model. Certification for this version was received on June 29, 1973. A distinctive feature of this aircraft was the large fin located above the cockpit. Other modifications included control linkage changes made specifically for IFR flight. During the early 1980's, the Sperry Company was developing a Supplemental Type Certificate for the VFR version of the 212. This STC, approved in 1982, gave the VFR version of the helicopter the ability to operate IFR. This chapter will highlight some of the specific limitations of the different versions of the 212 so that you can better understand the reason for the limitations and how to stay within them when operating the aircraft.

GENERAL

Both of the Bell versions of the 212 have their own Rotorcraft Flight Manual. Aircraft equipped with the Sperry system have a Flight Manual Supplement included with the normal RFM. This chapter is for training purposes only and is not intended to be used for flight planning or as a replacement for the Limitations Section of the RFM.

The Limitations Section of the RFM is an FAA approved section meaning that the information contained therein is regulatory in nature. There is a notation on the first page of the Limitations section that states, "Compliance with limitations in this section is required by appropriate operating rules". Those operating rules in most cases are the FAR's. Additionally, there is another statement on the first page that gives guidance to the operator in the event that a limitation is exceeded.

"Anytime an operating limitation is exceeded, an appropriate entry must be made in the helicopter log book. Entry shall state which limit was exceeded, duration of time, extreme value attained, and any additional information essential in determining maintenance action required." You will notice that it doesn't specify in any way what limitations must be written up. If the pilot inadvertently exceeded Vne with the doors off, for example, it would require a logbook entry.

Flight Crew

The minimum cockpit weight (FS 47.0) is 170 pounds. Refer to Section 5 of the RFM.

The flight crew requirements vary depending on the configuration and the type of mission being flown, so the RFM or Supplement should be consulted. One thing of interest is the requirement for an additional flight crewmember if the aircraft is loaded internally with cargo containing flammable materials. This additional crewmember shall have access throughout the cabin to perform duties of fire fighting and/or ventilating the cabin to remove smoke, toxic fumes, etc., in an emergency. Approved protective breathing equipment is required for each crewmember when transporting flammable cargo in the cabin.

Configuration

The required equipment for the specific type of operation is listed under this portion of the Limitations Section. Note that this section does not supersede the FAR with regard to the minimum equipment required for basic VFR or IFR flight. The aircraft must have the equipment listed in the Limitations section *as well as* any equipment specified in the FAR.

Optional Equipment

Refer to appropriate fight manual supplement(s) for additional procedures, and performance data with optional equipment installed. See Appendix A of the RFM.

Doors Opened / Removed

The helicopter may be flown with doors open or removed only with the Bell Standard Interior (utility) installed. Flight operations are approved for the following alternative configurations during VMC only:

- Both crew doors removed
- Both sliding doors locked open or removed with both hinged panels installed or removed.

Note: Opening or removing doors shifts the helicopter center of gravity and reduces Vne. Refer to Section 5 of the RFM and to Airspeed Limitations.

- In all cases, door configuration shall be symmetrical for both sides of the helicopter.

Passenger Seats

With the passenger seat kit installed, the helicopter is certified as a fifteen place aircraft. The above loading does not apply if cargo or a combination of cargo and passengers are being transported. It shall be the responsibility of the pilot to ensure that the helicopter is properly loaded so entire flight is conducted within the limits of gross weight center of gravity charts.

Note: Refer to Section 5 of the RFM for Loading Tables to be used in Weight/CG computations.

Cargo

Allowable deck loading is 100 pounds per square foot. (4.9 kilograms/100 centi-meters^2) Deck mounted tiedown fittings are provided and have an airframe structural capacity of 1250 Pounds (567 kg) vertical and 500 pounds horizontal per fitting. Provision for installation of cargo tiedown fittings are incorporated in aft cabin bulkhead and transmission support structure and have an airframe structural capacity of 1250 pounds (567 kg) at 90 degrees to bulkhead and 500 pounds (226.8 kg) in any direction parallel to the bulkhead. Cargo shall be secured by an approved restraint method that will not impede access to cargo in an emergency. All cargo and equipment must be securely tied down when operating with aft cabin doors open or removed.

The baggage compartment maximum allowable loading is 400 pounds (181.4 kg), not to exceed 100 pounds per foot^2.

Weight and Center of Gravity Limitations

One of the limitations that varies according to the version of the aircraft is the Center of Gravity Envelope. Although the maximum gross weight for the basic aircraft in its' various configurations is 11,200 pounds, there are considerable variations in the allowable center of gravity range. Figure 17-1 shows the CG range for the basic Bell 212VFR. The Longitudinal range extends from 130" aft of the datum to 144". This is the widest of the three configurations. The lateral CG range extends 4.7" to the left of the centerline and 6.5" to the right.

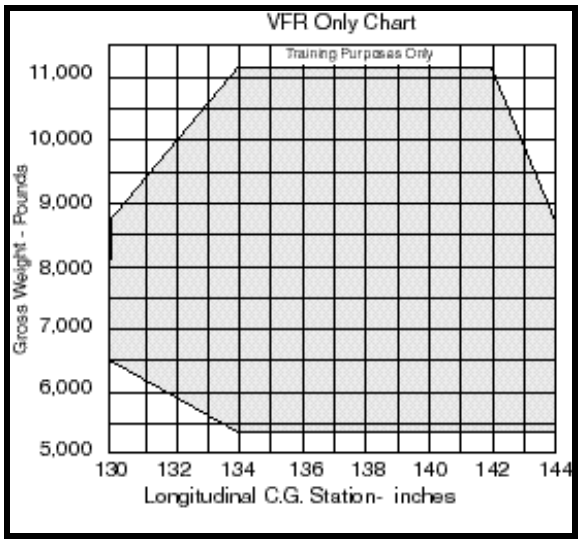


Figure 17-1 VFR Model CG Range

Airspeed Limitations

Each version of the Bell 212 (VFR vs IFR) has it's own specific speed limitations and the reader should reference the RFM or Supplement for specific information. However, there are certain limitations that are common to all versions and those are listed below.

Refer to the Figure 17-2 the V_{ne} limitation of the aircraft.

- The V_{ne} with the doors either open or removed is 100 kias.
- V_{ne} decreases at 3 Kts. per 1000 feet above 3000 feet $H_{D.}$
- Maximum airspeed when operating above maximum continuous torque (87.5%) is 80 KIAS.

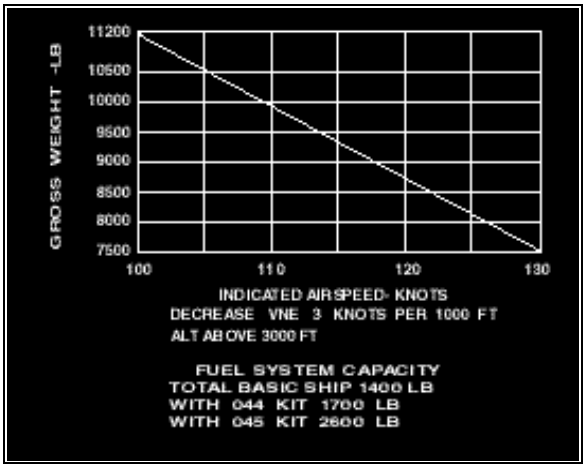


Figure 17-2 Bell 212 VFR V_{ne} Placard

Altitude

Maximum operating altitude is 20,000 feet pressure altitude.

Refer to applicable operating rules for high altitude oxygen requirements.

Caution: Monitor ITT when starting engine in manual fuel control mode.

Above 15,000 feet H_P, restart shall be accomplished in manual fuel mode. No airspeed restrictions.

Below 15,000 feet H_P, restart may be attempted in either manual or automatic fuel control mode.

Maneuvering

Aerobatic maneuvers are prohibited. The FAA, in Part 91.303, defines Aerobatic flight:

For the purposes of this section, Aerobatic flight is an intentional maneuver involving an abrupt change in an aircraft's attitude, or abnormal acceleration, not necessary for normal flight.

Climb and Descent

Refer to Section 4 "PERFORMANCE" of the RFM.

Height - Velocity

Each model of the Bell 212 has it's own height velocity chart. Because they are very similar a reproduction of the IFR version only has been included. The most important thing to keep in mind is that the Height-Velocity Charts are included in the limitations section which makes compliance mandatory. You're probably wondering how we can conduct external load operations in that case. Part 133 of the FAR specifically exempts helicopters from the limitations of the height velocity curve. (Figure 17-3)

Weight Altitude Temperature Chart

As discussed in chapter 19, the WAT Chart validates the HV Curve. (Figure 17-4) The WAT chart allows you to calculate the maximum gross weights allowable for takeoff, landing and in ground effect maneuvers. As long as the weight limits derived from the WAT Chart are not exceeded, the H-V Chart is valid.

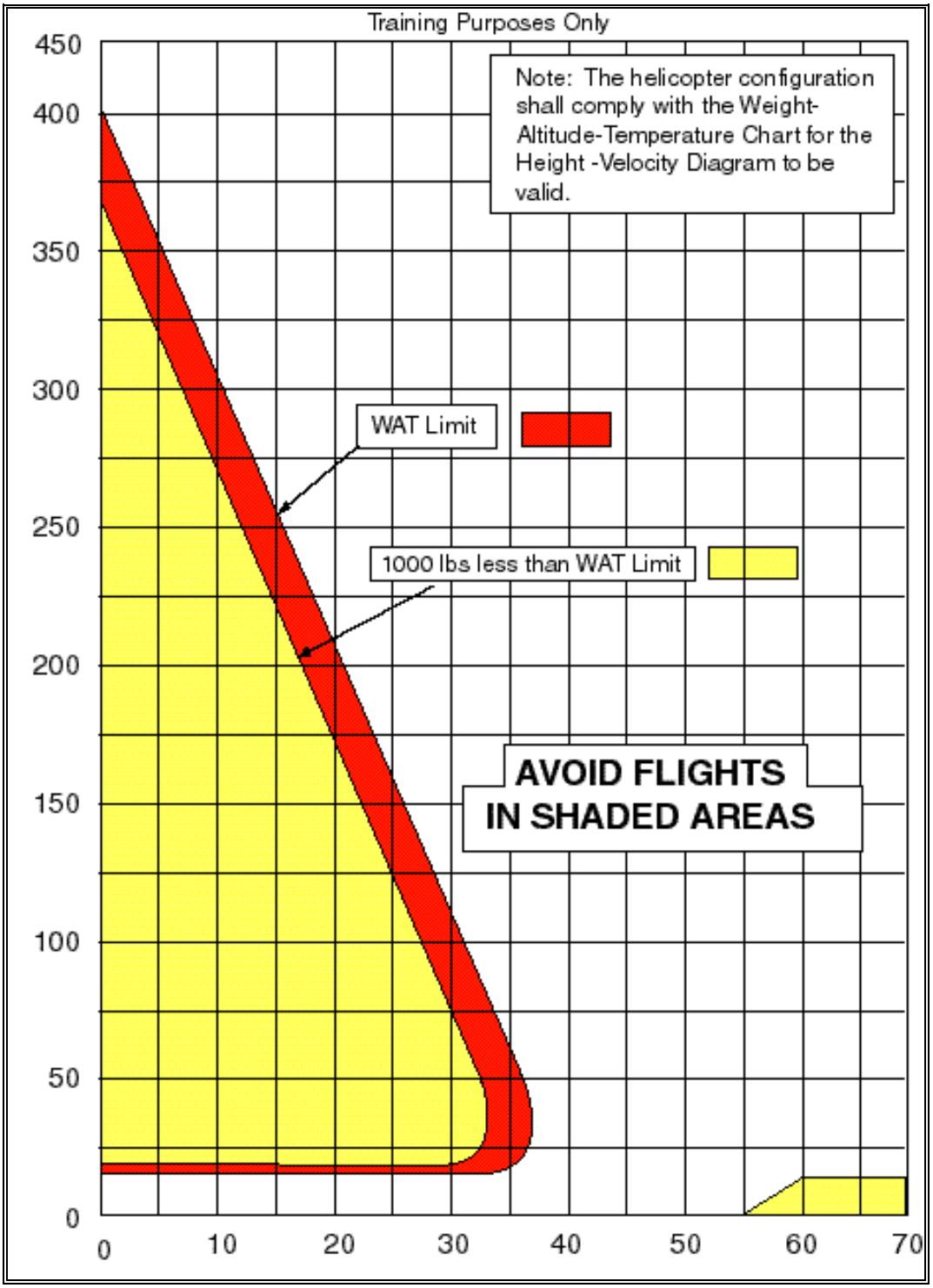


Figure 17-3 Height -Velocity Curve

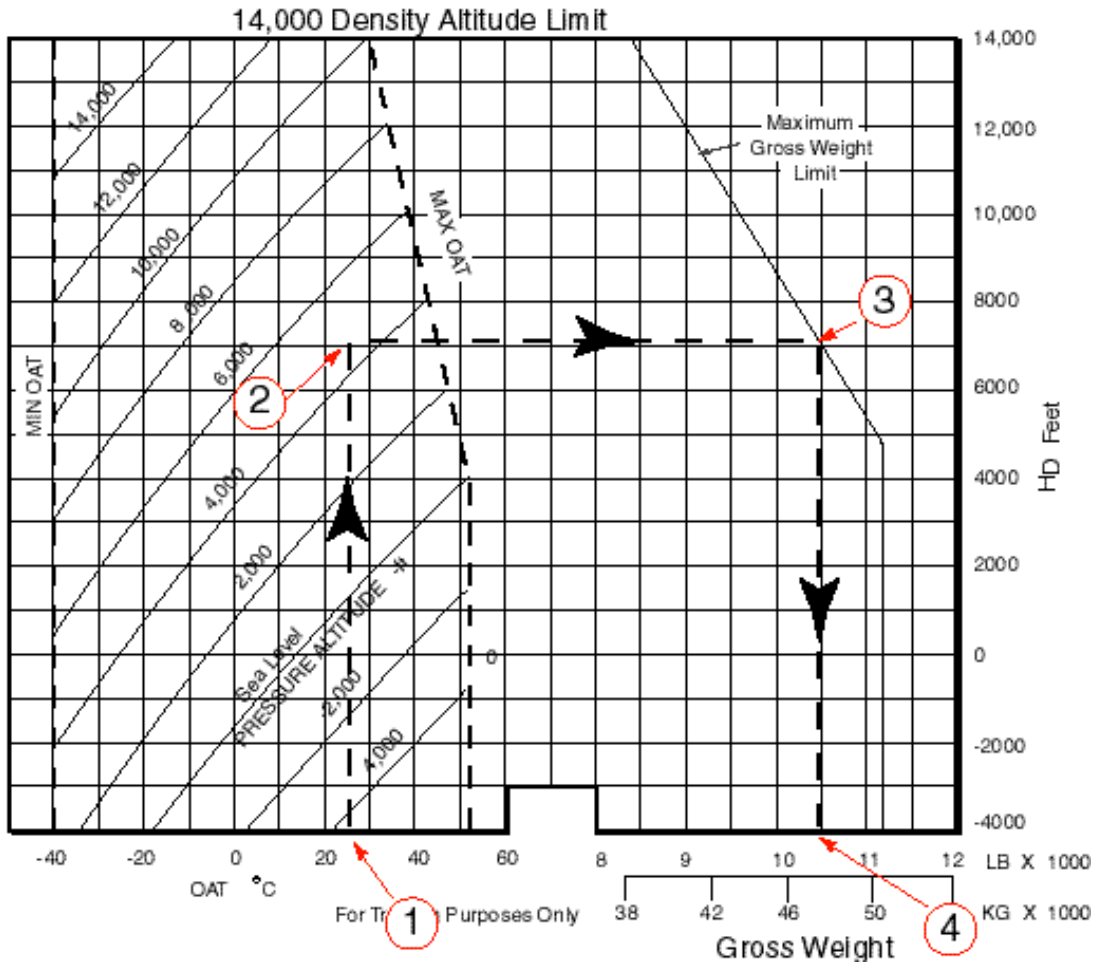


Figure 17-4a Example 1 Weight Altitude Temperature limitations Chart

The chart can also be used to determine whether the helicopter can be landed at a known altitude, weight and temperature. This is very useful for flight planning purposes.

Example 1:

Determine the maximum gross weight for a takeoff.

Conditions

OAT	25°C
H_P	4500’

Solution:

1. Locate the 25° temperature on the lower left side of the chart.

2. Move vertically until the temperature line intersects the 4500' H_P line
3. Move horizontally from the intersection of the 25° line and the 4500 foot HP line until you intersect the Maximum Gross Weight Line.
4. From this point descend vertically down to the weight.

Answer:

10,450 lbs. (Approx.)

Example 2:

Can the helicopter land in the given conditions?

Conditions:

OAT.....20°C
GW.....10,800
LZ Elev. .....2500'
Local Alt. Setting ..... 29.42"

Solution:

1. Enter the chart at the lower left portion where it has the GROSS WEIGHT line. Locate the 10,800 pound point.
2. Move vertically from this position until you intersect the MAXIMUM GROSS WEIGHT diagonal line.
3. From this intersection move horizontally to the right until the 20°C temperature line is intersected.
4. Read the maximum Pressure Altitude of 4,100' at the intersection of the temperature line and the horizontal line. This is the maximum pressure altitude that the landing can be safely made.
5. Determine the Pressure altitude of the LZ by factoring in the current altimeter and the LZ elevation:

{Standard sea level pressure-current altimeter} X 1,000' will give a correction to apply to the Elevation of the LZ in order to determine the Pressure altitude at landing.

{29.92 - 29.42} = .5

.5 X 1,000' = 500'

500' + 2,500' = 3,000' pressure altitude

Answer:

Because the chart gives us a maximum landing PA of 4,100', we can easily land under the prevailing conditions.

Ambient Temperatures

Maximum sea level ambient temperature for operation is +52°C (+125°F) and decreases with altitude at the standard lapse rate of 2°C per thousand feet of HP. Minimum ambient temperature for all altitudes is -54°C (-65°F). Refer to the weight-altitude-temperature limitations for takeoff, landing and in ground effect maneuvers chart (WAT chart).

Electrical

Battery

WARNING: Battery shall not be used for engine start after illumination of the battery temp light (if installed) battery shall be removed and serviced in accordance with manufacturers instructions prior to returning to service

Maximum battery Case temperature	54.5°C (130°F)
Maximum Battery Internal temp	62.7°C (145°F)

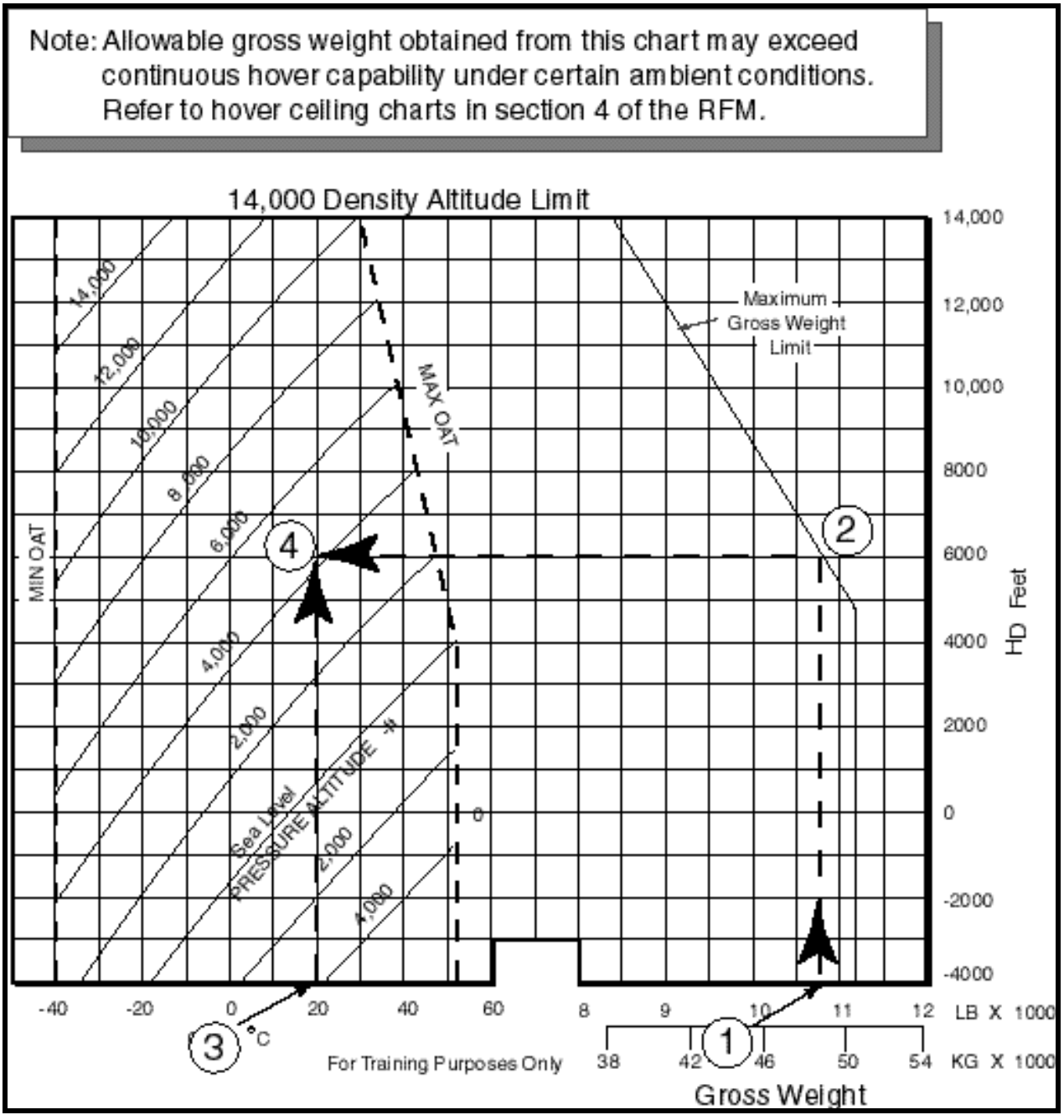


Figure 17-4b Example 2 WAT Chart

Generator

Maximum-150 amps per ammeter

Note: To attain published single engine performance, generator loads should not exceed 75 amps each during twin engine operation.

Ammeter needle may deflect full scale momentarily during generator assisted start of second engine.

Starter

Limit starter energizing time to:

30 Seconds ---------- ON
60 Seconds ---------- OFF
30 Seconds ---------- ON
5 Minutes ---------- OFF
30 Seconds ---------- ON
15 Minutes ---------- OFF

Above energizing cycle may then be repeated. Above 15,000 H_P restart shall be accomplished in manual fuel control mode only.

Below 15,000 H_P, restart may be in either manual or automatic fuel control mode.

Ground Power Unit

28 Vdc ground power units for starting shall be rated at a minimum of 400 amps and limited to a maximum of 1000 amps.

Powerplant

Note: Operation on the 2 ½ minute or 30 minute OEI range is intended for emergency use only, when one engine becomes inoperative due to actual malfunction. OEI ranges should not be used for training.

GAS PRODUCER RPM (N_1)

Twin Engine Operation

PT6T-3

Maximum continuous	100%
Maximum transient (Not to exceed 10 seconds)	101.5%

PT6T-3B
(Gauge P/N 212-075-037-101)

Continuous Operation	61 to 100.8%
Maximum Continuous	100.8%
Maximum for Takeoff	100.8%
Maximum Transient (Not to exceed 30 seconds)	102.6%

PT6T-3B
(Gauge P/N 212-075-037-113)

Continuous Operation	61 to 101.8%
Maximum Continuous	101.8%
Maximum for Takeoff	101.8%
Maximum Transient (Not to exceed 30 seconds)	102.6%

One Engine Inoperative (OEI)

PT6T-3B
(Gauge P/N 212-075-037-101)

2 ½ Minute Range	100.8 to 102.4%
Maximum	102.4%

PT6T-3B

(Gauge P/N 212-075-037-113)

2 ½ Minute Range	100.8 to 102.4%
Maximum	103.4%

POWER TURBINE (N_2)

Takeoff	100%
Minimum	97%
Continuous Operation	97-100%
Max. Continuous Operation	100%
Transient (Not to exceed 10 sec.)	---101.5%

INTERTURBINE TEMPERATURE

PT6T-3

5 minute range (twin engine operation)	765 to 810°C
30 minute range (single engine operation)	765 to 810°C
Maximum continuous limit (single or twin engine operation)	765°C
Power change transient limit (5 seconds above 810°C not to exceed 850°C)	850°C
Starting transient limit (not to exceed 2 seconds above 810°C)	1090°C

PT6T-3B (Twin Engine Operation)

Continuous Operation	300 to 765°C
Maximum Continuous	765°C
5 Minute Takeoff Range	765 to 810°C
Maximum for Takeoff	810°C
Maximum Transient (Not to exceed five seconds)	850°C
Maximum for Starting (Not to exceed 2 Seconds above 960°C)	1090°C

Note: If ITT remains above 810° longer than 15 seconds or exceeds other limits, ITT and duration shall be recorded in the helicopter logbook. Refer to Pratt and Whitney Maintenance Manual for inspection requirements.

PT6T-3B (OEI)

30 Minute OEI range	765 to 822°C
21/2 Minute range (OEI)	822 to 850°C
Maximum OEI	850°C

ENGINE TORQUE

One Engine Inoperative (OEI) (Engine Scale)

PT6T-3/3B - TORQUEMETERS MARKED 71.8%

Maximum Continuous	63.9%
30 minute power	63.9 to 71.8%
Maximum	71.8%

PT6T-3B - TORQUEMETERS MARKED 79.4%

Maximum Continuous	63.9%
30 minute power	63.9 to 79.4%
Maximum	79.4%

Fuel Pressure

Minimum	4 PSI
Continuous	4 to 35 PSI
Maximum	35 PSI

Engine Oil Pressure

Minimum	40 PSI
79% to 100%	80 to 115 PSI
Maximum	115 PSI

Engine Oil Temperature

NOTE: Helicopters with the PT6T-3B Engine shall use only the gauges marked 0-115°C. Helicopters with PT6T-3 engine may use either gauge.

PT6T-3 ONLY

Minimum	5°C
Maximum	107°C

PT6T-3 & -3B

Minimum	0°C
Continuous	0 to 115°C
Maximum	115°C

Combining Gearbox Oil Pressure

Minimum for idle	40 PSI
Operation below 94% N_2 rpm	40 to 60 PSI
Continuous Operation	60 TO 80 PSI
Maximum	80 PSI

Combining Gearbox Oil Temperature

NOTE: Helicopters with the PT6T -3B Engine shall use only the gauges marked 0-115°C. Helicopters with PT6T -3 engine may use either gauge.

PT6T-3B OR PT6T -3 (Typical)

Minimum	0°C
Maximum	115°C

PT6T-3 ONLY

Minimum	0°C
Maximum	107°C

TRANSMISSION

Transmission Oil Pressure

Minimum for idle	30 PSI
Continuous Operation	40 to 70 PSI
Maximum	70 PSI

Transmission Oil Temperature

Continuous Operation	15 to 110°C
Maximum	110°C

Transmission Torque

Twin Engine Operation

Transmission Scale (Δ)

Maximum Continuous	87.5%
Takeoff Power Range (5 minute)	87.5% to 100%
Maximum	100%

ROTOR

Rotor RPM -Power On

Minimum	97%
Maximum	100%

Rotor RPM Power Off

Minimum	91%
Maximum	104.5%

HYDRAULIC SYSTEM

Note: Refer to BHT - 212 - MD -1 for approved fluids and vendors

Hydraulic fluid MIL-PRF-87257 (NATO H-538)or MIL-PRF-5606 (NATO H-515) may be used at all ambient temperatures.

Both hydraulic systems shall be operative prior to takeoff.

Hydraulic Pressure

Minimum	600 PSI
Caution Range	600 - 900 PSI
Normal Operating	900 - 1100 PSI
Maximum	1100 PSI

Hydraulic Temperature

Maximum	88°C

FUEL and OIL

Note: Refer to BHT - 212 - MD -1 for approved fuels list.

Fuel conforming to ASTM D-1655 Type B, NATO F-40, or MIL-T-5624, Grade JP-4 may be used at all approved ambient temperatures.

Fuel conforming to ASTM D-1655 Type A or A-1, NATO F-44 MIL-T-5624, grade JP-5, NATO F-34, or MIL-T-83133, Grade JP-8 may be used at ambient temperatures above -30°C. (-22°F)

OIL- ENGINE AND COMBINING GEARBOX

Note: Refer to BHT - 212 - MD -1 for approved vendors.

Oil conforming to PWA specification No. 521 Type 1, and MIL-L-7808 (NATO O-148) may be used at all approved ambient temperatures.

Oil conforming to PWA Specification No. 521 Type 2, and MIL -L-23699 (NATO O-156), or DOD-L-85734AS (Turbine oil 555) may be used at all approved ambient temperatures above -40°C. (40°F)

OIL - TRANSMISSION, INTERMEDIATE AND TAIL ROTOR GEARBOXES

Oil conforming to MIL-L-7808 (NATO O-148) may be used at all approved ambient temperatures.

Oil conforming to, DOD -L-85734AS (Turbine Oil 555) and MIL-L-23699 (NATO O-156), may be used at al approved ambient temperatures above -40°C. (-40°F)

NOTE: DOD-L-8537AS or MIL-L-23699 is recommended.

Rotor Brake

Engine starts with the rotor brake engaged are prohibited. Rotor brake application is limited to ground operation and shall not be applied until engines have been shut down and rotor rpm (N_R) has decreased to 40% or less.

Landing Gear

No flight manual limitations.

Instrument Markings and Placards

Refer to Figures beginning with 17-8 for instrument range markings, placards and decals.

Heater

Heater shall not be operated when the OAT is above 21°C.

Refer to appendix A of the RFM for listing of Flight Manual Supplements (FMS) covering optional equipment kits available.

Instrument Markings

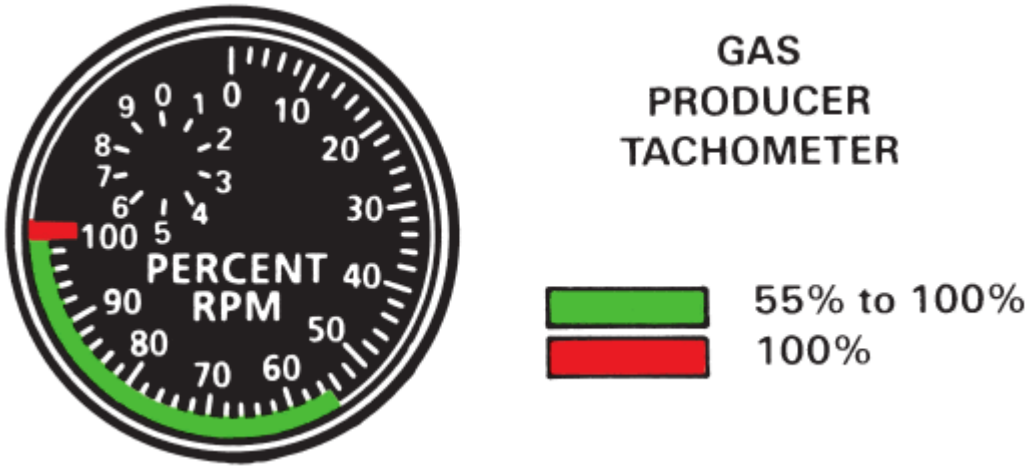


Figure 17-5a PT6T-3 Gas Producer Gauge

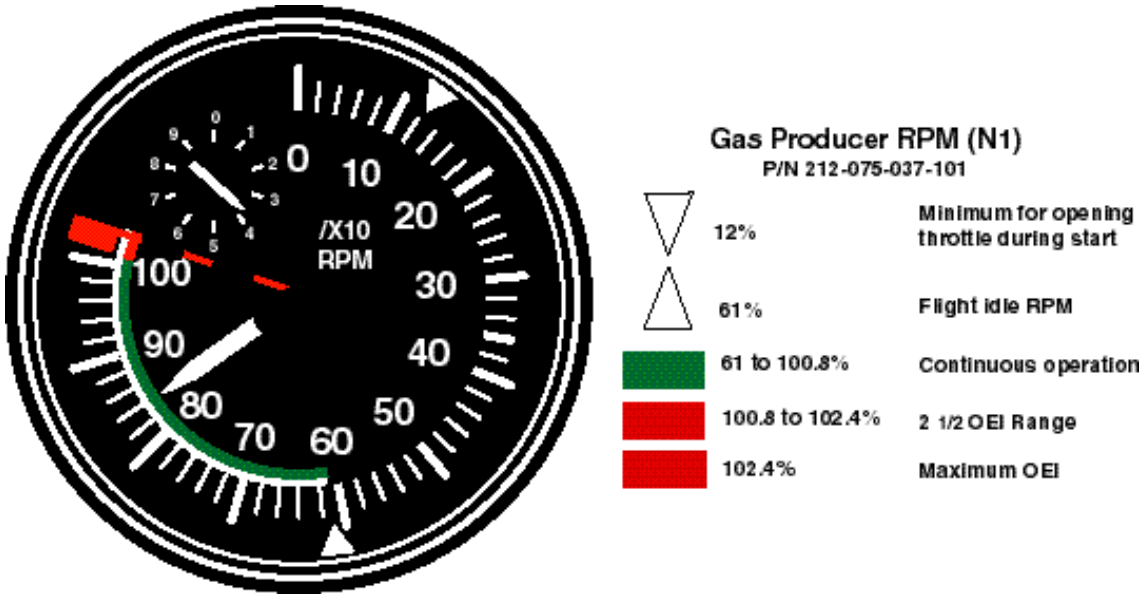


Figure 17-5b PT6T-3B Gas Producer Gauge (P/N 212-075-037-101)

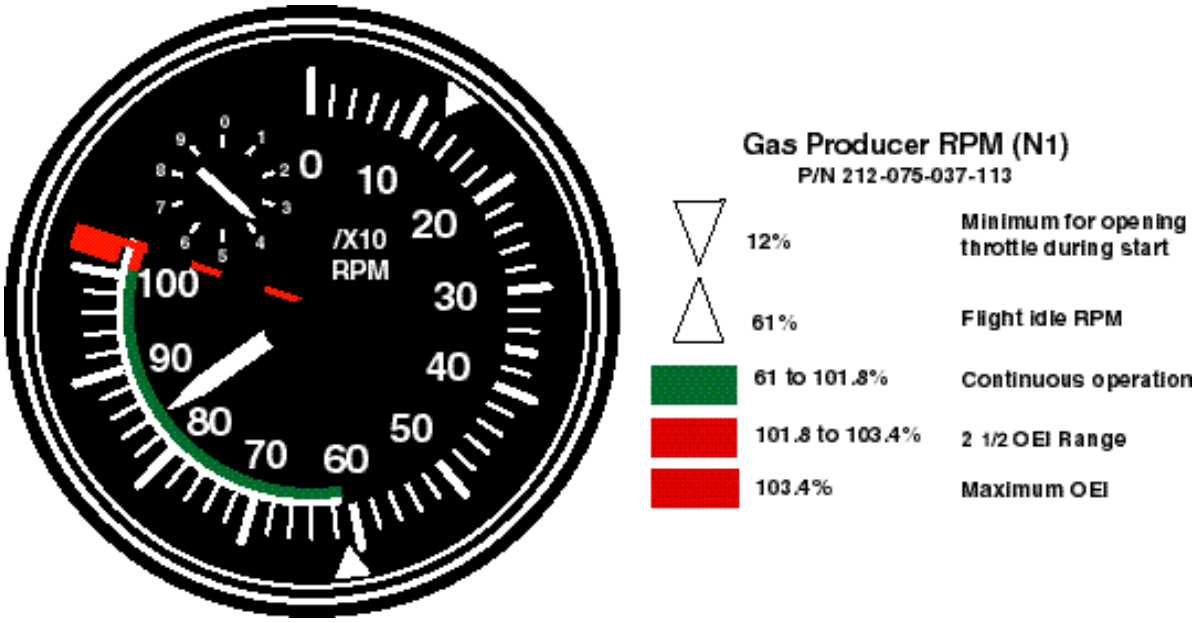


Figure 17-5c PT6T-3B Gas Producer Gauge (P/N 212-075-037-113)

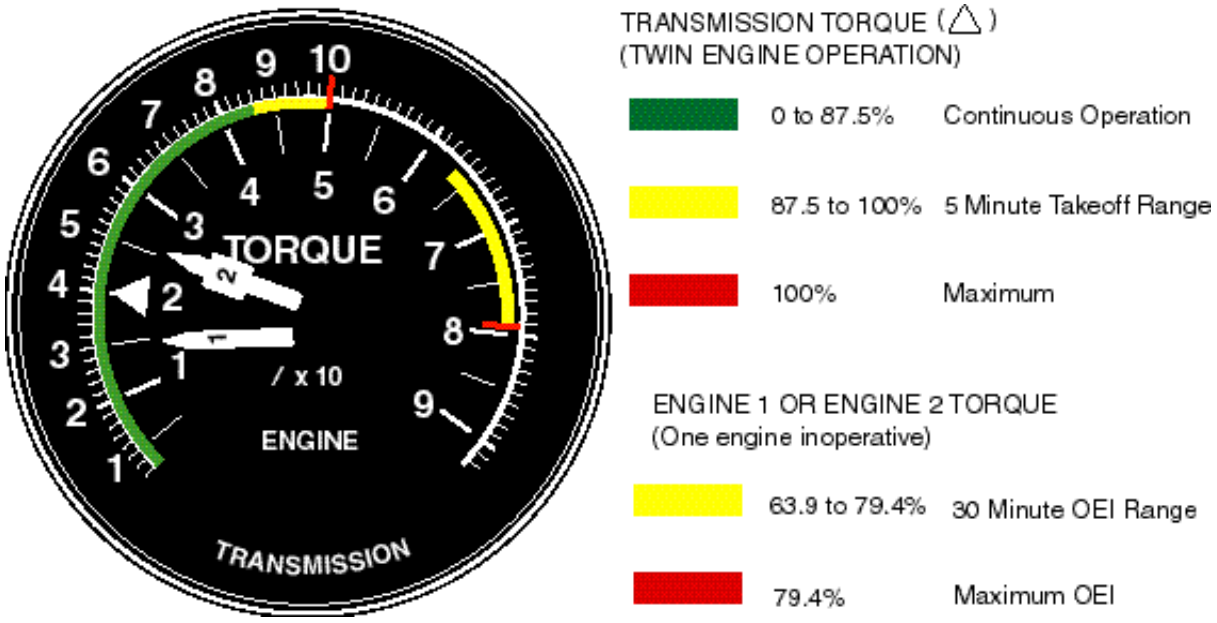


Figure 17-6 PT6T-3 OR -3B Torquemeter

300 to 765° C — Continuous Operation

765 to 810° C — 5 Minute Takeoff Range

810° C — Maximum for Takeoff

822° C — Maximum 30 minute OEI

850° C — Maximum 2 1/2 minute OEI

1090° C — Maximum for Starting (2 seconds above 960° C)

Note: This Gage may be used in helicopters equipped with either the PT6T -3B or the PT6T -3 engine.

Figure 17-7a PT6T-3B ITT Gauge

INTERTURBINE TEMPERATURE

200 to 765°C

765 to 810°C

810°C

Figure 17-7b PT6T-3 ITT Gauge

Temperature

	0 °C	Minimum
	0 to 115 °C	Continuous Operation
	115 °C	Maximum

Pressure

	40 PSI	Minimum for Flight Idle
	40 to 80 PSI	Conditional Operation (Below 79% N_1 RPM)
	80 to 115 PSI	Continuous Operation
	115 PSI	Maximum

Figure 17-8 Engine Oil Temperature and Pressure

Temperature

	0 °C	Minimum
	0 to 115 °C	Continuous Operation
	115 °C	Maximum

Pressure

	40 PSI	Minimum for Flight Idle
	40 to 60 PSI	Conditional Operation (Below 94% N_2 RPM)
	60 to 80 PSI	Continuous Operation
	80 PSI	Maximum

Figure 17-9 Combining Gearbox Oil Temperature and Pressure

General Instrument Markings

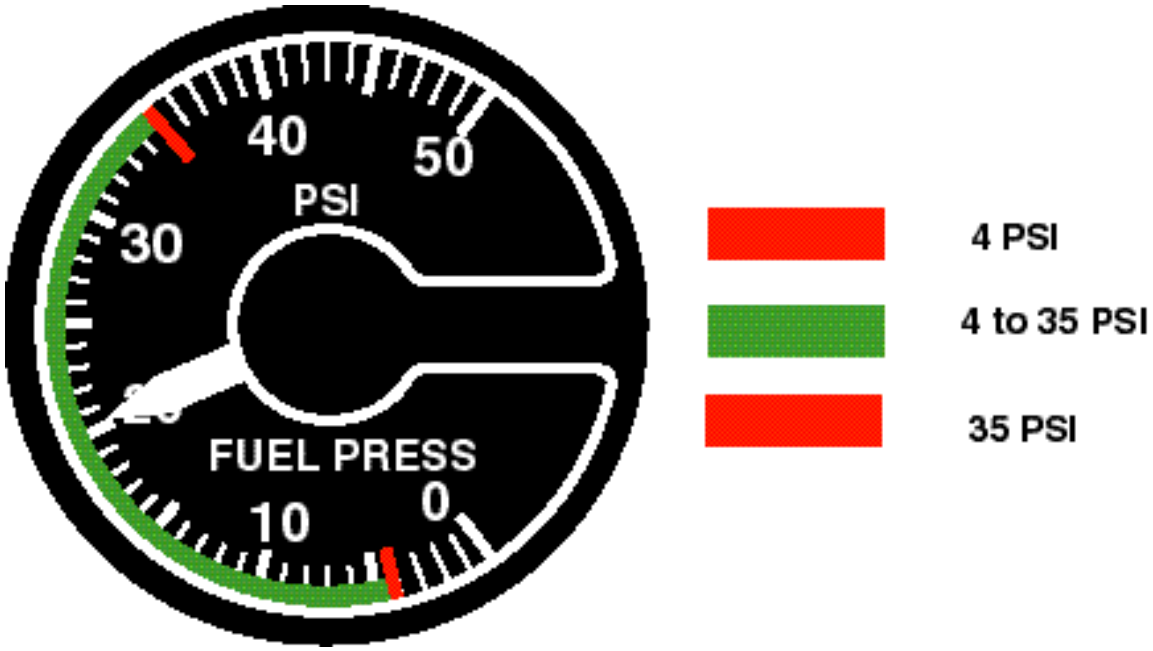


Figure 17-10 Fuel Pressure Gauge

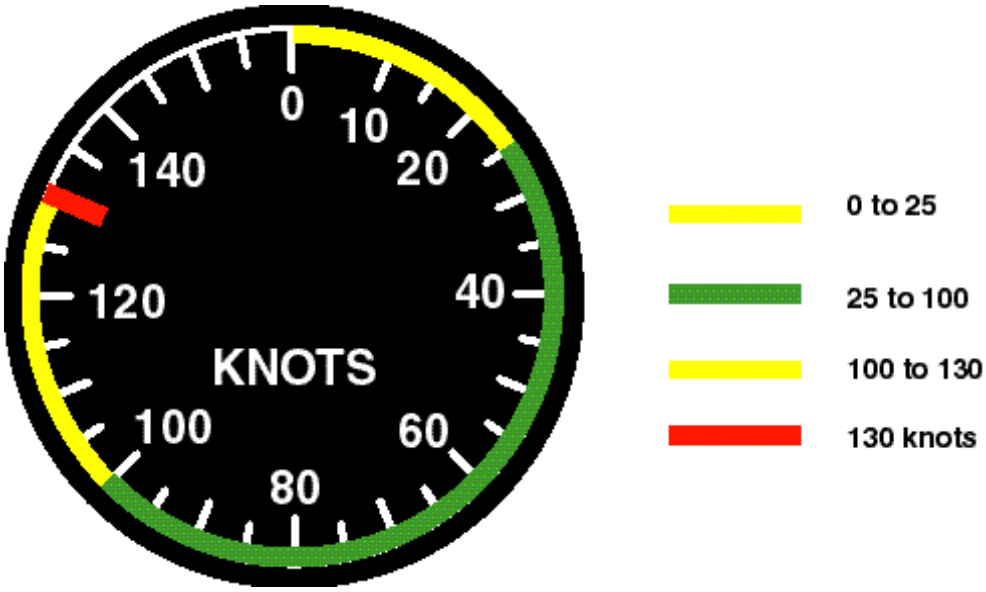


Figure 17-11 Airspeed Indicator (212 VFR)

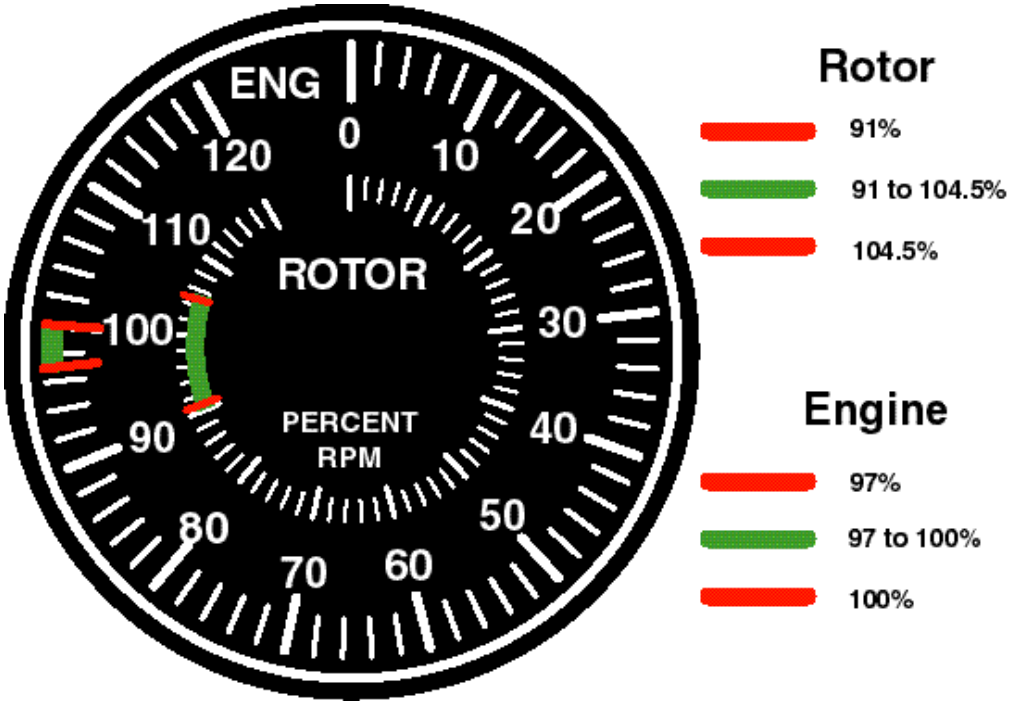


Figure 17-12 Triple Tachometer

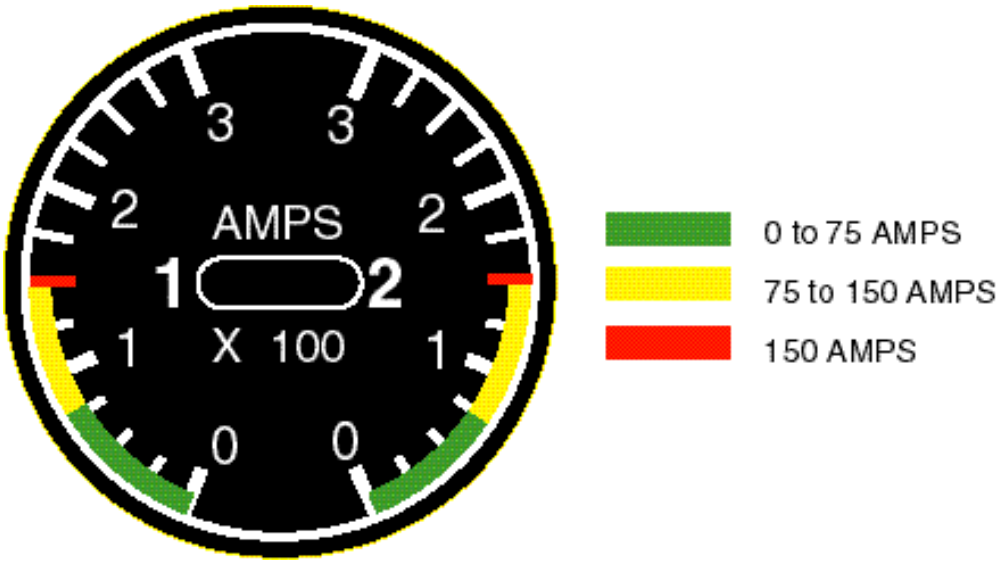


Figure 17-13 Ampere Meter

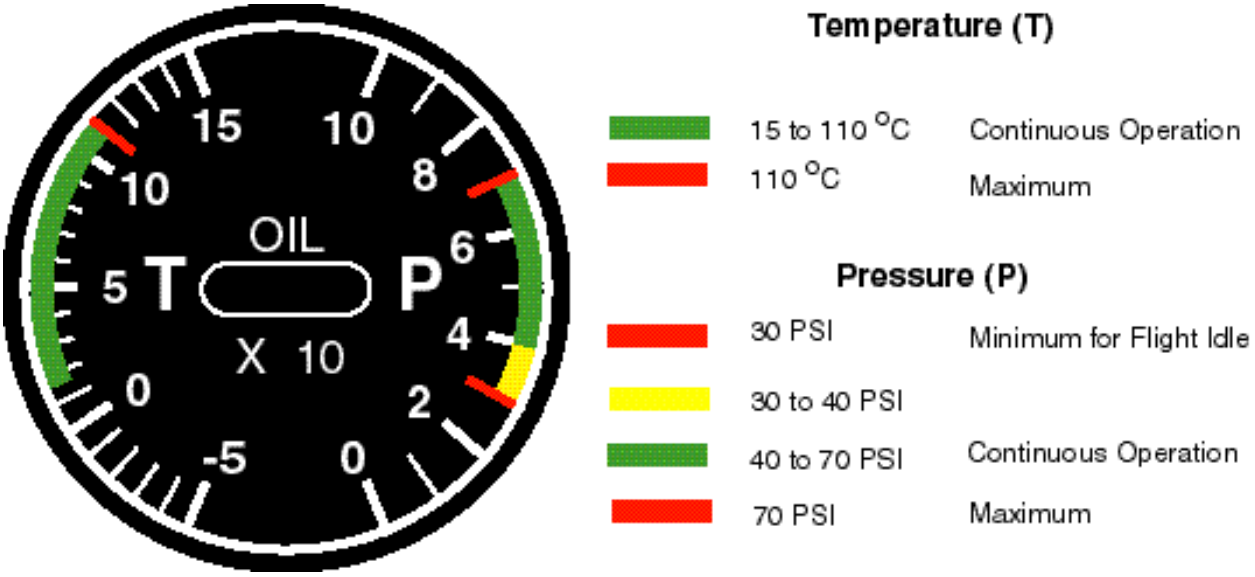


Figure 17-14 Transmission Oil Temperature and Pressure

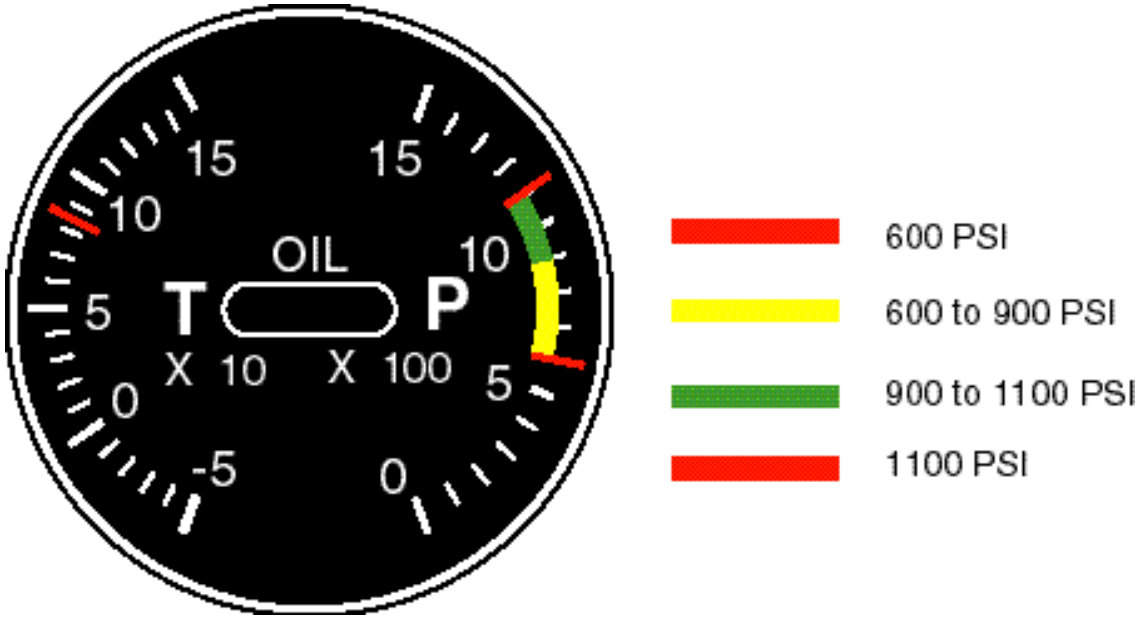


Figure 17-15 Hydraulic Pressure Indicator

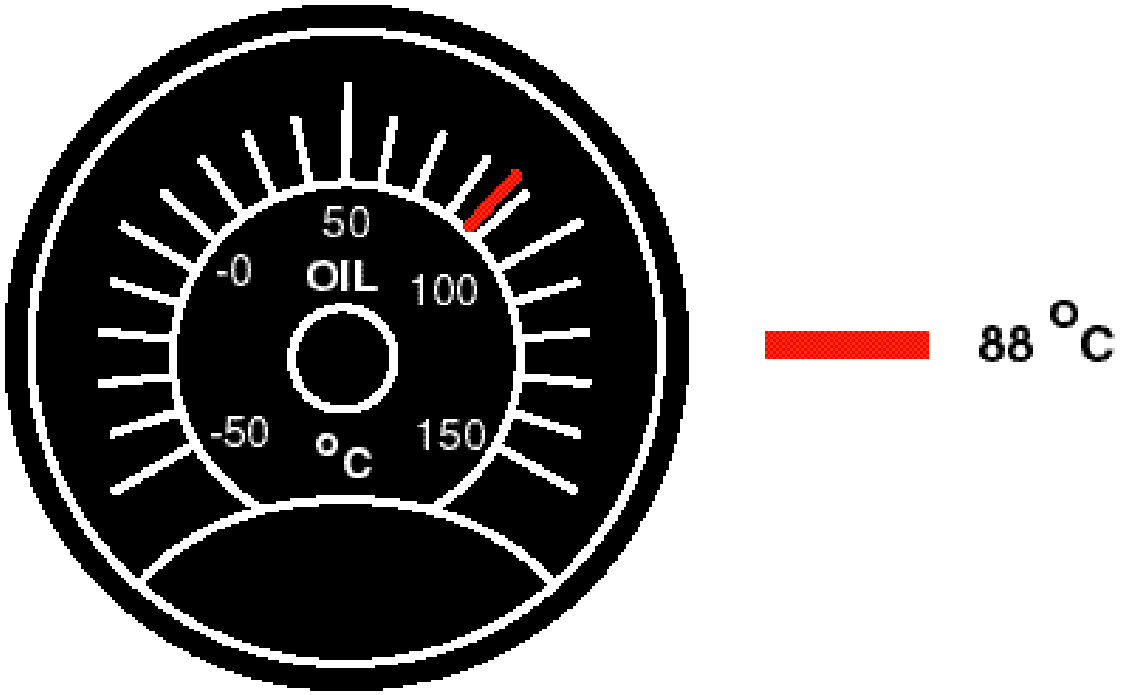


Figure 17-16 Hydraulic Temperature Indicator

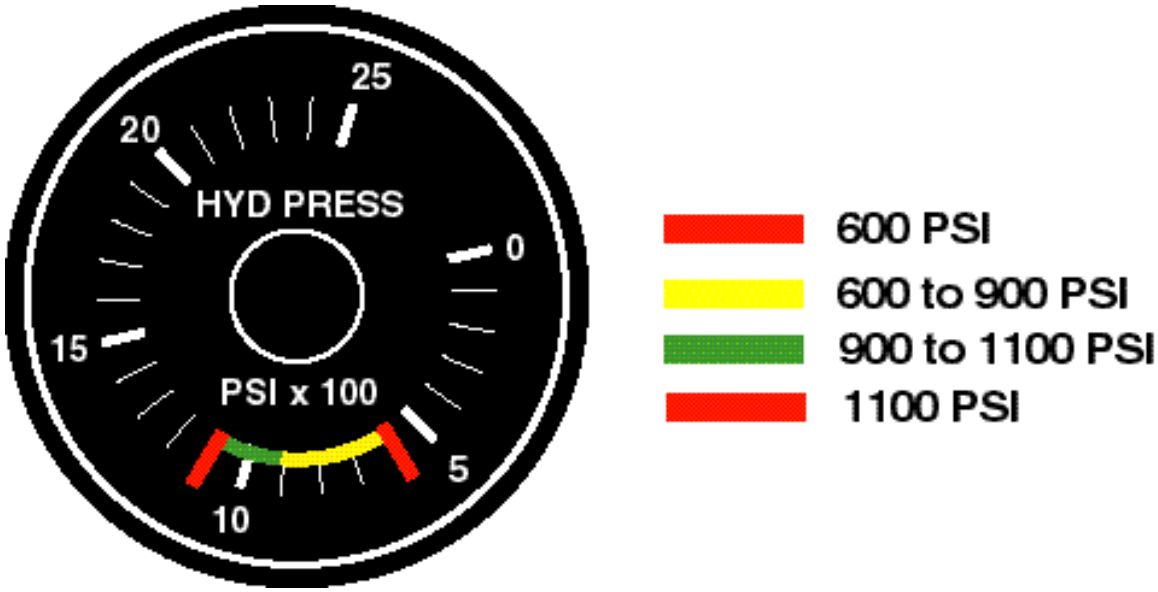


Figure 17-17 Hydraulic Pressure Gauge