

## **5.0 TERMINAL SERVICING**

- 5.1 Airplane Servicing Arrangement - Typical Turnaround**
- 5.2 Terminal Operations - Turnaround Station**
- 5.3 Terminal Operations - En Route Station**
- 5.4 Ground Servicing Connections**
- 5.5 Engine Starting Pneumatic Requirements**
- 5.6 Ground Pneumatic Power Requirements**
- 5.7 Conditioned Air Requirements**
- 5.8 Ground Towing Requirements**

## 5.0 TERMINAL SERVICING

During turnaround at the terminal, certain services must be performed on the aircraft, usually within a given time, to meet flight schedules. This section shows service vehicle arrangements, schedules, locations of service points, and typical service requirements. The data presented in this section reflect ideal conditions for a single airplane. Service requirements may vary according to airplane condition and airline procedure.

Section 5.1 shows typical arrangements of ground support equipment during turnaround. As noted, if the auxiliary power unit (APU) is used, the electrical, air start, and air-conditioning service vehicles would not be required. Passenger loading bridges or portable passenger stairs could be used to load or unload passengers.

Sections 5.2 and 5.3 show typical service times at the terminal. These charts give typical schedules for performing service on the airplane within a given time. Service times could be rearranged to suit availability of personnel, airplane configuration, and degree of service required.

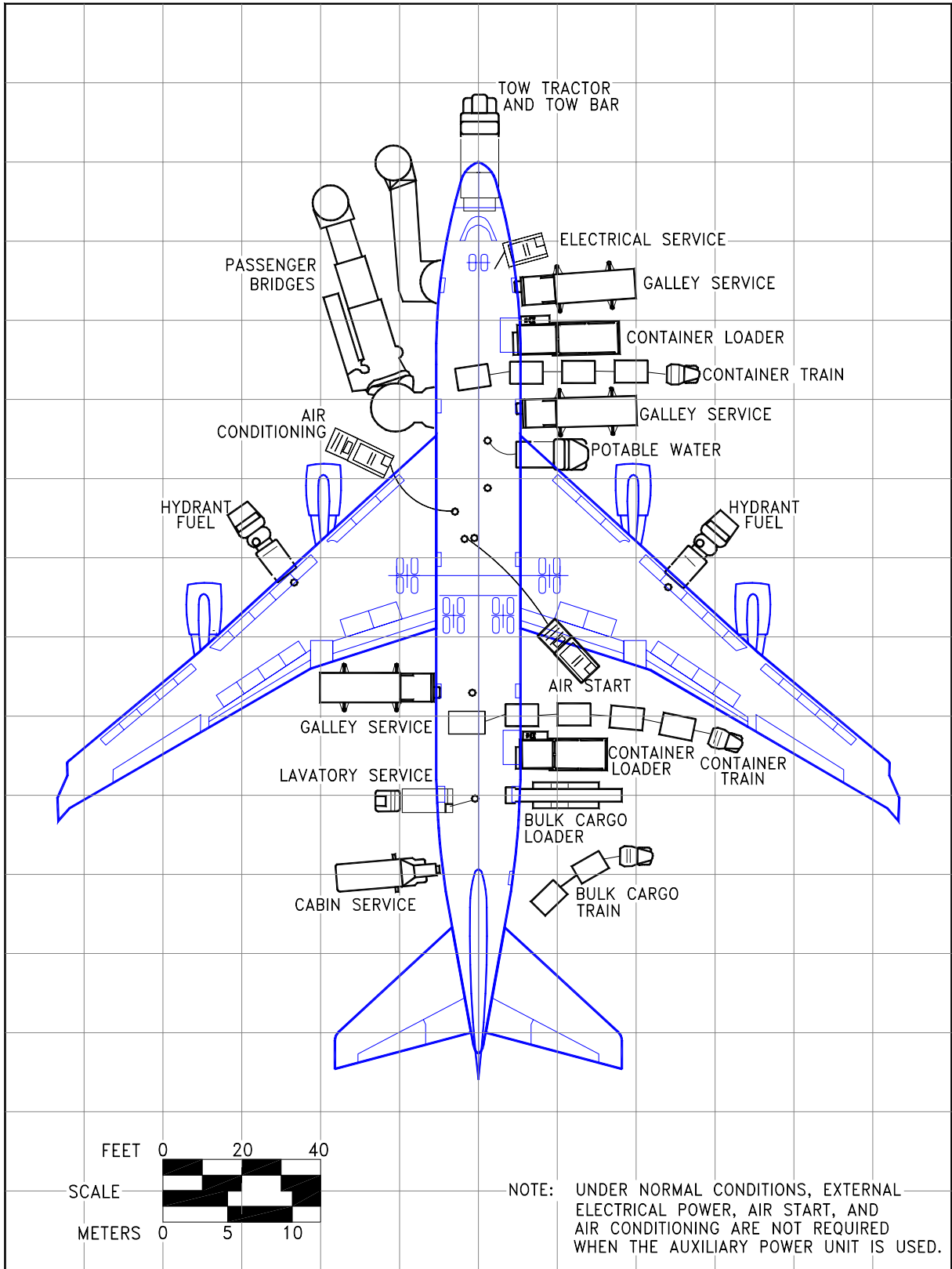
Section 5.4 shows the locations of ground service connections in graphic and in tabular forms. Typical capacities and service requirements are shown in the tables. Services with requirements that vary with conditions are described in subsequent sections.

Section 5.5 shows typical sea level air pressure and flow requirements for starting different engines. The curves are based on an engine start time of 90 seconds.

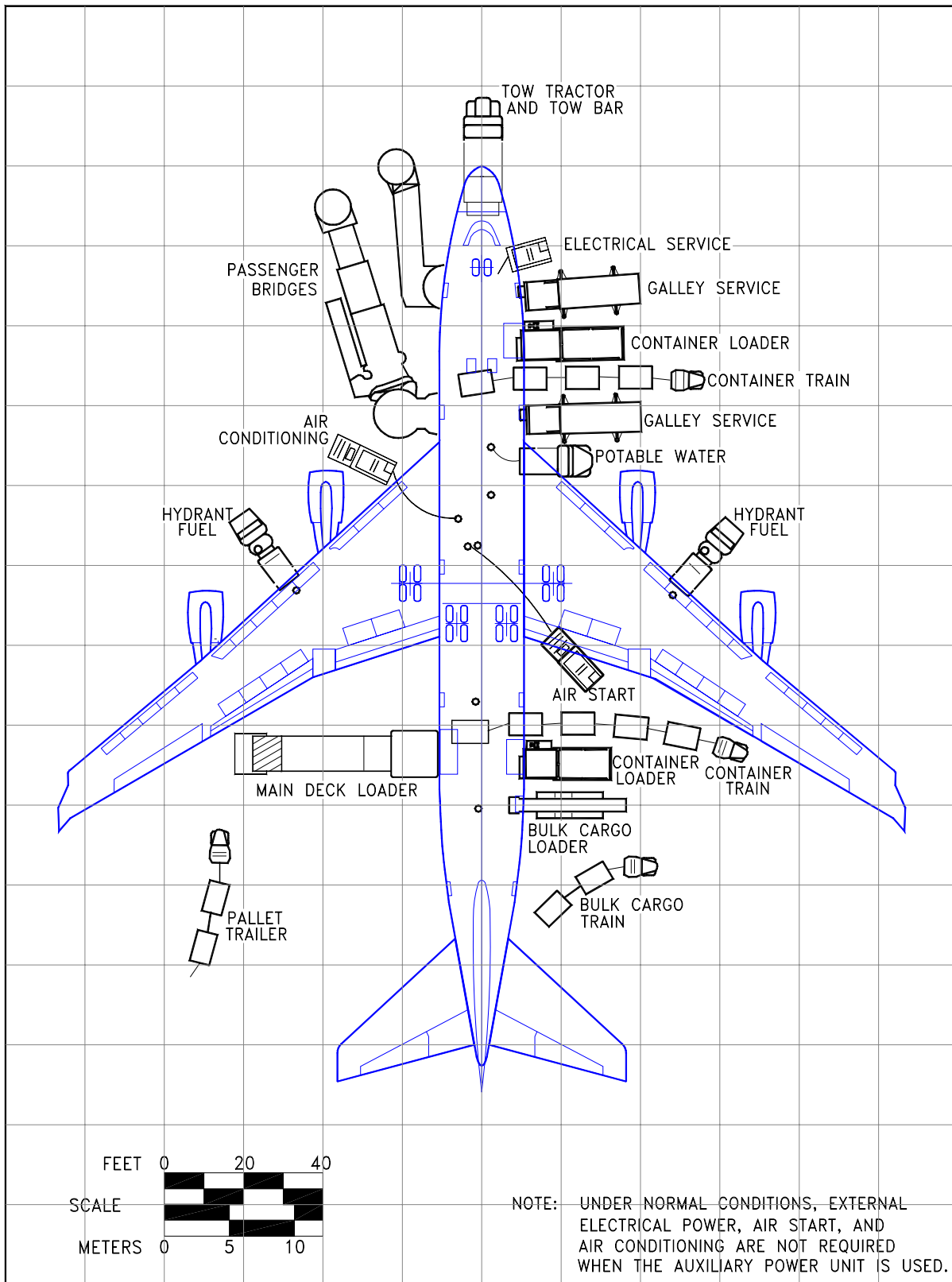
Section 5.6 shows pneumatic requirements for heating and cooling (air conditioning) using high pressure air to run the air cycle machine. The curves show airflow requirements to heat or cool the airplane within a given time and ambient conditions. Maximum allowable pressure and temperature for air cycle machine operation are 60 psia and 450<sup>0</sup>F, respectively.

Section 5.7 shows pneumatic requirements for heating and cooling the airplane, using low pressure conditioned air. This conditioned air is supplied through an 8-in ground air connection (GAC) directly to the passenger cabin, bypassing the air cycle machines.

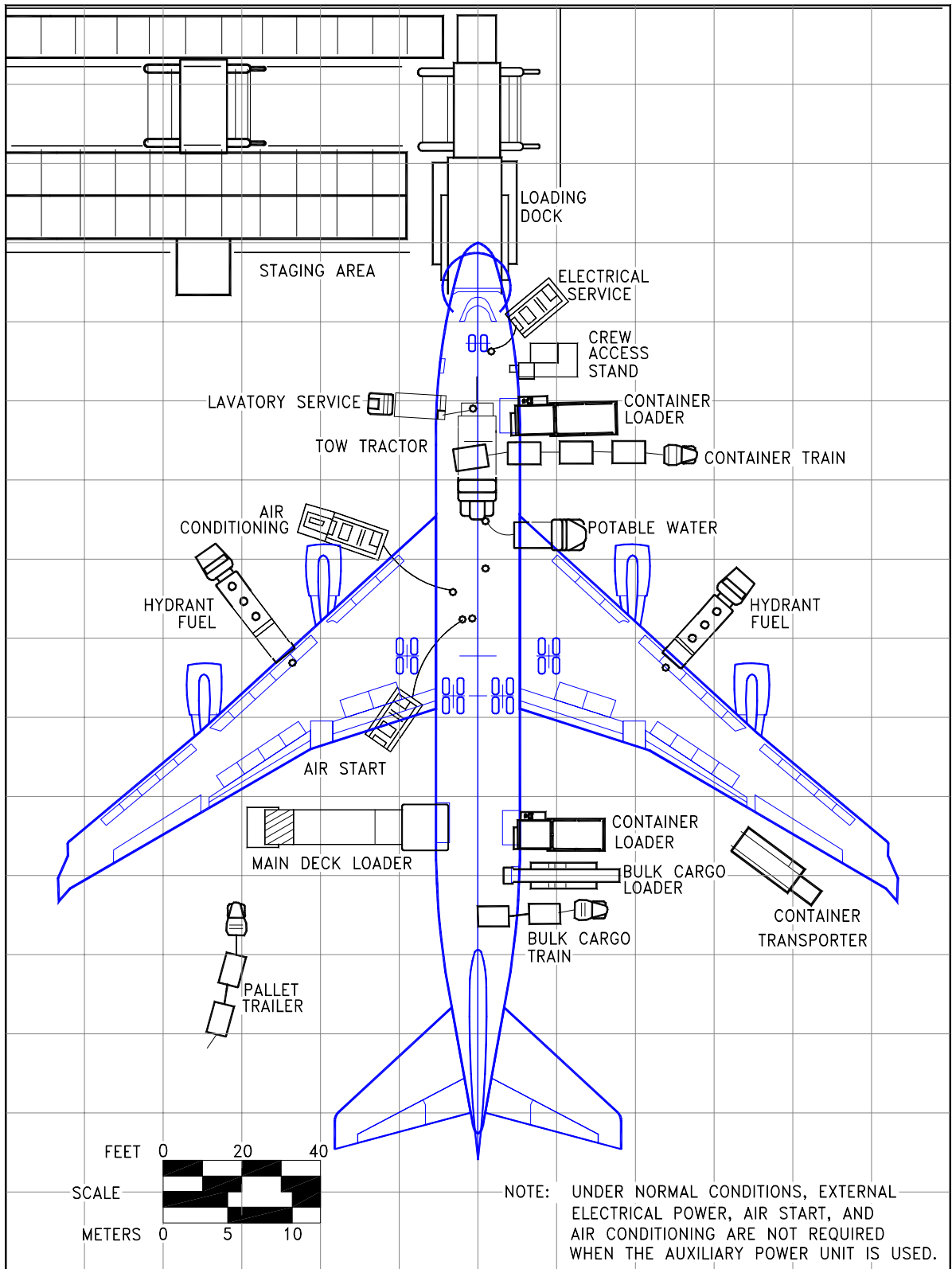
Section 5.8 shows ground towing requirements for various ground surface conditions.



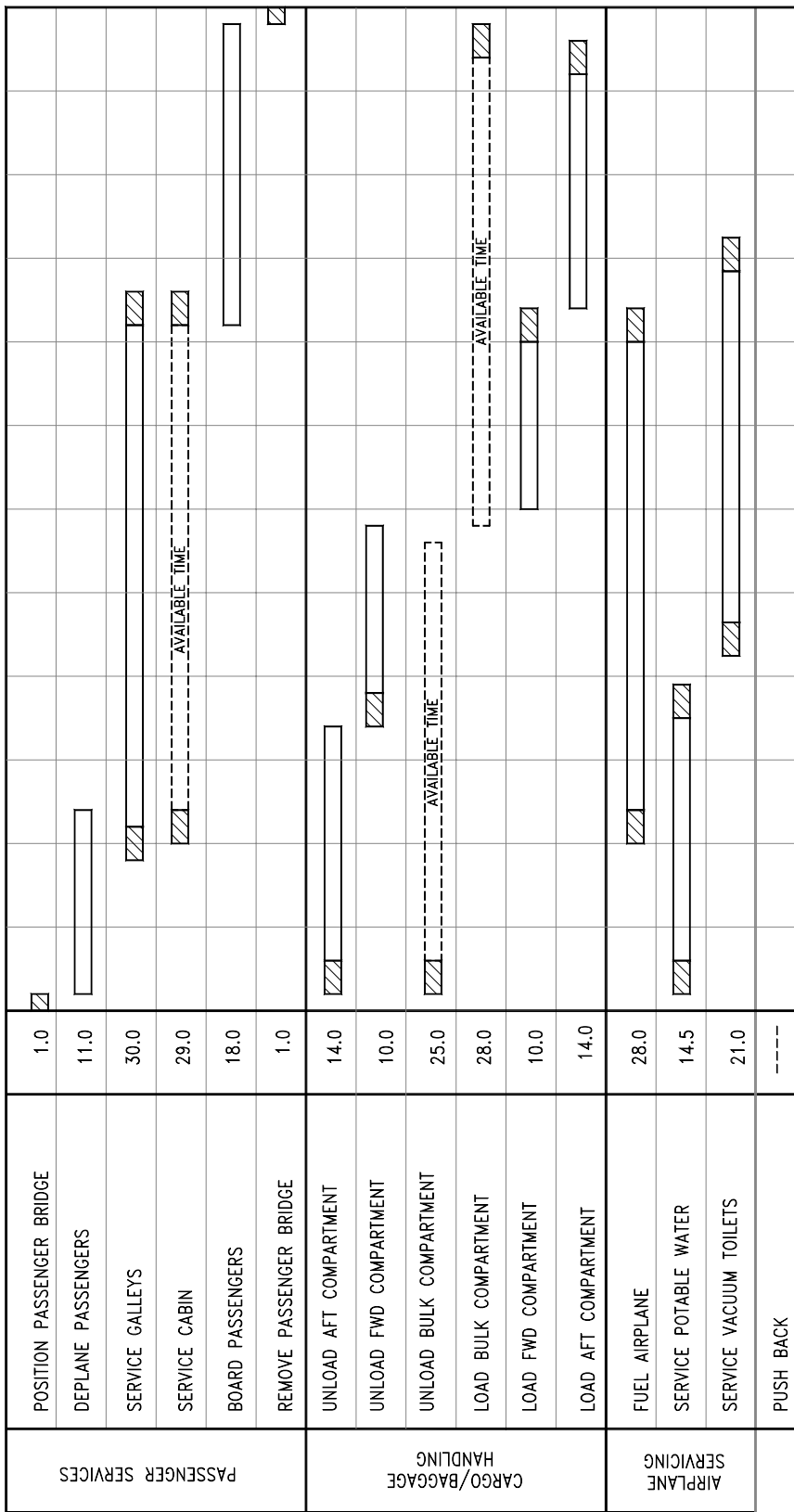
**5.1.1 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND**  
 MODEL 747-400, -400 DOMESTIC, -400ER



**5.1.2 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND**  
 MODEL 747-400 COMBI



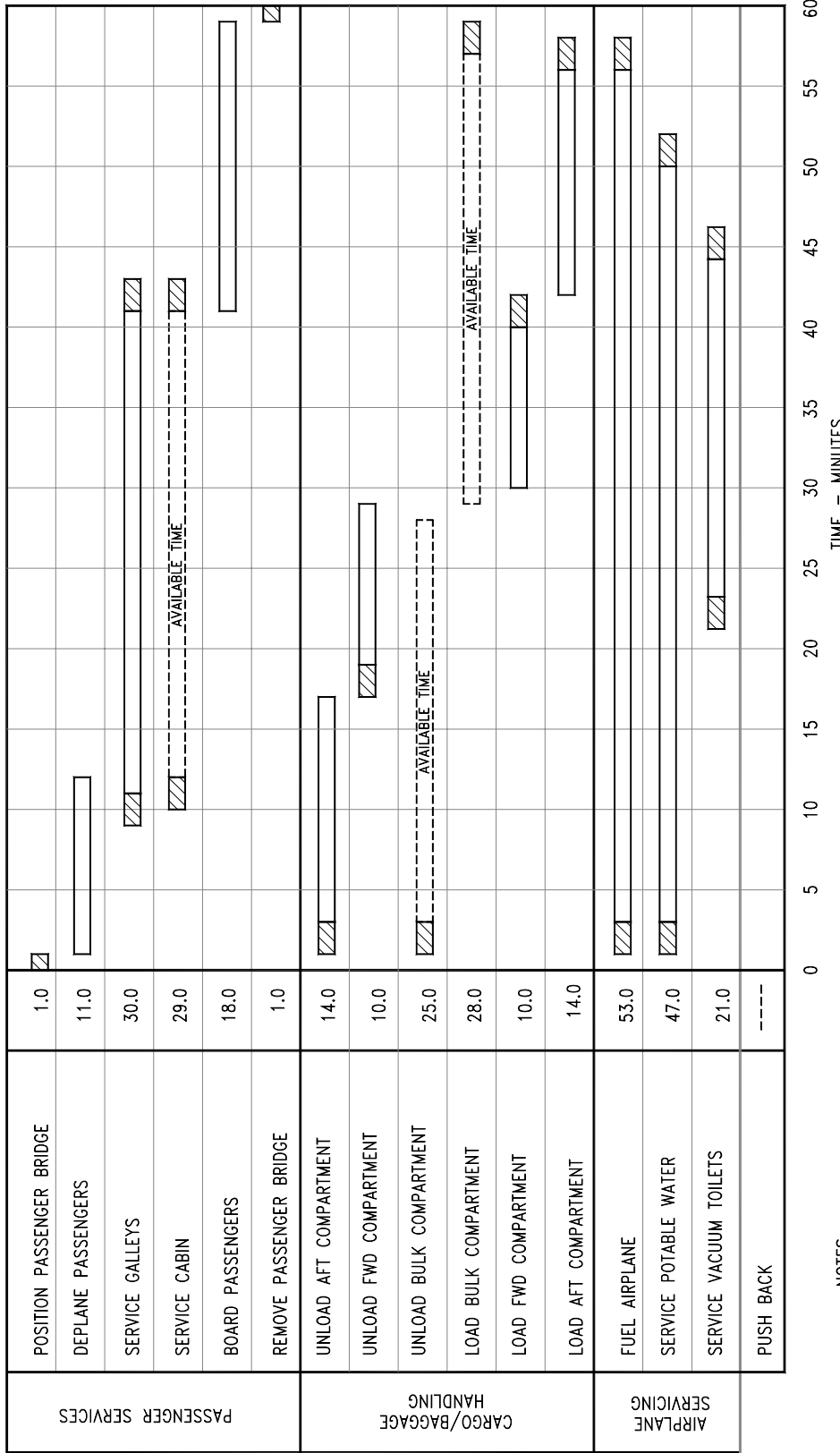
**5.1.3 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND**  
 MODEL 747-400 FREIGHTER, -400ER FREIGHTER



NOTES:

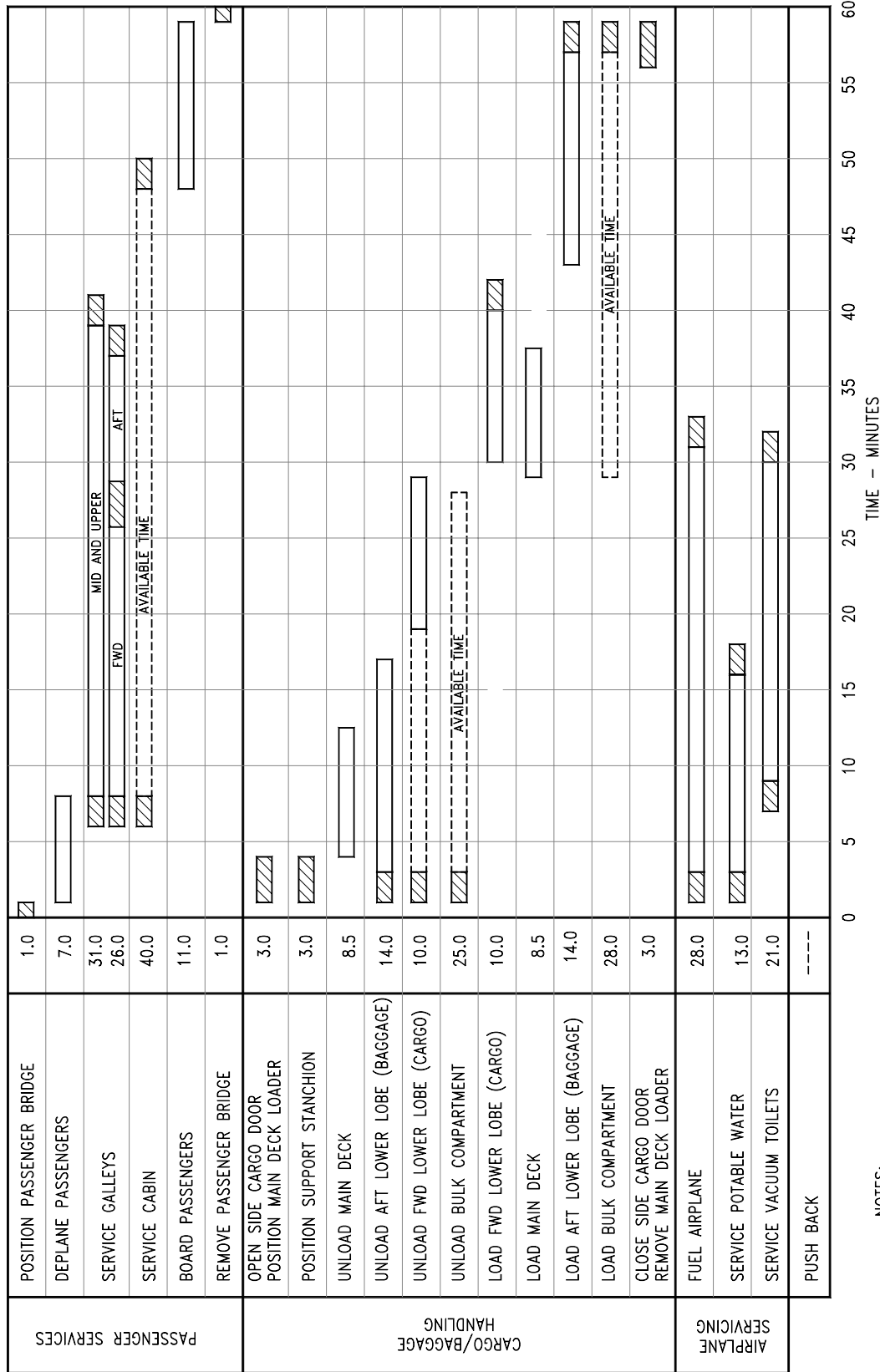
- [Hatched box] POSITION/REMOVE EQUIPMENT
- 100% EXCHANGE OF PASSENGERS AND CARGO
- 442 PASSENGERS - ONE DOOR
- THREE GALLEY SERVICE TRUCKS
- CABIN SERVICE IS TIME AVAILABLE BETWEEN PASSENGER EXCHANGE
- PASSENGER LOADING RATES:  
UNLOADING - 40 PER MINUTE  
LOADING - 25 PER MINUTE
- CARGO IN BULK CARGO COMPARTMENT AT 75% VOLUME UTILIZATION AND 8.5 POUNDS PER CUBIC FOOT.
- ONE LAVATORY TRUCK
- POTABLE WATER 435 GALLONS AT 30 GPM AND 25 PSIG
- 43,300 GALLONS FUEL LOADED 4,200 GALLONS RESERVE FOUR-NOZZLE HYDRANT FUELING AT 35 PSIG

**5.2.1 TERMINAL OPERATIONS - TURNAROUND STATION - ALL PASSENGER**  
 MODEL 747-400, -400 COMBI, -400 DOMESTIC



### 5.2.2 TERMINAL OPERATIONS - TURNAROUND STATION - ALL PASSENGER MODEL 747-400ER

**5.2.3 TERMINAL OPERATIONS - TURNAROUND STATION – PASSENGER/CARGO**  
 MODEL 747-400 COMBI



- NOTES:
- ▨ POSITION/REMOVE EQUIPMENT
  - SIX PALLETS – MAIN DECK
  - POSITION/REMOVE EQUIPMENT
  - 100% EXCHANGE OF PASSENGERS AND CARGO
  - FORTY-FOUR PALLETS – AFT LOWER LOBE
  - FIVE PALLETS – FORWARD LOWER LOBE
  - 271 PASSENGERS – ONE DOOR
  - TWO GALLEY SERVICE TRUCKS
  - ONE LAVATORY TRUCK
  - 43,300 GALLONS FUEL LOADED
  - 4,200 GALLONS RESERVE
  - POTABLE WATER 330 GALLONS
  - AT 30 GPM AND 25 PSIG
  - FOUR-NOZZLE HYDRANT FUELING AT 35 PSIG



		TIME - MINUTES													
		0	15	30	45	60	75	90						90	
CARGO HANDLING MAIN DECK	OPEN NOSE CARGO DOOR AND POSITION LOADER	3.0													
	POSITION SUPPORT STANCHION	3.0													
	UNLOAD MAIN DECK	37.5													
	LOAD MAIN DECK	37.5													
	CLOSE NOSE CARGO DOOR AND CLEAR EQUIPMENT	3.0													
	UNLOAD AFT LOWER LOBE	16.0													
CARGO HANDLING LOWER LOBE	UNLOAD FWD LOWER LOBE	10.0													
	UNLOAD BULK COMPARTMENT	41.0													
	LOAD BULK COMPARTMENT	10.0													
	LOAD FWD LOWER LOBE	16.0													
	LOAD AFT LOWER LOBE	43.0													
	FUEL AIRPLANE	25.0													
AIRPLANE SERVICING	SERVICE POTABLE WATER	5.0													
	SERVICE VACUUM TOILETS	5.0													
	PUSH BACK	----													

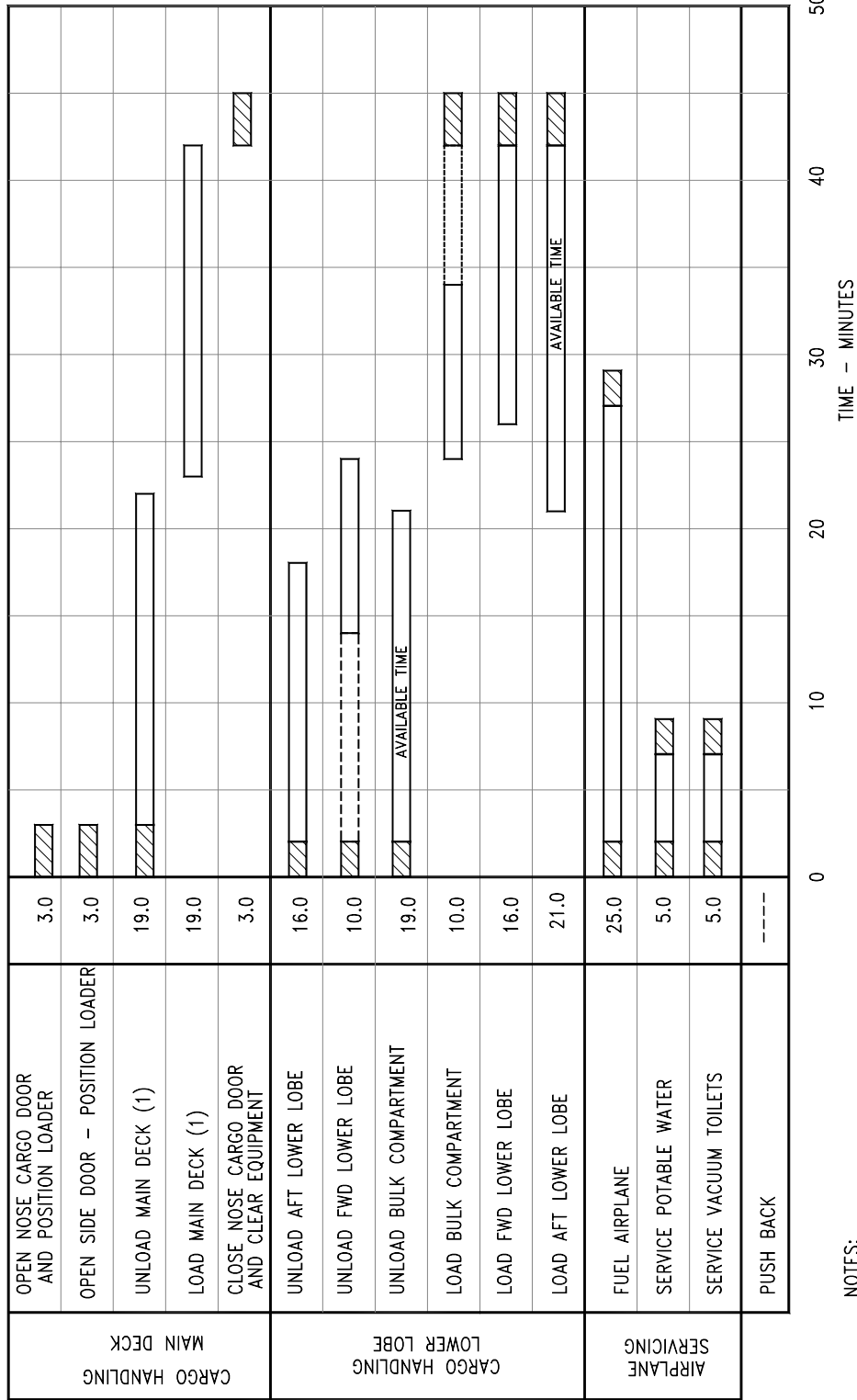
- NOTES:
- ▨ POSITION/REMOVE EQUIPMENT
  - MAIN DECK CARGO - (30) 96 x 125-IN ULD'S
  - 100% CARGO EXCHANGE
  - 16 CONTAINERS - AFT LOWER LOBE
  - 5 PALLETS - FWD LOWER LOBE
  - 40,000 GALLONS FUEL LOADED
  - 4,200 GALLONS RESERVE
  - 4-NOZZLE HYDRANT FUELING AT 35 PSIG
  - ONE TOILET TRUCK - FORWARD TOILET
  - POTABLE WATER - 30 GALLONS

**5.2.4 TERMINAL OPERATIONS - TURNAROUND STATION - ALL CARGO, NOSE DOOR LOADING**  
 MODEL 747-400 FREIGHTER, -400ER FREIGHTER

		TIME -- MINUTES											
		0	15	30	45	60	75	90					
CARGO HANDLING MAIN DECK	OPEN SIDE CARGO DOOR AND POSITION LOADER	3.0											
	POSITION SUPPORT STANCHION	3.0											
	UNLOAD MAIN DECK	40.5											
	LOAD MAIN DECK	40.5											
	CLOSE NOSE CARGO DOOR AND CLEAR EQUIPMENT	3.0											
	UNLOAD AFT LOWER LOBE	16.0											
CARGO HANDLING LOWER LOBE	UNLOAD FWD LOWER LOBE	10.0											
	UNLOAD BULK COMPARTMENT	41.0											
	LOAD BULK COMPARTMENT	10.0											
	LOAD FWD LOWER LOBE	16.0											
	LOAD AFT LOWER LOBE	43.0											
	FUEL AIRPLANE	25.0											
AIRPLANE SERVICING	SERVICE POTABLE WATER	5.0											
	SERVICE VACUUM TOILETS	5.0											
	PUSH BACK	---											

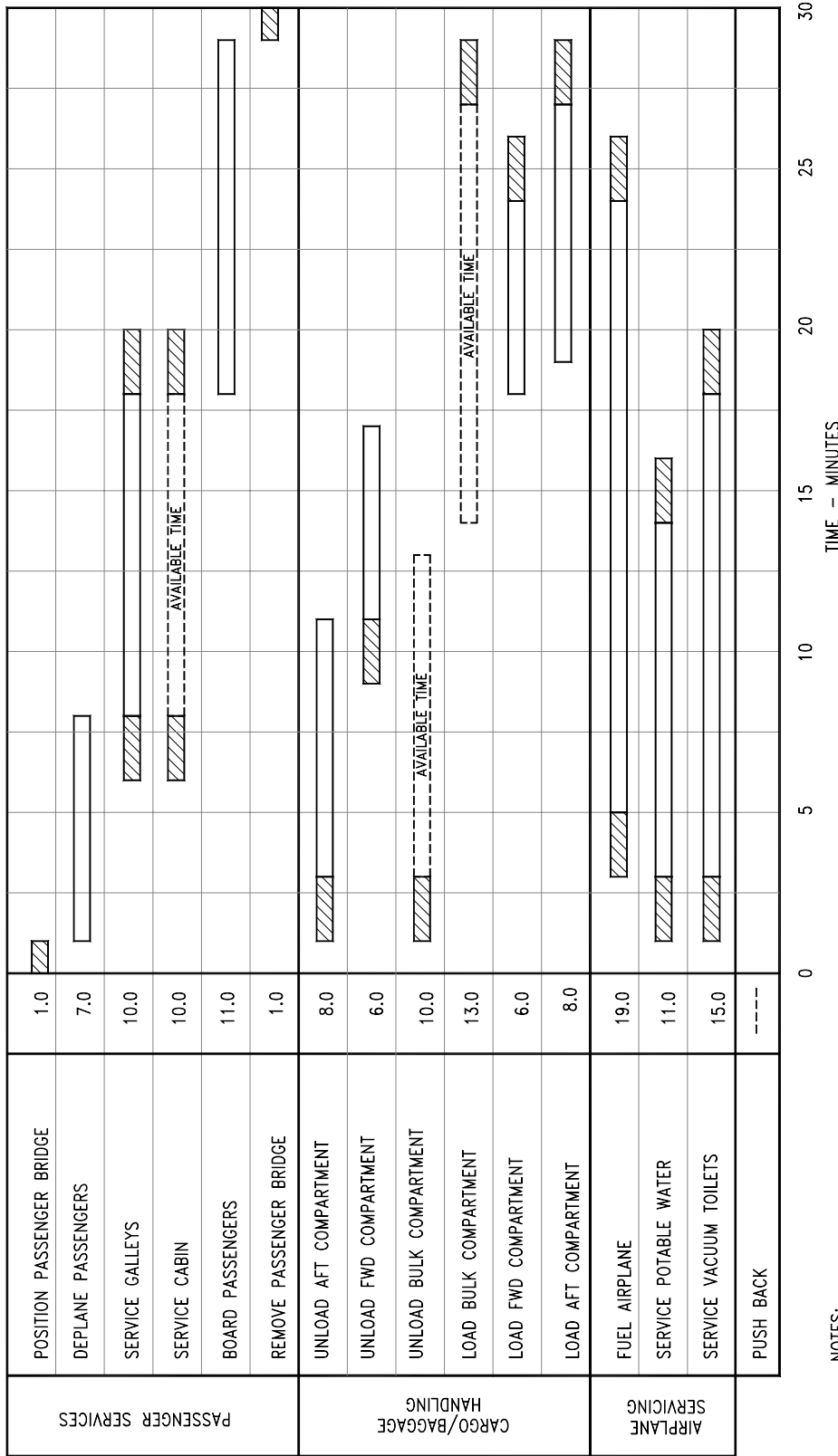
- NOTES:
- ▨ POSITION/REMOVE EQUIPMENT
  - MAIN DECK CARGO - (30) 96 x 125-IN ULD'S
  - 100% CARGO EXCHANGE
  - 16 CONTAINERS - AFT LOWER LOBE
  - 5 PALLETS - FWD LOWER LOBE
  - 40,000 GALLONS FUEL LOADED
  - 4,200 GALLONS RESERVE
  - 4-NOZZLE HYDRANT FUELING AT 35 PSIG
  - ONE TOILET TRUCK - FORWARD TOILET
  - POTABLE WATER - 30 GALLONS

**5.2.5 TERMINAL OPERATIONS - TURNAROUND STATION - ALL CARGO, SIDE DOOR LOADING**  
 MODEL 747-400 FREIGHTER, -400ER FREIGHTER



- NOTES:
- ▨ POSITION/REMOVE EQUIPMENT
  - MAIN DECK CARGO - (30) 96 x 125-IN ULD'S
  - 100% CARGO EXCHANGE
  - 16 CONTAINERS - AFT LOWER LOBE
  - 5 PALLETS - FWD LOWER LOBE
  - 40,000 GALLONS FUEL LOADED
  - 4,200 GALLONS RESERVE
  - 4-NOZZLE HYDRANT FUELING AT 35 PSIG
  - ONE TOILET TRUCK - FORWARD TOILET
  - POTABLE WATER - 30 GALLONS
  - (1) SIMULTANEOUS NOSE AND SIDE DOOR CARGO LOADING

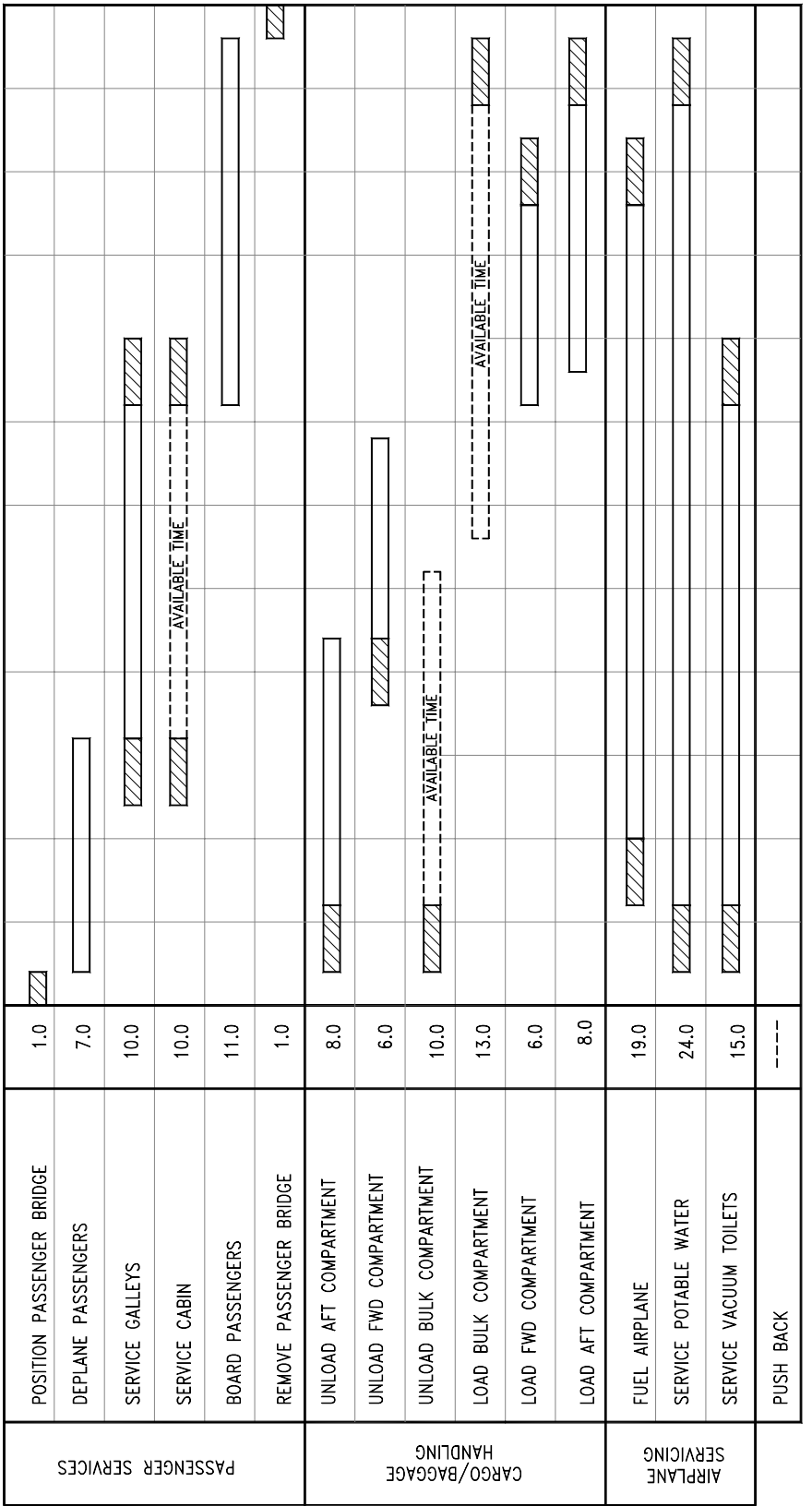
**5.2.6 TERMINAL OPERATIONS - TURNAROUND STATION - ALL CARGO, NOSE AND SIDE CARGO DOOR LOADING**  
 MODEL 747-400 FREIGHTER, -400ER FREIGHTER



NOTES:

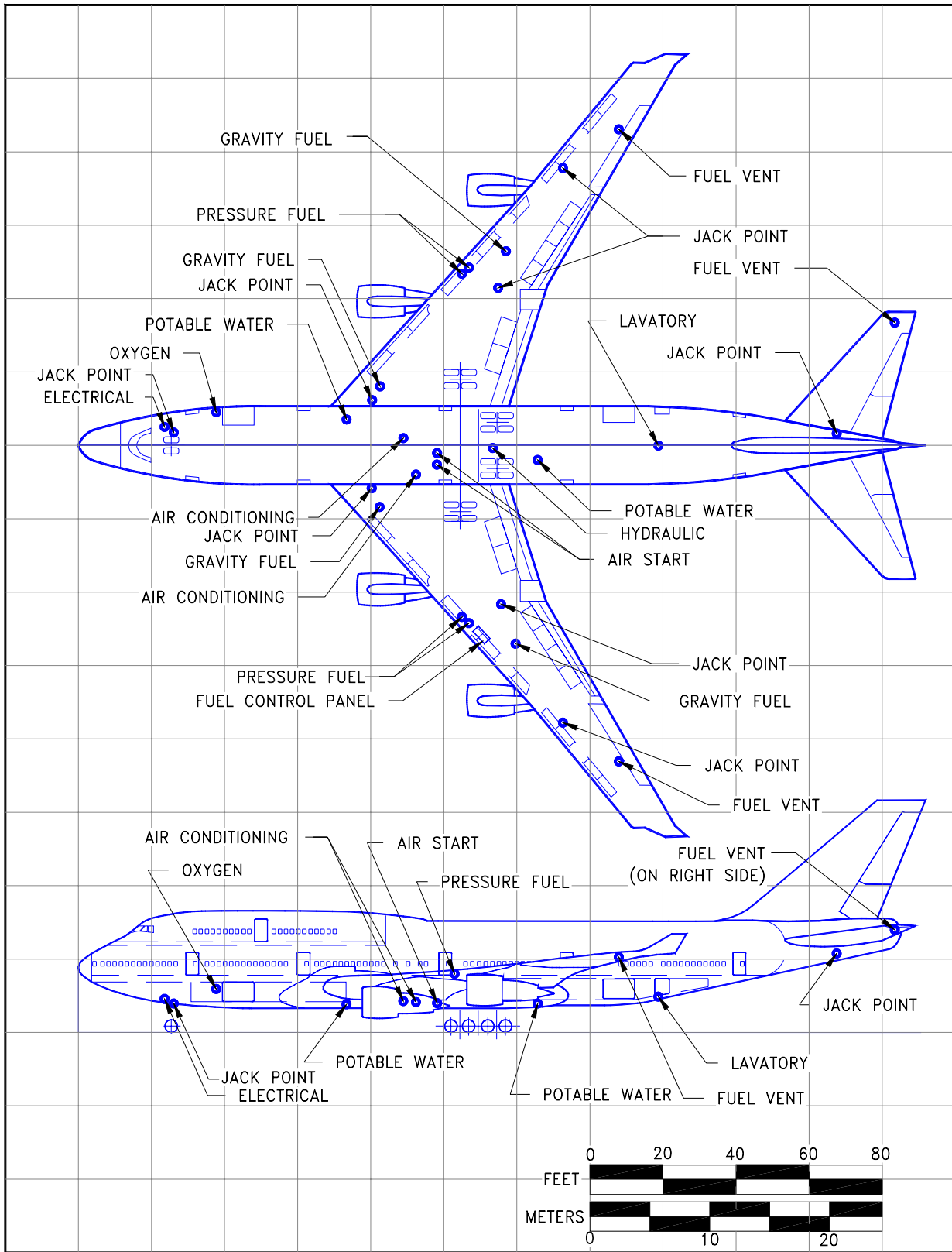
- ▨ POSITION/REMOVE EQUIPMENT
- 100% LOAD FACTOR, 50% EXCHANGE OF CARGO
- 442 PASSENGERS – ONE DOOR, 60% EXCHANGE
- PASSENGER LOADING RATES:  
UNLOADING – 40 PER MINUTE  
LOADING – 25 PER MINUTE
- EXCHANGE – THREE PALLETS FWD,  
EIGHT LD3'S AFT
- 40% BULK CARGO EXCHANGE AT  
75% VOLUME UTILIZATION AND  
8.5 POUNDS PER CUBIC FOOT.
- THREE GALLEY SERVICE TRUCKS – REPLENISH ONLY
- CABIN CLEANING – TOUCH UP ONLY
- ONE LAVATORY TRUCK – TANKS ASSUMED HALF-FULL
- POTABLE WATER – 330 GALLONS  
AT 00 GPM AND 35 PSIG
- 18,000 GALLONS FUEL LOADED  
4,200 GALLONS RESERVE  
FOUR-NOZZLE HYDRANT FUELING AT 35 PSIG

**5.3.1 TERMINAL OPERATIONS - EN ROUTE STATION - ALL PASSENGER  
MODEL 747-400, -400 COMBI, -400 DOMESTIC**



- NOTES:
- ▨ POSITION/REMOVE EQUIPMENT
  - 100% LOAD FACTOR, 50% EXCHANGE OF CARGO
  - 442 PASSENGERS - ONE DOOR, 60% EXCHANGE
  - PASSENGER LOADING RATES: UNLOADING - 40 PER MINUTE, LOADING - 25 PER MINUTE
  - EXCHANGE - THREE PALLETES FWD, EIGHT LD3'S AFT
  - 40% BULK CARGO EXCHANGE AT 75% VOLUME UTILIZATION AND 8.5 POUNDS PER CUBIC FOOT.
  - THREE GALLEY SERVICE TRUCKS - REPLENISH ONLY
  - CABIN CLEANING - TOUCH UP ONLY
  - ONE LAVATORY TRUCK - TANKS ASSUMED HALF-FULL
  - POTABLE WATER - 240 GALLONS AT 10 GPM AND 60 PSIG
  - 18,000 GALLONS FUEL LOADED, 4,200 GALLONS RESERVE
  - FOUR-NOZZLE HYDRANT FUELING AT 35 PSIG

**5.3.2 TERMINAL OPERATIONS - EN ROUTE STATION - ALL PASSENGER**  
 MODEL 747-400ER



**5.4.1 GROUND SERVICE CONNECTIONS**  
*MODEL 747-400*

SYSTEM	DISTANCE AFT OF NOSE		DISTANCE FROM AIRPLANE CENTERLINE				HEIGHT ABOVE GROUND			
			LH SIDE		RH SIDE		MINIMUM		MAXIMUM	
	FT-IN	M	FT-IN	M	FT-IN	M	FT-IN	M	FT-IN	M
ELECTRICAL TWO COLLOCATED CONNECTORS 90 KVA , 200/115 V AC 400 HZ, 3-PHASE EACH	26 - 9	8.15	-	-	3 - 4	1.02	7 - 10	2.39	9 - 4	2.85
FUEL FOUR UNDERWING PRESSURE CONNECTORS (2 ON EACH WING) MAX FUELING RATE 500 US GPM (1890 LPM) PER NOZZLE OR 2000 US GPM (7570 LPM) TOTAL MAX FUEL PRESSURE 50 PSIG (3.52 KG/CM <sup>2</sup> ) OVERWING GRAVITY FUEL CONNECTIONS WING FUEL VENT TAIL FUEL VENT TANK CAPACITIES:	104 - 7 105 - 7	31.89 32.18	45 - 8 46 - 9	13.91 14.26	45 - 8 46 - 9	13.91 14.26	14 - 9 14 - 9	4.50 4.50	15 - 10 15 - 10	4.84 4.84
	82 - 10 116 - 7	25.25 35.53	16 - 7 53 - 9	5.06 16.39	16 - 7 53 - 9	5.06 16.39	15 - 3 16 - 11	4.65 5.14	16 - 3 18 - 2	4.96 5.54
	146 - 9	44.73	89 - 4	27.23	89 - 4	27.23	16 - 10	5.12	19 - 3	5.86
	221 - 3	67.44	-	-	29 - 10	9.09	27 - 1	8.24	28 - 9	8.75
TANK	VOLUME		RB211-524G, RB211-524H PW 4058, PW 4062				CF6-80C2B1 CF6-80C2B5F			
RESERVE NO 2 & 3	U.S. GALLONS		1,298 EACH				1,322 EACH			
	LITERS		4,913 EACH				5,004 EACH			
MAIN NO 1 & 2	U.S. GALLONS		4,506 EACH				4,372 EACH			
	LITERS		17,055 EACH				16,548 EACH			
MAIN NO 2 & 3	U.S. GALLONS		12,546 EACH				12,546 EACH			
	LITERS		47,486 EACH				47,486 EACH			
CENTER WING	U.S. GALLONS		17,164				17,164			
	LITERS		64,960				64,960			
HORIZONTAL STABILIZER	U.S. GALLONS		3,300				3,300			
	LITERS		12,490				12,490			
BODY FUEL TANKS (747-400ER ONLY)	U.S. GALLONS		3,060 EACH				3,060 EACH			
	LITERS		11,582 EACH				11,582 EACH			
MANIFOLD, LINES, & MISC	U.S. GALLONS		121 (-400), 176 (-400ER)				121 (-400), 176 (-400ER)			
	LITERS		458 (-400), 666 (-400ER)				458 (-400), 666 (-400ER)			
TOTAL USABLE (747-400 ONLY)	U.S. GALLONS		57,340				57,120			
	LITERS		217,032				216,199			
TOTAL USABLE (747-400ER ONLY)	U.S. GALLONS		63,460				63,240			
	LITERS		240,196				239,363			

**5.4.2 GROUND SERVICE CONNECTIONS**  
MODEL 747-400

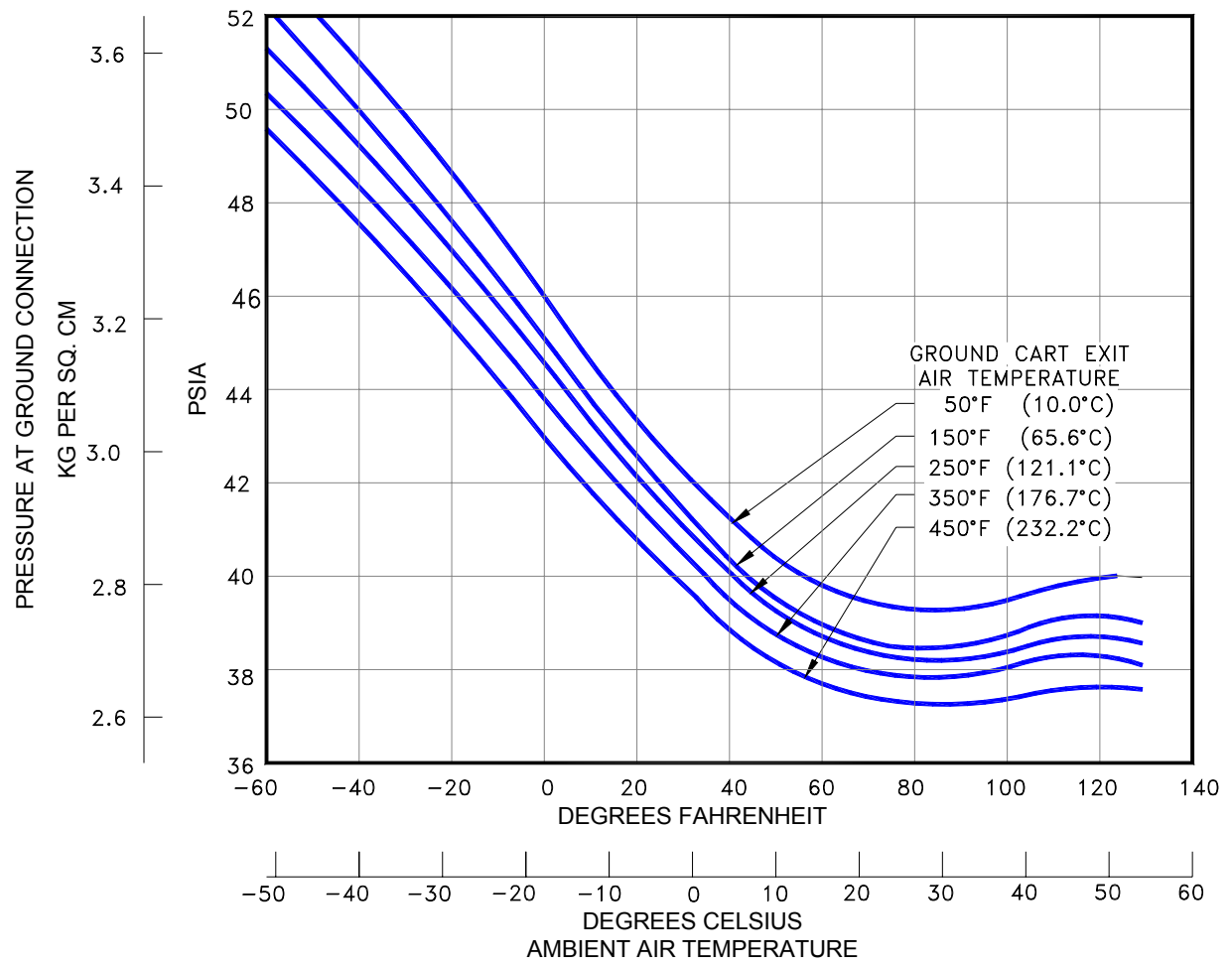
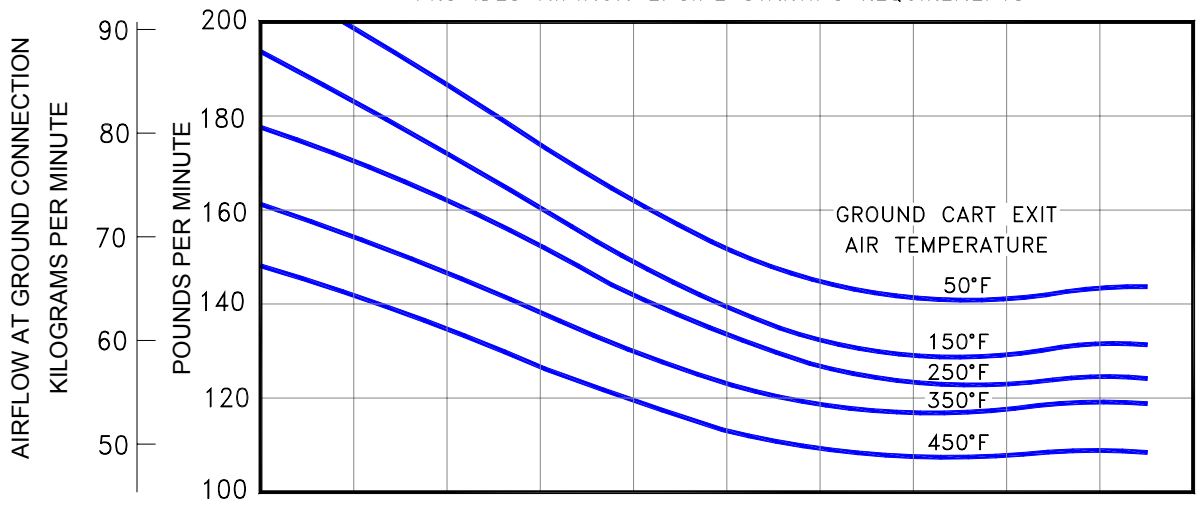
SYSTEM	DISTANCE AFT OF NOSE		DISTANCE FROM AIRPLANE CENTERLINE				HEIGHT ABOVE GROUND			
			LH SIDE		RH SIDE		MINIMUM		MAXIMUM	
	FT-IN	M	FT-IN	M	FT-IN	M	FT-IN	M	FT-IN	M
LAVATORY ONE SERVICE PANEL THREE SERVICE CONNECTIONS DRAIN: ONE 4-IN (10.2 CM) FLUSH: TWO 1-IN (2.5 CM) FLUSH REQUIREMENTS FLOW: 10 GPM (38 LPM) PRESSURE: 30 PSIG (2.11 KG/CM <sup>2</sup> ) TOTAL CAPACITY, 4 TANKS 300 US GAL (1140 L)	160 - 0	48.77	0	0	0	0	8 - 9	2.67	9 - 11	3.03
PNEUMATIC TWO 3-IN(7.6CM) HIGH-PRESSURE PORTS	96 - 6 96 - 6	29.42 29.42	2 - 0 3 - 0	0.61 0.91	- -	- -	6 - 7 6 - 7	2.01 2.01	7 - 5 7 - 5	2.27 2.27
TWO 8-IN (0.20 M) GROUND CONDITIONED AIR CONNECTIONS	89 - 0 93 - 4	27.13 28.45	- 7 - 11	- 2.40	1 - 10 -	0.55 -	7 - 4 7 - 0	2.24 2.13	8 - 3 7 - 11	2.52 2.40
POTABLE WATER ONE SERVICE CONNECTION CONNECTOR SIZE 3/4 IN (1.95 CM) TANK CAPACITY - 330 U.S GAL (1,250 L) FILL PRESSURE - 30 PSIG (2.11 KG/SQ CM) FILL RATE - 30 GPM (113.5 LPM) DRAIN SIZE 1 IN (2.54 CM) SECOND CONNECTION (ON 747-400ER ONLY)	74 - 4      127 - 2	22.66      38.76	-     2 - 10	-     0.87	1 - 5     -	0.6     -	7 - 2     7 - 3	2.18     2.20	8 - 3     8 - 2	2.50     2.48
HYDRAULIC ONE SERVICE PANEL 4 RESERVOIRS ENG 1 - 9.5 U.S. GAL (35.9 L) ENG 2 - 5.5 U.S. GAL (20.8 L) ENG 3 - 5.5 U.S. GAL (20.8 L) ENG 4 - 9.5 U.S. GAL (35.9 L) 150 PSI (10.6 KG/CM <sup>2</sup> ) MAX	114 - 0	34.75	0 - 10	0.25	-	-	7 - 0	2.13	7 - 0	2.13
OXYGEN ONE SERVICE CONNECTION - SIZE 3/16 IN (0.48 CM) 1850 PSIG (130 KG/CM <sup>2</sup> ) MAX	39 - 2	11.94	-	-	8 - 5	2.55	13 - 5	4.09	14 - 10	4.51

**5.4.3 GROUND SERVICE CONNECTIONS**  
MODEL 747-400

D6-58326-1

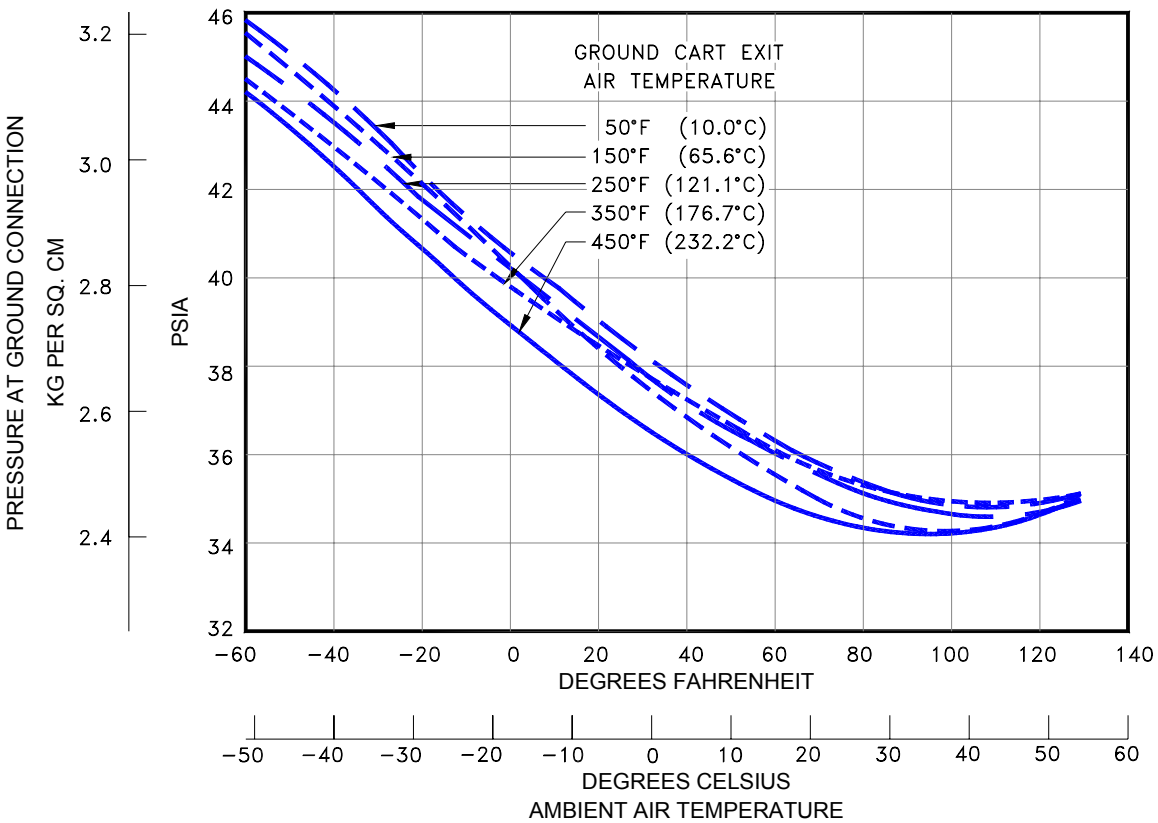
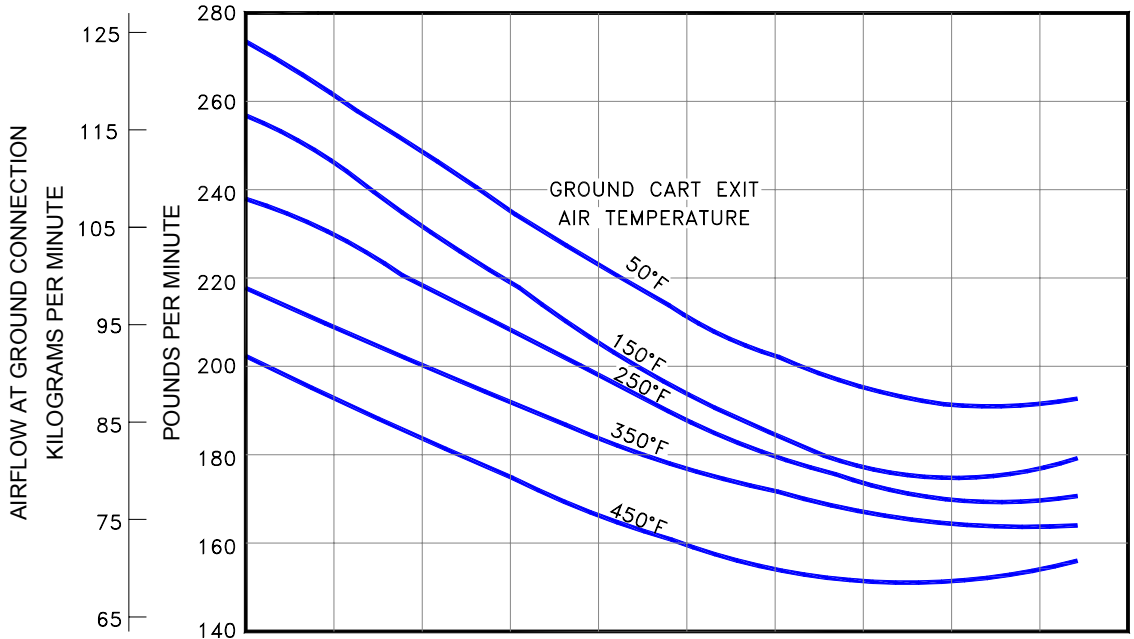


- NOTES:
- ALTITUDE – SEA LEVEL
  - GARRETT STARTER MODEL ATS100–350L
  - USE OF TWO GROUND CONNECTIONS IS ASSUMED
  - PROVIDES MINIMUM ENGINE STARTING REQUIREMENTS



**5.5.1 ENGINE START PNEUMATIC REQUIREMENTS - SEA LEVEL**  
 MODEL 747-400 (CF6-80C2B1 ENGINES, GARRETT STARTER)

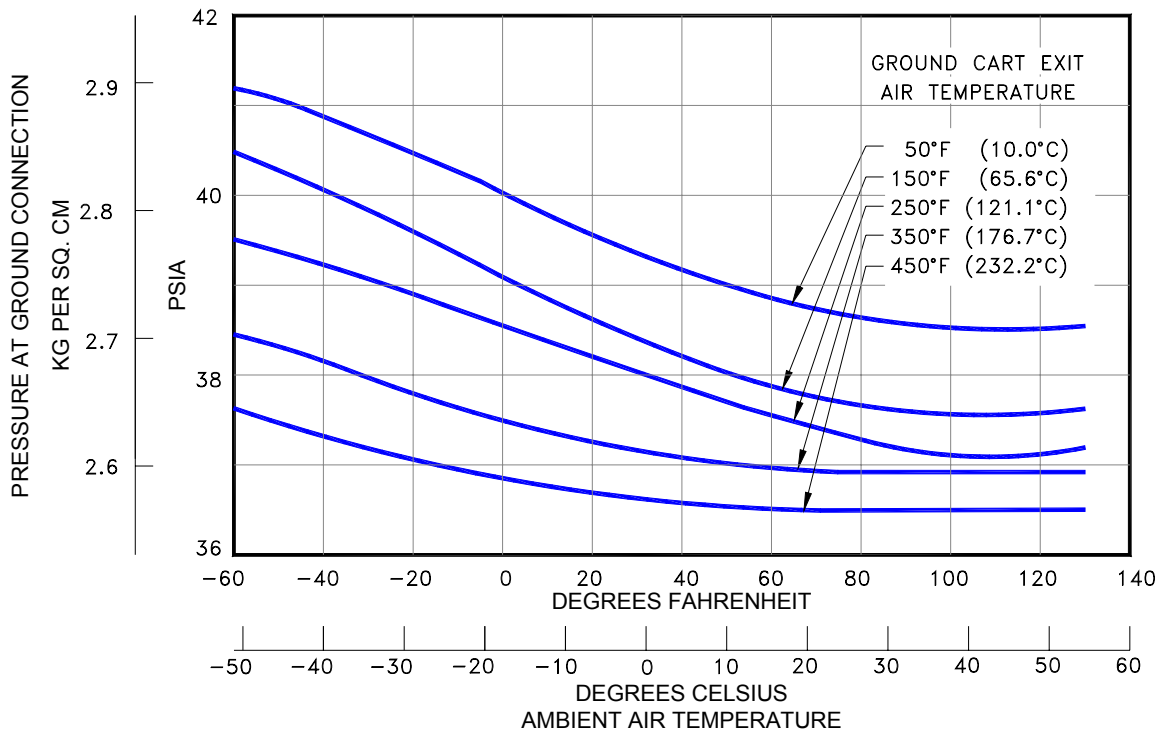
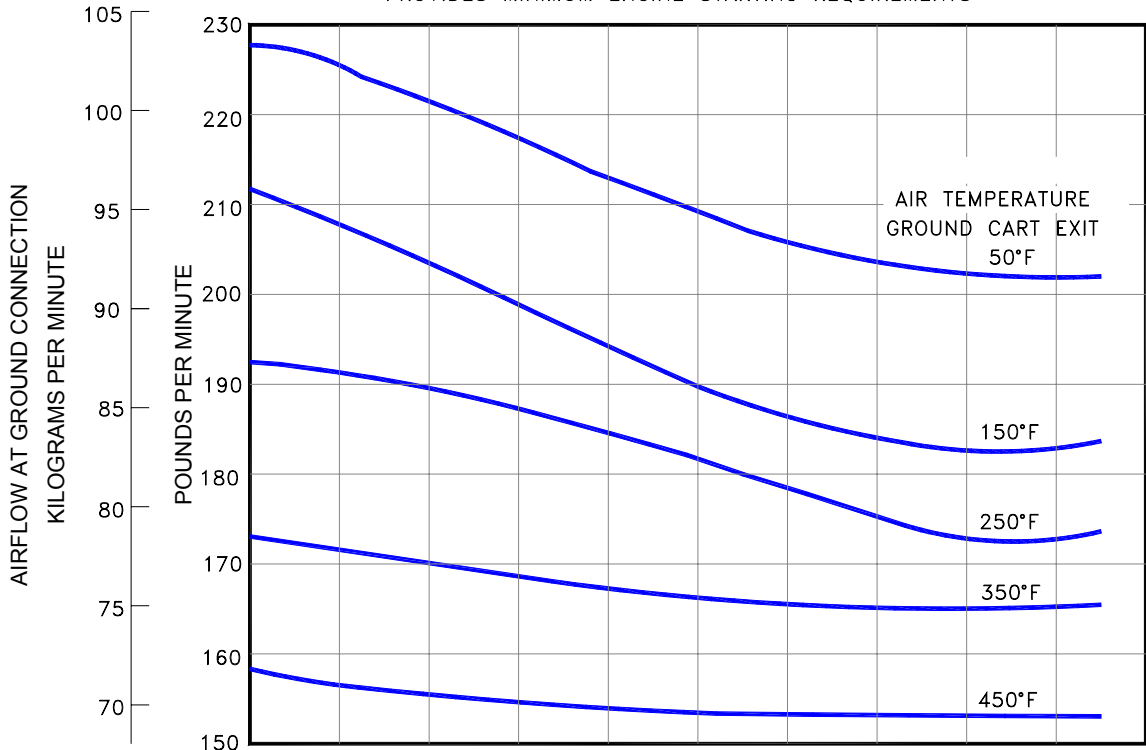
- NOTES:
- ALTITUDE - SEA LEVEL
  - HAMILTON STANDARD STARTER MODEL PS600-6
  - USE OF TWO GROUND CONNECTIONS IS ASSUMED
  - PROVIDES MINIMUM ENGINE STARTING REQUIREMENTS



**5.5.2 ENGINE START PNEUMATIC REQUIREMENTS - SEA LEVEL**  
 MODEL 747-400 (CF6-80C2B1 ENGINES, HAMILTON STANDARD STARTER)

D6-58326-1

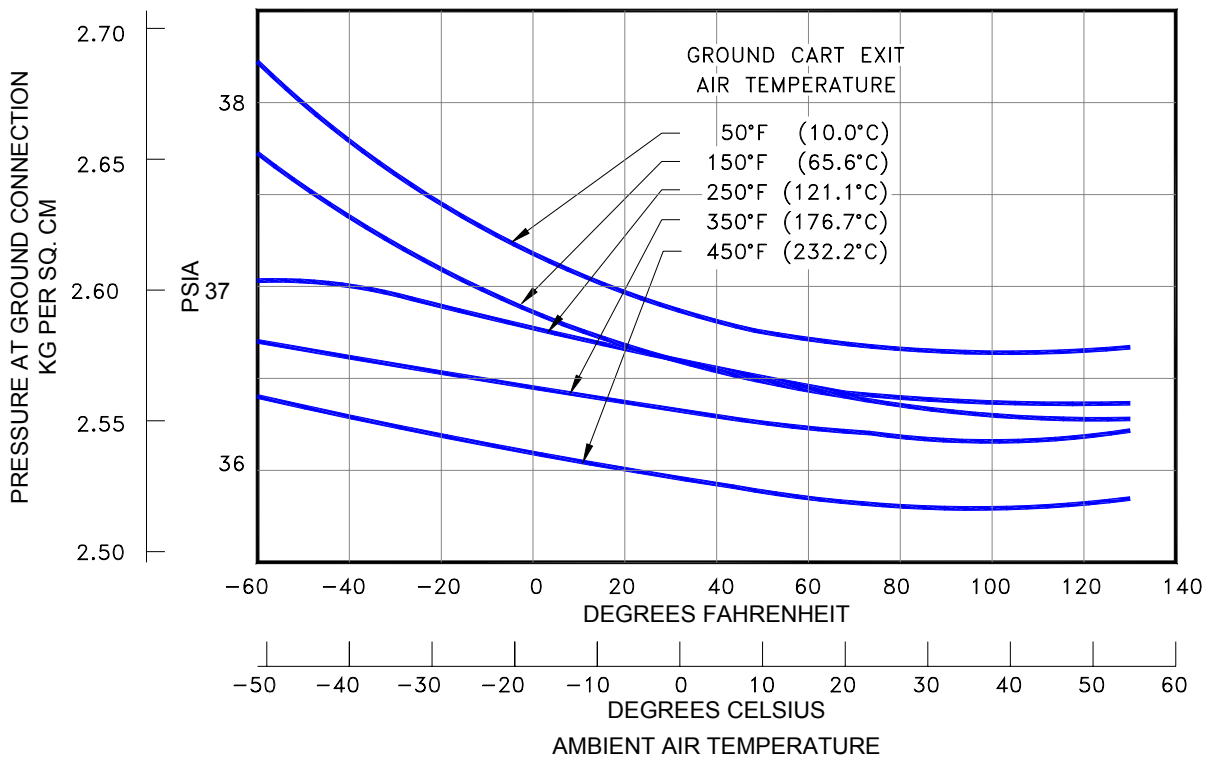
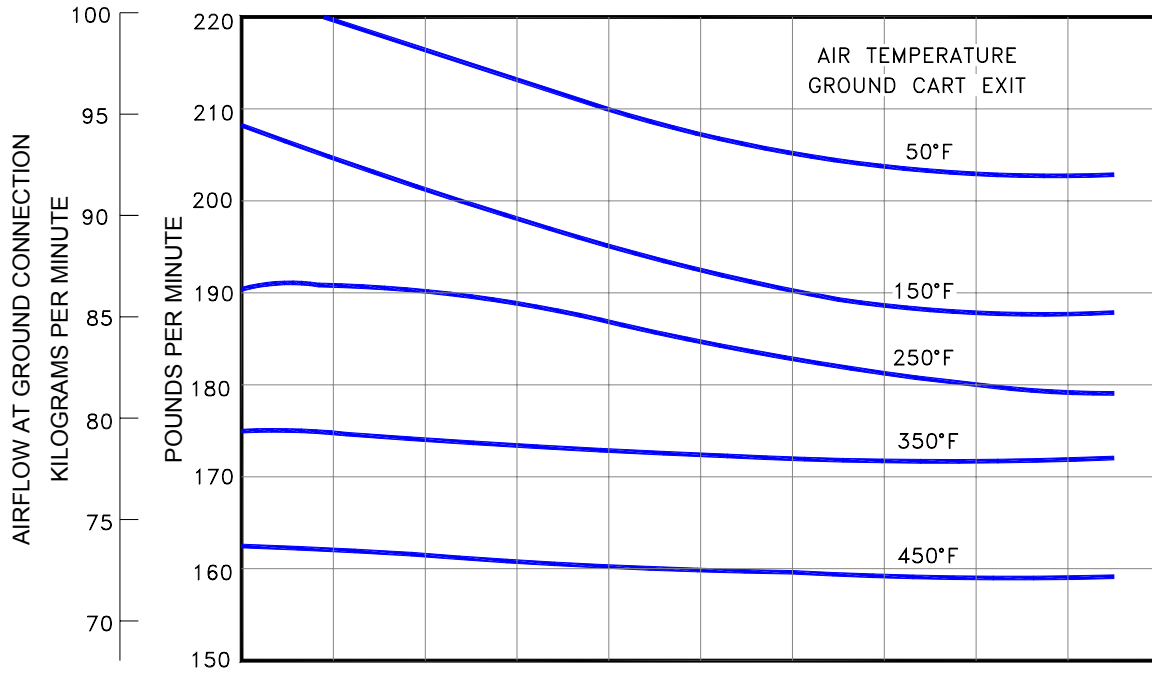
- NOTES:
- ALTITUDE – SEA LEVEL
  - GARRETT STARTER MODEL ATS200-58
  - USE OF TWO GROUND CONNECTIONS IS ASSUMED
  - PROVIDES MINIMUM ENGINE STARTING REQUIREMENTS



**5.5.3 ENGINE START PNEUMATIC REQUIREMENTS - SEA LEVEL**  
 MODEL 747-400 (PW 4056 ENGINES, GARRETT STARTER)

NOTES:

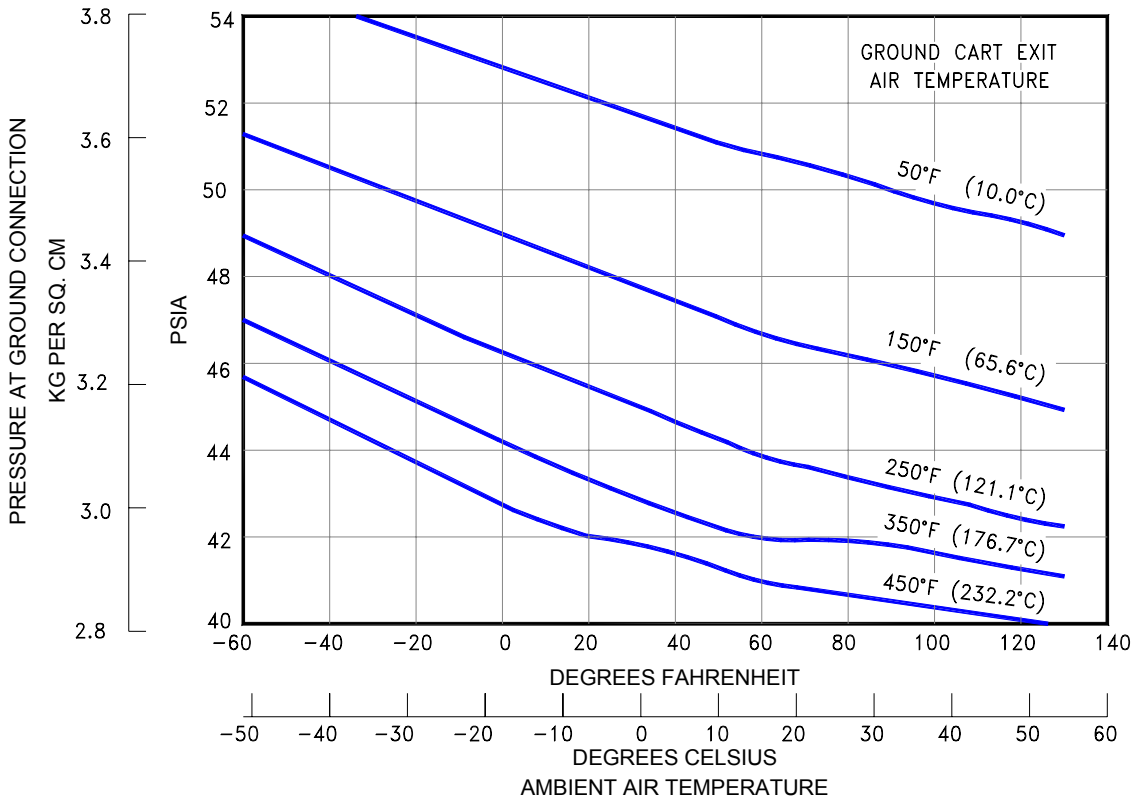
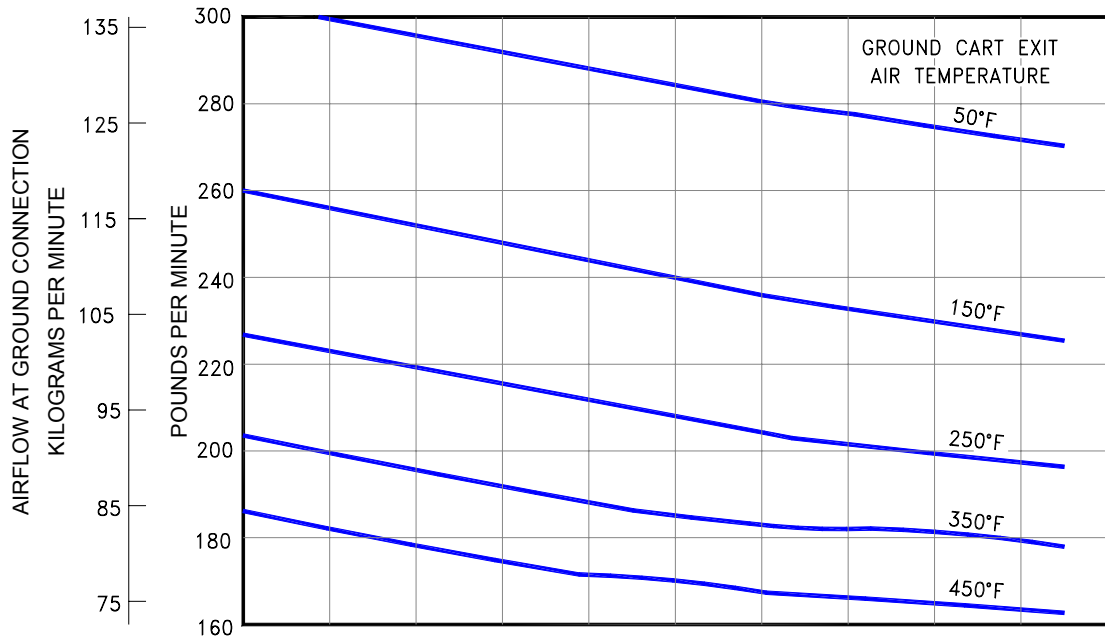
- ALTITUDE - SEA LEVEL
- HAMILTON STANDARD STARTER MODEL PS700-5
- USE OF TWO GROUND CONNECTIONS IS ASSUMED
- PROVIDES MINIMUM ENGINE STARTING REQUIREMENTS



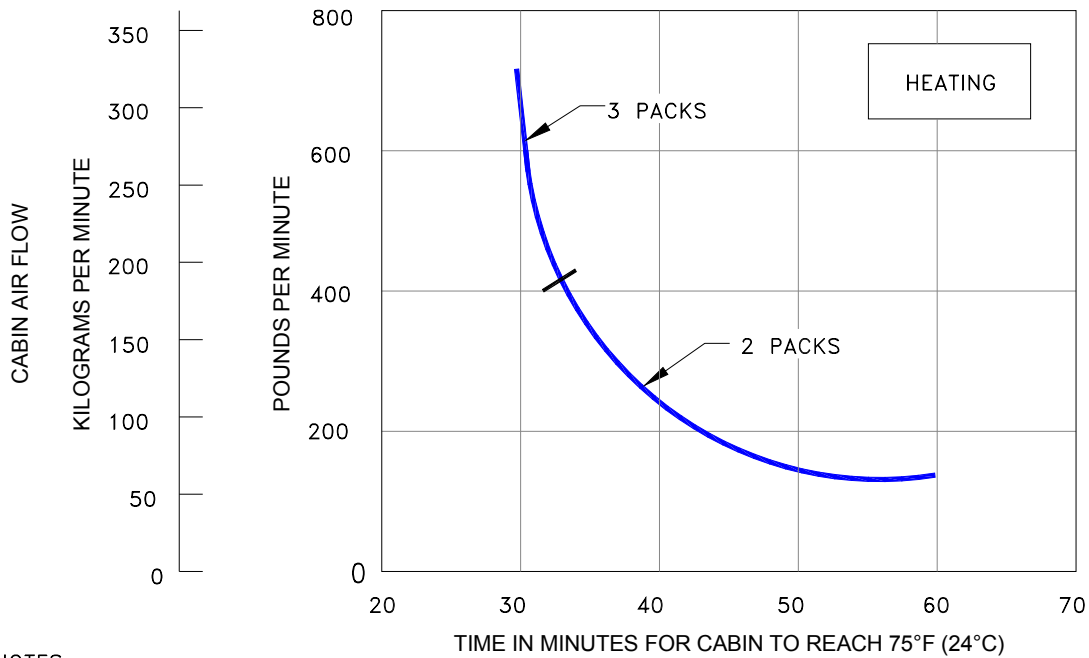
**5.5.4 ENGINE START PNEUMATIC REQUIREMENTS - SEA LEVEL**  
 MODEL 747-400 (PW 4056 ENGINES, HAMILTON STANDARD STARTER)

NOTES:

- ALTITUDE – SEA LEVEL
- HAMILTON STANDARD STARTER MODEL PS600-6
- USE OF TWO GROUND CONNECTIONS IS ASSUMED
- PROVIDES MINIMUM ENGINE STARTING REQUIREMENTS

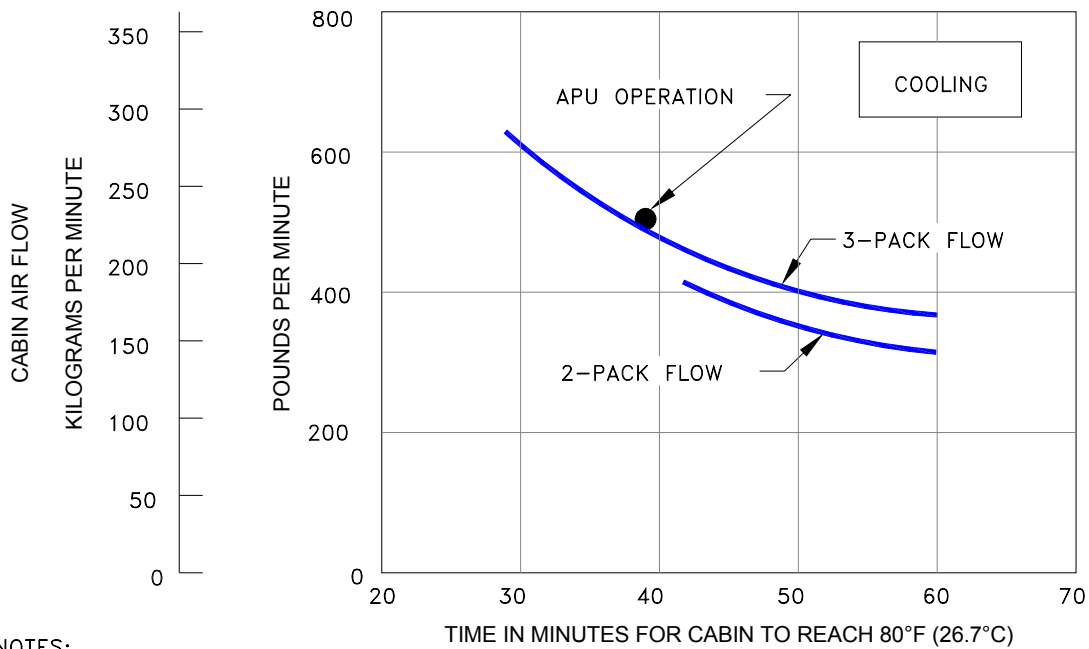


**5.5.5 ENGINE START PNEUMATIC REQUIREMENTS - SEA LEVEL**  
 MODEL 747-400 (RB211-524G ENGINES)



NOTES:

- AMBIENT AND INITIAL CABIN TEMP.  $-25^{\circ}\text{F}$  ( $-32^{\circ}\text{C}$ )
- PACK OUTLET TEMP.  $160^{\circ}\text{F}$  ( $71^{\circ}\text{C}$ )
- RECIRCULATING FANS OFF
- NO PASSENGERS
- DOORS CLOSED
- NO GALLEY LOAD
- NO LIGHTING LOAD



NOTES:

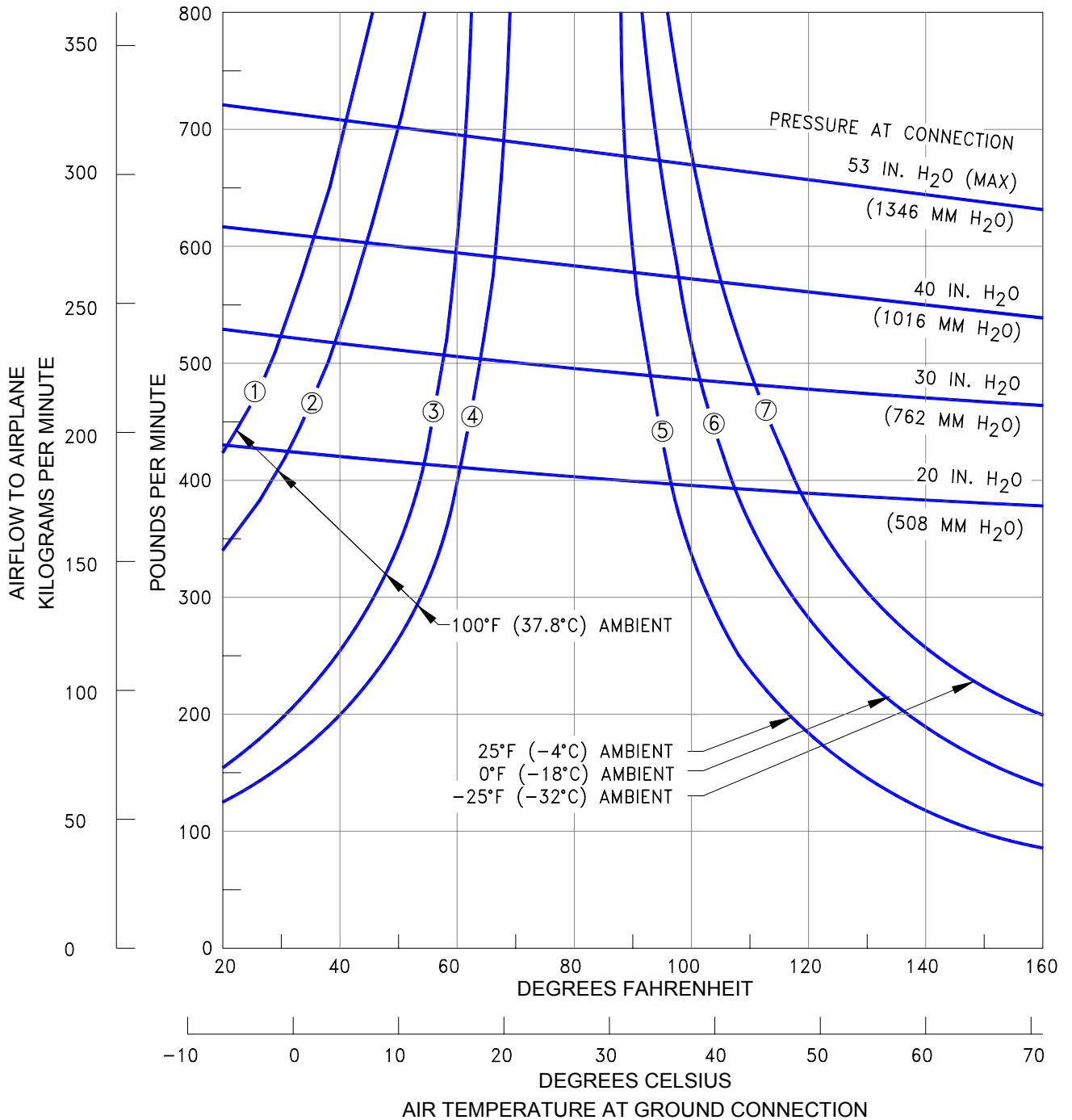
- INITIAL CABIN TEMP. AT  $115^{\circ}\text{F}$  ( $46.1^{\circ}\text{C}$ )
- OUTSIDE AIR TEMP. AT  $100^{\circ}\text{F}$  ( $37.8^{\circ}\text{C}$ )
- TEMP. AT GROUND CONNECTION  $400^{\circ}\text{F}$  ( $204.4^{\circ}\text{C}$ )
- NO PASSENGERS
- DOORS CLOSED
- NO GALLEY LOAD
- NO LIGHTING LOAD

**5.6 GROUND PNEUMATIC POWER REQUIREMENTS - HEATING/COOLING**  
 MODEL 747-400

CONDITIONS:

ALL DOORS AND HATCHES CLOSED

- ① 75°F (23.9°C) CABIN TEMP. 590 OCCUPANTS: 28,000 BTU/HR (7,050 KCAL/HR) SOLAR LOAD AND 75,000 BTU/HR (18,900 KCAL/HR) ELECTRICAL LOAD
- ② 80°F (26.7°C) CABIN TEMP. HEAT LOADS SAME AS ①, ABOVE
- ③ 75°F (23.9°C) CABIN TEMP. 3 OCCUPANTS 28,000 BTU/HR (7,050 KCAL/HR) SOLAR LOAD
- ④ 80°F (26.7°C) CABIN TEMP. HEAT LOADS SAME AS ③, ABOVE
- ⑤⑥⑦ 75°F (23.9°C) CABIN TEMP. NO OCUPANTS OR HEAT LOADS

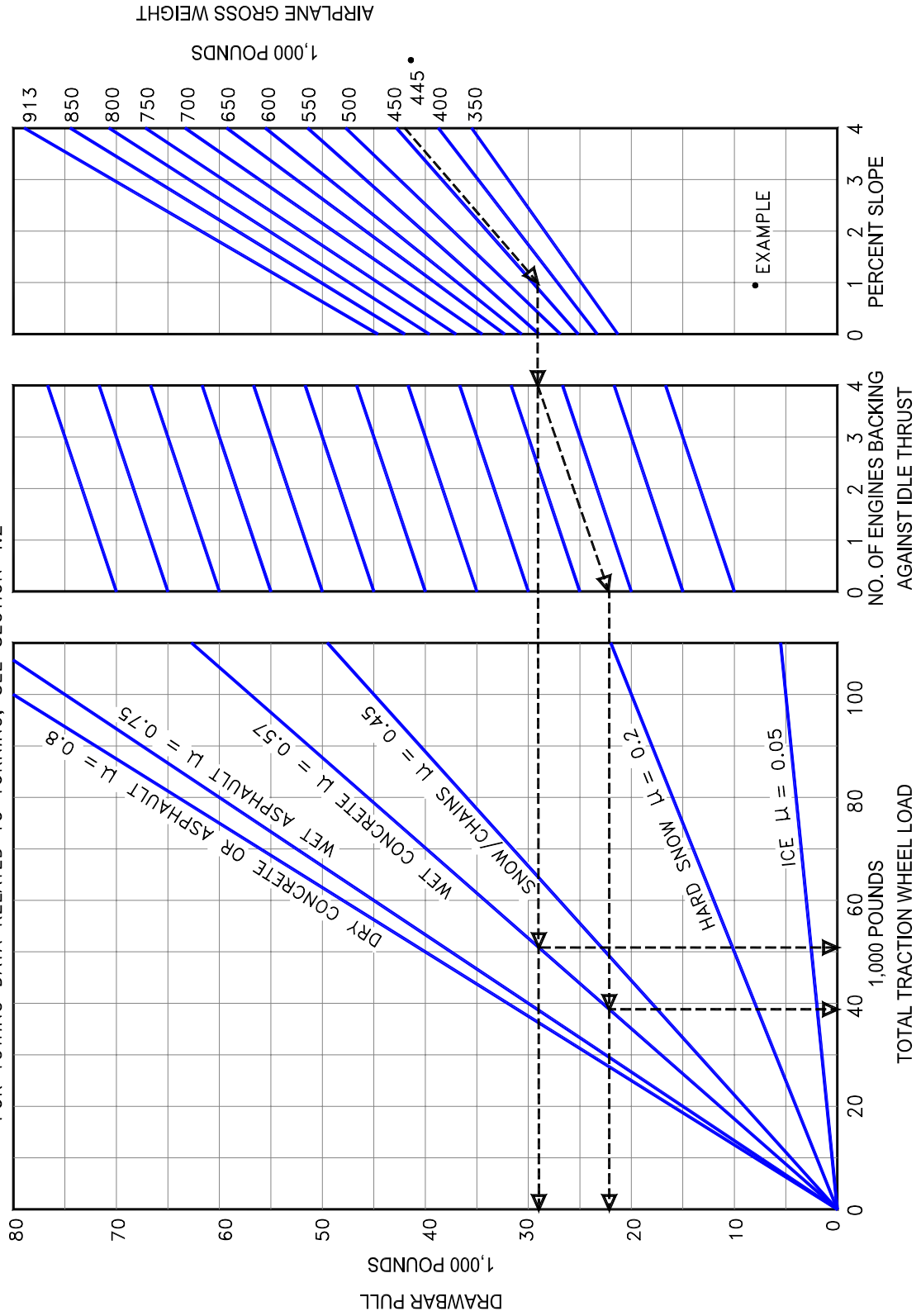


**5.7 CONDITIONED AIR FLOW REQUIREMENTS**

MODEL 747-400

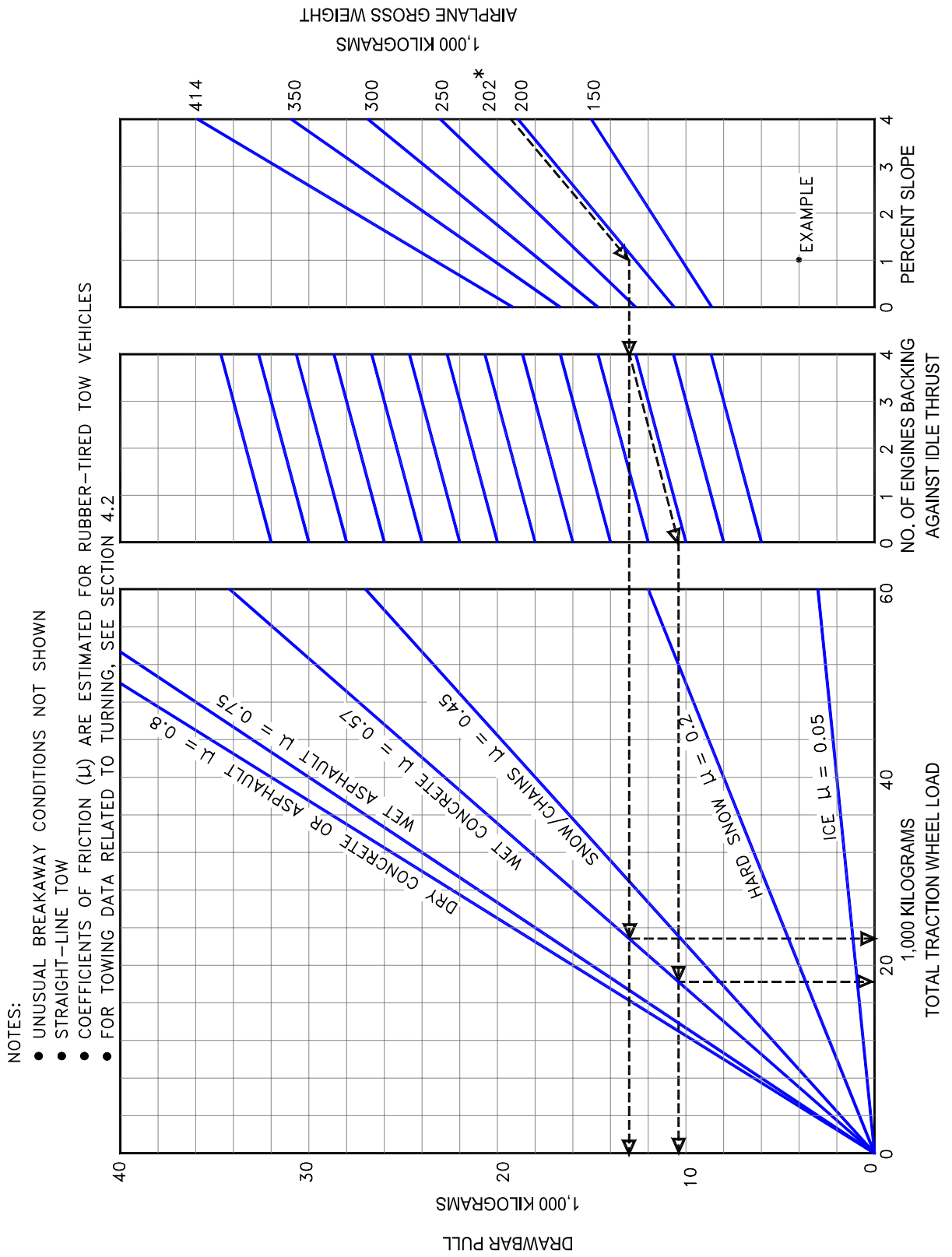
NOTES:

- UNUSUAL BREAKAWAY CONDITIONS NOT SHOWN
- STRAIGHT-LINE TOW
- COEFFICIENTS OF FRICTION ( $\mu$ ) ARE ESTIMATED FOR RUBBER-TIRED TOW VEHICLES
- FOR TOWING DATA RELATED TO TURNING, SEE SECTION 4.2



**5.8.1 GROUND TOWING REQUIREMENTS - ENGLISH UNITS**  
 MODEL 747-400





**5.8.2 GROUND TOWING REQUIREMENTS - METRIC UNITS**  
 MODEL 747-400

THIS PAGE INTENTIONNALLY LEFT BLANK