



AEROSPACE INFORMATION REPORT

AIR5005™

REV. A

Issued 2000-03
Revised 2010-05
Reaffirmed 2015-09

Superseding AIR5005

(R) Aerospace - Commercial Aircraft Hydraulic Systems

RATIONALE

AIR5005A has been reaffirmed to comply with the SAE five-year review policy.

TABLE OF CONTENTS

1.	SCOPE.....	4
2.	REFERENCES.....	5
2.1	Applicable Documents	5
2.2	Definitions	7
3.	WIDE BODY JET AIRLINERS	8
3.1	Airbus A300B/A300-600	10
3.2	Airbus A310-200/300	15
3.3	Airbus A330-200/300/Airbus A340-200/300	19
3.4	Airbus A340-500/600	25
3.5	Airbus A380-800	29
3.6	Boeing 747-100/200/300.....	34
3.7	Boeing 747-400.....	38
3.8	Boeing 767-200/300/400.....	42
3.9	Boeing 777-200/300.....	46
3.10	Boeing MD-11	50
3.11	Lockheed L-1011-1/100/200/500	54
3.12	McDonnell Douglas DC-10-10/30/40	58
4.	NARROW BODY JET AIRLINERS	62
4.1	Aerospatiale/BAC Concorde	64
4.2	Airbus A318/A319/A320/A321	69
4.3	BAC 111-500.....	74
4.4	BAE Systems 146-100/200/300/Avro RJ70/85/100/115.....	78
4.5	Boeing 707-120/320/420.....	82
4.6	Boeing 717-200.....	86
4.7	Boeing 727-100/200	90
4.8	Boeing 737-100/200	94
4.9	Boeing 737-300/400/500.....	98
4.10	Boeing 737-600/700/800/900.....	102
4.11	Boeing 757-200/300.....	106
4.12	Boeing MD-81/82/83/87/88	110

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2015 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

Full document details: SAE AIR5005A

SAE values your input. To provide feedback
on this Technical Report, please visit
<http://www.sae.org/technical/standards/AIR5005A>

Documents

Visit Document Sharing Hub

4.13	Boeing MD-90-30	114
4.14	Bombardier CRJ 100/200	118
4.15	Bombardier CRJ 700/900	122
4.16	Embraer ERJ-135/140/145	126
4.17	Embraer ERJ-170/175/190/195	129
4.18	McDonnell Douglas DC-8-60/70	137
4.19	McDonnell Douglas DC-9-10/20/30/40/50	141
5.	TURBOPROP/COMMUTER AIRCRAFT	145
5.1	ATR 42/ATR 72	147
5.2	BAE Systems ATP/Jetstream 61	150
5.3	BAE Systems Jetstream 31/32	153
5.4	BAE Systems Jetstream 41	156
5.5	Beechcraft 1900C/D	159
5.6	Bombardier DHC-8 Dash 8 Q100/200/300	161
5.7	Bombardier DHC-8 Dash 8 Q400	166
5.8	De Havilland DHC-7 Dash 7	170
5.9	Dornier 328	173
5.10	EADS CASA CN-235	178
5.11	Embraer EMB-110 Bandeirante	181
5.12	Embraer EMB-120 Brasilia	184
5.13	Fairchild Metro	187
5.14	Fokker 50	190
5.15	Lockheed L.188 Electra	193
5.16	SAAB 340	196
5.17	SAAB 2000	199
5.18	Short 360	203
6.	BUSINESS JET AIRCRAFT	206
6.1	Bombardier Challenger 300	207
6.2	Bombardier Challenger 604	211
6.3	Bombardier Global Express/500	215
6.4	Bombardier Learjet 40/45	219
6.5	Bombardier Learjet 60	222
6.6	Cessna Citation Mustang Model 510	225
6.7	Cessna CitationJet (CJ) Series Model 525	228
6.8	Cessna Citation Bravo, Model 550	231
6.9	Cessna Citation Ultra Encore+, Model 560	234
6.10	Cessna Citation XLS+	237
6.11	Gulfstream IV	240
7.	NOTES	243
7.1	Revision Indicator	243
TABLE 1	WIDE BODY AIRCRAFT HYDRAULIC SYSTEM DATA	8
TABLE 2	NARROW BODY JET AIRCRAFT HYDRAULIC SYSTEM DATA	62
TABLE 3	TURBOPROP/COMMUTER AIRCRAFT HYDRAULIC SYSTEM DATA	145
TABLE 4	BUSINESS JET AIRCRAFT HYDRAULIC SYSTEM DATA	206
FIGURE 3.1.1	AIRBUS A300B HYDRAULIC SYSTEM SCHEMATIC	13
FIGURE 3.1.2	AIRBUS A300-600 HYDRAULIC SYSTEM SCHEMATIC	14
FIGURE 3.2	AIRBUS A310-200/300 HYDRAULIC SYSTEM SCHEMATIC	18
FIGURE 3.3.1	AIRBUS A330-200/300 HYDRAULIC SYSTEM SCHEMATIC	23
FIGURE 3.3.2	AIRBUS A340-200/300 HYDRAULIC SYSTEM SCHEMATIC	24
FIGURE 3.4	AIRBUS A340-500/600 HYDRAULIC SYSTEM SCHEMATIC	28
FIGURE 3.5	AIRBUS A380-800 HYDRAULIC SYSTEM SCHEMATIC	33
FIGURE 3.6	BOEING 747-100/200/300 HYDRAULIC SYSTEM SCHEMATIC	37
FIGURE 3.7	BOEING 747-400 HYDRAULIC SYSTEM SCHEMATIC	41
FIGURE 3.8	BOEING 767-200/300/400 HYDRAULIC SYSTEM SCHEMATIC	45
FIGURE 3.9	BOEING 777-200/300 HYDRAULIC SYSTEM SCHEMATIC	49

FIGURE 3.10	BOEING MD-11 HYDRAULIC SYSTEM SCHEMATIC	53
FIGURE 3.11	LOCKHEED L.1011-1/100/200/500 HYDRAULIC SYSTEM SCHEMATIC.....	57
FIGURE 3.12	MCDONNELL DOUGLAS DC-10-10/30/40 HYDRAULIC SYSTEM SCHEMATIC.....	61
FIGURE 4.1	AEROSPATIALE/BAC CONCORDE HYDRAULIC SYSTEM SCHEMATIC.....	68
FIGURE 4.2	AIRBUS A318/A319/A320/A321 HYDRAULIC SYSTEM SCHEMATIC.....	73
FIGURE 4.3	BAC 111-500 HYDRAULIC SYSTEM SCHEMATIC	77
FIGURE 4.4	BAE SYSTEMS 146-100/200/300/AVRO RJ70/85/100/115 HYDRAULIC SYSTEM SCHEMATIC	81
FIGURE 4.5	BOEING 707-120/320/420 HYDRAULIC SYSTEM SCHEMATIC.....	85
FIGURE 4.6	BOEING 717-200 HYDRAULIC SYSTEM SCHEMATIC.....	89
FIGURE 4.7	BOEING 727-100/200 HYDRAULIC SYSTEM SCHEMATIC.....	93
FIGURE 4.8	BOEING 737-100/200 HYDRAULIC SYSTEM SCHEMATIC.....	97
FIGURE 4.9	BOEING 737-300/400/500 HYDRAULIC SYSTEM SCHEMATIC.....	101
FIGURE 4.10	BOEING 737-600/700/800/900 HYDRAULIC SYSTEM SCHEMATIC	105
FIGURE 4.11	BOEING 757-200/300 HYDRAULIC SYSTEM SCHEMATIC.....	109
FIGURE 4.12	BOEING MD-81/82/83/87/88 HYDRAULIC SYSTEM SCHEMATIC	113
FIGURE 4.13	BOEING MD-90-30 HYDRAULIC SYSTEM SCHEMATIC.....	117
FIGURE 4.14	BOMBARDIER CRJ 100/200 HYDRAULIC SYSTEM SCHEMATIC.....	121
FIGURE 4.15	BOMBARDIER REGIONAL JET 700/900 HYDRAULIC SYSTEM SCHEMATIC	125
FIGURE 4.16	EMBRAER ERJ-135/140/145 HYDRAULIC SYSTEM SCHEMATIC.....	128
FIGURE 4.17	EMBRAER ERJ-170/175/190/195 HYDRAULIC SYSTEM SCHEMATIC.....	132
FIGURE 4.18	FOKKER 70/100 HYDRAULIC SYSTEM SCHEMATIC	136
FIGURE 4.19	MCDONNELL DOUGLAS DC-8-60/70 HYDRAULIC SYSTEM SCHEMATIC.....	140
FIGURE 4.20	MCDONNELL DOUGLAS DC-9-10/20/30/40/50 HYDRAULIC SYSTEM SCHEMATIC.....	144
FIGURE 5.1	ATR 42/ ATR 72 HYDRAULIC SYSTEM SCHEMATIC.....	149
FIGURE 5.2	BAE SYSTEMS ATP/JETSTREAM 61 HYDRAULIC SYSTEM SCHEMATIC	152
FIGURE 5.3	BAE SYSTEMS JETSTREAM 31/32 HYDRAULIC SYSTEM SCHEMATIC.....	155
FIGURE 5.4	BAE SYSTEMS JETSTREAM 41 HYDRAULIC SYSTEM	158
FIGURE 5.5	BEECHCRAFT 1900C/D HYDRAULIC SYSTEM SCHEMATIC	160
FIGURE 5.6.1	BOMBARDIER DHC-8 DASH 8 Q100/200/300 - CURRENT PRODUCTION STANDARD - HYDRAULIC SYSTEM SCHEMATIC.....	164
FIGURE 5.6.2	BOMBARDIER DHC-8 DASH 8 Q100/200/300 - IN-SERVICE RETROFIT STANDARD - HYDRAULIC SYSTEM SCHEMATIC.....	165
FIGURE 5.7	BOMBARDIER DHC-8 DASH 8 Q400 HYDRAULIC SYSTEM SCHEMATIC.....	169
FIGURE 5.8	DE HAVILLAND DHC-7 DASH 7 HYDRAULIC SYSTEM SCHEMATIC.....	172
FIGURE 5.9.1	DORNIER 328 - WITHOUT GROUND SPOILERS - HYDRAULIC SYSTEM SCHEMATIC.....	176
FIGURE 5.9.2	DORNIER 328 - WITH GROUND SPOILERS - HYDRAULIC SYSTEM SCHEMATIC	177
FIGURE 5.10	EADS CASA CN-235 HYDRAULIC SYSTEM SCHEMATIC.....	180
FIGURE 5.11	EMBRAER EMB-110 BANDEIRANTE HYDRAULIC SYSTEM SCHEMATIC	183
FIGURE 5.12	EMBRAER EMB-120 BRASILIA HYDRAULIC SYSTEM SCHEMATIC.....	186
FIGURE 5.13	FAIRCHILD METRO HYDRAULIC SYSTEM SCHEMATIC.....	189
FIGURE 5.14	FOKKER 50 HYDRAULIC SYSTEM SCHEMATIC	192
FIGURE 5.15	LOCKHEED L.188 ELECTRA HYDRAULIC SYSTEM SCHEMATIC	195
FIGURE 5.16	SAAB 340 HYDRAULIC SYSTEM SCHEMATIC	198
FIGURE 5.17	SAAB 2000 HYDRAULIC SYSTEM SCHEMATIC	202
FIGURE 5.18	SHORT 360 HYDRAULIC SYSTEM SCHEMATIC	205
FIGURE 6.1	BOMBARDIER CHALLENGER 300 HYDRAULIC SYSTEM SCHEMATIC	210
FIGURE 6.2	BOMBARDIER CHALLENGER 604 HYDRAULIC SYSTEM SCHEMATIC	214
FIGURE 6.3	BOMBARDIER GLOBAL EXPRESS/500 HYDRAULIC SYSTEM SCHEMATIC	218
FIGURE 6.4	BOMBARDIER LEARJET 40/45 HYDRAULIC SYSTEM SCHEMATIC.....	221
FIGURE 6.5	BOMBARDIER LEARJET 60 HYDRAULIC SYSTEM SCHEMATIC.....	224
FIGURE 6.6	CESSNA CITATION MUSTANG MODEL 510 HYDRAULIC SYSTEM SCHEMATIC	227
FIGURE 6.7	CESSNA CITATIONJET SERIES HYDRAULIC SYSTEM SCHEMATIC.....	230
FIGURE 6.8	CESSNA CITATION BRAVO HYDRAULIC SYSTEM SCHEMATIC.....	233
FIGURE 6.9	CESSNA CITATION ULTRA ENCORE+ HYDRAULIC SYSTEM SCHEMATIC.....	236
FIGURE 6.10	CESSNA CITATION XLS+ HYDRAULIC SYSTEM SCHEMATIC	239
FIGURE 6.11	GULFSTREAM IV HYDRAULIC SYSTEM SCHEMATIC.....	242

1. SCOPE

This SAE Aerospace Information Report (AIR) has been compiled to provide information on hydraulic systems fitted to commercial aircraft.

Data has been provided for following aircraft types:

- a. Wide body jet airliners
- b. Narrow body jet airliners
- c. Turboprop/commuter aircraft
- d. Business jet aircraft

The airliners that have been included in this document are generally in operational service with either airlines or cargo operators. Information on aircraft that have been retired from in-service use has been included for reference purposes. No information is presented for aircraft that are currently being developed.

The following information is provided for each aircraft

- Design requirements: Governing airworthiness regulations
- System pressure: Fluid power system operating pressure
- Hydraulic fluid: Type of fluid the hydraulic system uses
- Number of hydraulic systems: Number and identification of independent hydraulic systems
- System temperature: Minimum and maximum design operating temperatures
- Main hydraulic pump data: Flow, pressure, displacement
- Auxiliary pump data: System auxiliary pump or back-up data
- Hydraulic motor data: System hydraulic motor requirements
- Accumulator data: Usage, volume and precharge requirements
- Reservoir data: Type, volume and pressure
- Relief valve data: Usage, crack and reseal pressures, rated flow
- Filtration data: Usage, filtration rating
- Tubing data: Materials, sizes, wall thicknesses
- Fitting data: Type, size range, material
- Schematic diagram: System architecture, services supplied

NOTES

1. For some aircraft, the data is incomplete. This is due to difficulties in obtaining the data (particularly for the older aircraft presented in this report).
2. For some aircraft, the pumps may not be those as stated in this document. This is because when they are supplied by more than one vendor for a specific aircraft application, the pumps' displacement and running speed may differ.
3. Electric motor pumps are fixed frequency type unless otherwise stated.
4. The schematic diagrams for each aircraft have been simplified for clarity and ease of understanding. For example:
 - The return side of each system has not been shown
 - Specific features such as internal leak measuring systems are not shown
 - Single accumulators are shown at locations where multiple accumulators are usedHowever, the complete power generation system and elements of the supply system for each aircraft is shown using symbols in accordance with AS1290.
5. The filtration ratings that are presented in this report are the absolute rather than nominal ratings. However, it should be noted that there is no consistent definition of the absolute rating for the filters for the aircraft hydraulic systems that are described in this report.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this standard to the extent specified herein. The latest issue of the SAE documents shall apply. The applicable issue of the other documents shall be the issue in effect at the date of the purchase order. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

ARP4386	Terminology and Definition for Aerospace Fluid Power, Actuation and Control Technologies
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
AS1290	Graphic Symbols for Aircraft Hydraulic and Pneumatic Systems
AMS4071	Aluminum Alloy, Drawn, Round, Seamless Hydraulic Tubing 2.5Mg - 0.25Cr (5052-0) Annealed
AMS4083	Aluminum Alloy Tubing, Hydraulic, Seamless, Drawn, Round, 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6), Solution and Precipitation Heat Treated
AMS4928	Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al - 4V Annealed
AMS4944	Titanium Alloy Tubing, Seamless, Hydraulic, 3.0Al-2.5V, Cold Worked, Stress Relieved

AMS4945	Titanium Alloy Tubing, Seamless, Hydraulic 3Al-2.5V, Controlled Contractile Strain Ratio Cold Worked, Stress Relieved
AMS5561	Steel, Corrosion and Heat-Resistant, Welded and Drawn or Seamless and Drawn Tubing 9.0Mn - 20Cr - 6.5Ni - 0.28N High-Pressure Hydraulic
AMS5566	Steel, Corrosion Resistant, Seamless or Welded Hydraulic Tubing 19Cr - 10 Ni (SAE 30304) High Pressure, Cold Drawn

AMS-WW-T-700/4 Tube, Aluminum Alloy, Drawn, Seamless, 5052

AMS-WW-T-700/6 Tube, Aluminum Alloy, Drawn, Seamless, 6061

2.1.2 ADS Publications:

Available from ADS Group Ltd., Salamanca Square, 9 Albert Embankment, London, SE1 7SP, United Kingdom. Tel: +44 207-091-4500, www.sbac.co.uk.

AGS 1100 Pipe Couplings, Typical Joints

2.1.3 BSi Standards

Available from BSi Standards, BSI British Standards, 389 Chiswick High Road, London W4 4AL, United Kingdom, United Kingdom, Tel: +44 208-996-9001, www.bsi-global.com.

BS 1471	Specification for Wrought Aluminum And Aluminum Alloys for General Engineering Purposes - Drawn Tube
BS L56	Specification For Tube Of Aluminum - 2¼% Magnesium Alloy (Temper Designation - O) (Seamless Tested Hydraulically) (Not Exceeding 12 mm Wall Thickness)
BS T72-T73	Specifications For ¹⁸ / ₁₀ Chromium Nickel Corrosion Resisting Steel Tube For Hydraulic Purposes (Niobium/Titanium Stabilized 550 MPa)

2.1.4 Civil Aviation Authority Documents

Available from Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex RH6 0YR, United Kingdom. Tel: +44 129-356-7171, www.caa.co.uk.

BCAR Section D British Civil Airworthiness Requirements – Aeroplanes

Concorde TSS Standards

2.1.5 European Aviation Safety Agency Publications

Available from European Aviation Safety Agency, Postfach 10 12 53, D-50452 Cologne, Germany. Tel: 49 221-8999-0000, www.easa.eu.int.

CS-23	Certification Specifications for Normal, Utility, Aerobatic, and Commuter Category Aeroplanes
CS-25	Certification Specifications for Large Aeroplanes

2.1.6 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591. Tel: 866-835-5322, www.faa.gov.

14CFR Part 23 Code of Federal Regulations, Part 23 Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes

14CFR Part 25 Code of Federal Regulations, Part 25 Airworthiness Standards: Transport Category Airplanes

2.1.7 Joint Aviation Authorities Committee Publications

Available from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado, 80112-5776. Tel: 1-800-854-7179 (inside USA and Canada) or 1-303-397-7956 (outside USA), <http://global.ihs.com>.

JAR 23 Joint Airworthiness Requirements, Normal, Utility, Aerobatic, and Commuter Category Aeroplanes

JAR 25 Joint Airworthiness Requirements, Large Aeroplanes

2.1.8 United Kingdom Ministry of Defence Procurement Executive Standards

Available from DStan, UK Defence Standardization, Kentigern House, 65 Brown Street, Glasgow G2 8EX, United Kingdom Tel: +44 141-224-2531, www.dstan.mod.uk.

DTD5016 35-45 Ton Chromium Nickel Corrosion Resisting Steel Solid Drawn Circular Tubes

DTD5019 Aluminum-Nickel-Silicon Brass Tubes

2.1.9 US Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, <http://assist.daps.dla.mil/quicksearch>.

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base; Aircraft, Missile and Ordnance

MIL-T-6845 Tubing, Steel, Corrosion Resistant (530400), Aerospace Vehicle Hydraulic System $\frac{1}{8}$ Hard Condition

MIL-T-8504 Tubing, Steel, Corrosion Resistant (304), Aerospace Vehicle Hydraulic Systems, Annealed, Seamless and Welded

MIL-T-8808 Tubing, Steel, Corrosion Resistant (18-8 Stabilized), Aircraft Hydraulic Quality

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base; Aircraft,

MIL-PRF-87257 Hydraulic Fluid, Fire Resistant Synthetic Hydrocarbon Base; Aircraft

WW-T-787 Tubing, Aluminum Alloy 52S, Round, Seamless, Draw

NOTE: Many of these standards are obsolete or inactive for new designs. However, they were valid when the applicable hydraulic system was designed.

2.2 Definitions

Refer to ARP4386.

3. WIDE BODY JET AIRLINERS

TABLE 1 – WIDE BODY AIRCRAFT HYDRAULIC SYSTEM DATA

Aircraft	System Pressure	Number of Systems	Hydraulic Fluid	Main Pumps - Number/Type	Backup Pumps - Number/Type	Accumulators Number/Type	Reservoirs - Type
Airbus A300 B4/A300-600	3000 psi (20 690 kPa)	3	AS1241	4 - Engine driven pumps	3 - AC pumps 1 - RAT pump 2 - Power transfer units	3 - Bladder separator type	Air pressurized
Airbus A310-200/300	3000 psi (20 690 kPa)	3	AS1241	4 - Engine driven pumps	3 - AC pumps 1 - RAT pump 2 - Power transfer units	3 - Bladder separator type	Air pressurized
Airbus A330-200/300 A340-200/300	3000 psi (20 690 kPa)	3	AS1241	4 - Engine driven pumps	3 - AC pumps 1 - RAT pump	3 - Bladder separator type	Air pressurized
Airbus A340-500/600	3000 psi (20 690 kPa)	3	AS1241	4 - Engine driven pumps	3 - AC pumps 1 - RAT pump	3 - Bladder separator type	Air pressurized
Airbus A380-800	5080 psi (35 000 kPa)	2	AS1241	8 - Engine driven pumps	2 - AC pumps 3 - DC pumps (landing gear systems)	5 - Factory pre-charged, welded bellows	Air pressurized
Boeing 747-100/200/300	3000 psi (20 690 kPa)	4	AS1241	4 - Engine driven pumps	4 - Air Turbine Driven Pumps 3 - AC pumps 1 - Power Transfer Unit	4 - Piston Type	Air pressurized
Boeing 747-400	3000 psi (20 690 kPa)	4	AS1241	4 - Engine driven pumps	2 - Air Turbine Driven Pumps 3 - AC pumps	4 - Piston type	Air pressurized
Boeing 767-200/300/400	3000 psi (20 690 kPa)	3	AS1241	2 - Engine driven pumps 2 - AC pumps	2 - AC pumps 1 - Air Turbine Driven Pump 1 - RAT pump	3 - Piston type	Air pressurized



TABLE 1 (CONTINUED) – WIDE BODY AIRCRAFT HYDRAULIC SYSTEM DATA

Aircraft	System Pressure	Number of Systems	Hydraulic Fluid	Main Pumps - Number/Type	Backup Pumps - Number/Type	Accumulators Number/Type	Reservoirs - Type
Boeing 777-200/300	3000 psi (20 690 kPa)	3	AS1241	2 - Engine driven pumps 2 - AC pumps	2 - AC pumps 1 - Air Turbine Driven Pump 1 - RAT pump	3 – Piston type	Air pressurized
Boeing MD-11	3000 psi (20 690 kPa)	3	AS1241	6 - Engine driven pumps	2 - APU driven pumps 2 - AC pumps 4 - Power transfer units	3 – Piston type	Bootstrap
Lockheed L-1011-1/100/200/500	3000 psi (20 690 kPa)	4	AS1241	4 - Engine driven pumps	2 - AC pumps 1 - RAT pump 2 - Power transfer units 2 - Air Turbine Driven Pumps	2 – Piston type	Bootstrap
McDonnell Douglas DC-10-10/30/40	3000 psi (20 690 kPa)	3	AS1241	6 - Engine driven pumps	2 - APU driven pumps 2 - AC pumps 4 - Power transfer units	3 – Piston type	Bootstrap

3.1 Airbus A300B/A300-600

3.1.1 Design Requirements: 14CFR Part 25/JAR 25 requirements

3.1.2 System Pressure: 3000 psi (20 690 kPa)

3.1.3 Hydraulic Fluid: AS1241

3.1.4 Number of Hydraulic Systems: 3 – Blue System, Yellow System, Green System

3.1.5 System Temperature: -58 to +194 °F (-50 to +90 °C)

3.1.6 Main Hydraulic Pump Data

- 3.1.6.1 Engine Driven Pump: 4 per aircraft; 2 in Green System, 1 in Blue System, 1 in Yellow System
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 37.5 gpm (142 L/min) at 2950 psi (20 345 kPa)
Displacement: 2.40 in³/rev (39.3 mL/rev)
Rated Speed: 3750 rpm
Rotation from Shaft End: Clockwise

3.1.7 Back-up Pump Data

- 3.1.7.1 AC Electric Motor Pump: 2 in Green System
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 8.0 gpm (30.3 L/min) at 2950 psi (20 345 kPa)
Displacement: 0.253 in³/rev (4.15 mL/rev)
Rated Speed: 7200 rpm
- 3.1.7.2 AC Electric Motor Pump: 1 in Yellow System
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 3.65 gpm (13.8 L/min) at 2950 psi (20 345 kPa)
Displacement: 0.052 in³/rev (0.85 mL/rev)
Rated Speed: 7500 rpm
- 3.1.7.3 Ram Air Turbine Driven Pump: 1 in Yellow System
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 13.6 gpm (51.9 L/min) at 2950 psi (20 345 kPa)
Displacement: 0.75 in³/rev (12.2 mL/rev)
Rated Speed: 5200 rpm
- 3.1.7.4 Power Transfer Unit: 2 per aircraft; 1 in Green System to power Yellow System, 1 in Green System to power Blue System
Type: Unidirectional fixed displacement hydraulic motor driving a fixed displacement pump
Rated Flow: 31.5 gpm (119 L/min)
Displacement: Motor - 1.519 in³/rev (24.89 mL/rev), pump - 1.318 in³/rev (21.6 mL/rev)
Rated Speed: 5600 rpm
- 3.1.7.5 Hand Pump: 1 in Yellow System to open cargo door
Pressure - Displacement: 725 - 3000 psi (5000 - 20 690 kPa); 0.6 in³ (10 mL)/cycle
- 3.1.7.6 Hand Pump: 1 to fill hydraulic systems
Pressure - Displacement: 500 - 725 psi (3 448 - 5000 kPa); 1.8 in³ (30 mL)/cycle

3.1.8 Hydraulic Motor Data

- 3.1.8.1 Constant Speed Motor Electrical Generator: 1 per aircraft (not fitted to all aircraft)
Type: Variable displacement
Displacement: 0.5 in³/rev (8.19 mL/rev)
Running Speed: 12 000 rpm
Flow at Rated Electrical Load/Pressure Differential: 16.6 gpm (62.5 L/min) at 2100 psi (14 483 kPa)
- 3.1.8.2 Flap Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.91 in³/rev (14.91 mL/rev)
Running Speed: 3350 rpm
Flow at Rated Pressure Differential: 27.5 gpm (104 L/min)
- 3.1.8.3 Slat Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.91 in³/rev (14.91 mL/rev)
Running Speed: 2850 rpm
Flow at Rated Pressure Differential: 23.8 gpm (90 L/min)
- 3.1.8.4 Tailplane Trim Actuator Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.55 in³/rev (9.01 mL/rev)
Running Speed: 5200 rpm
Flow at Rated Pressure Differential: 19.8 gpm (75 L/min)

3.1.9 Accumulator Data

- 3.1.9.1 Power Generation System: 3 per aircraft; 1 per system
Type: Spherical, membrane separator, gas charged
Volume: 60 in³ (1.0 L)
Precharge pressure: 1450 psi (10 000 kPa)
- 3.1.9.2 Braking System: 2 in Yellow System
Type: Spherical, membrane separator, gas charged
Volume: 195 in³ (3.2 L)
Precharge pressure: 1450 psi (10 000 kPa)

3.1.10 Reservoir Data

- 3.1.10.1 Green System
Type: Air pressurized
Volume: 10.6 gal (40 L)
Pressure: 51 psig (352 kPa)
- 3.1.10.2 Yellow System
Type: Air pressurized
Volume: 7.4 gal (28 L)
Pressure: 51 psig (352 kPa)
- 3.1.10.3 Blue System
Type: Air pressurized
Volume: 5.8 gal (22 L)
Pressure: 51 psig (352 kPa)

3.1.11 Relief Valve Data

- 3.1.11.1 Main System Relief Valve: 3 per aircraft; 1 per system
Cracking Pressure: 3400 - 3500 psi (23 448 - 24 1388 kPa)
Reseat Pressure: 3200 psi (22 069 kPa)
Rated Flow: 31.0 gpm (117 L/min)
- 3.1.11.2 Thermal Relief Valve: 1 per aircraft on alternate braking system
Cracking Pressure: 3800 psi (26 207 kPa)
Reseat Pressure: 3500 psi (24 138 kPa)
Rated Flow: 0.02 gpm (0.08 L/min)
- 3.1.11.3 Cargo Door System Relief Valve: 1 per aircraft
Cracking Pressure: 3450 psi (23 793 kPa)
Reseat Pressure: 3200 psi (22 069 kPa)
Rated Flow: 0.22 gpm (0.83 L/min)

3.1.12 Filtration

- 3.1.12.1 Pressure Filtration: 10 per aircraft
Location: 1 in each main pump, electric motor pump, power transfer unit and ram air turbine driven pump delivery line
Filtration Rating: 15 µm
- 3.1.12.2 Case Drain Filtration: 4 per aircraft
Location: 1 in each main pump line
Filtration Rating: 15 µm
- 3.1.12.3 Return Filtration: 3 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 3 µm

3.1.13 Tubing Data

- 3.1.13.1 High Pressure Lines
Material Specification: 21-6-9 corrosion resistant steel (CRES) per AMS5561
Diameters/Wall thicknesses 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.35/0.508 mm), 0.5/0.026 in (12.7/0.66 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (9.53/0.991 mm), 1.0/0.052 in (25.4/1.321 mm), 1.5/0.024 in (38.1/0.609 mm)
- 3.1.13.2 Low Pressure Lines
Material Specification: 6061-T6 Aluminum alloy per AMS4083
Diameters/Wall Thicknesses: 0.25/0.035 in (6.35/0.889 mm), 0.375/0.035 in (9.35/0.889 mm), 0.5/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (9.53/0.889 mm), 1.0/0.048 in (25.4/1.219 mm), 1.5/0.035 in (38.1/0.889 mm)

3.1.14 Fitting Data

- 3.1.14.1 Separable Type: 24 degree flareless
Material: Stainless steel for high pressure, Aluminum alloy for low pressure
End Connections: Internal swage, external pressure swage
- 3.1.14.2 Permanent Type: Externally pressure swaged
Material: Stainless steel for high pressure, Aluminum alloy for low pressure

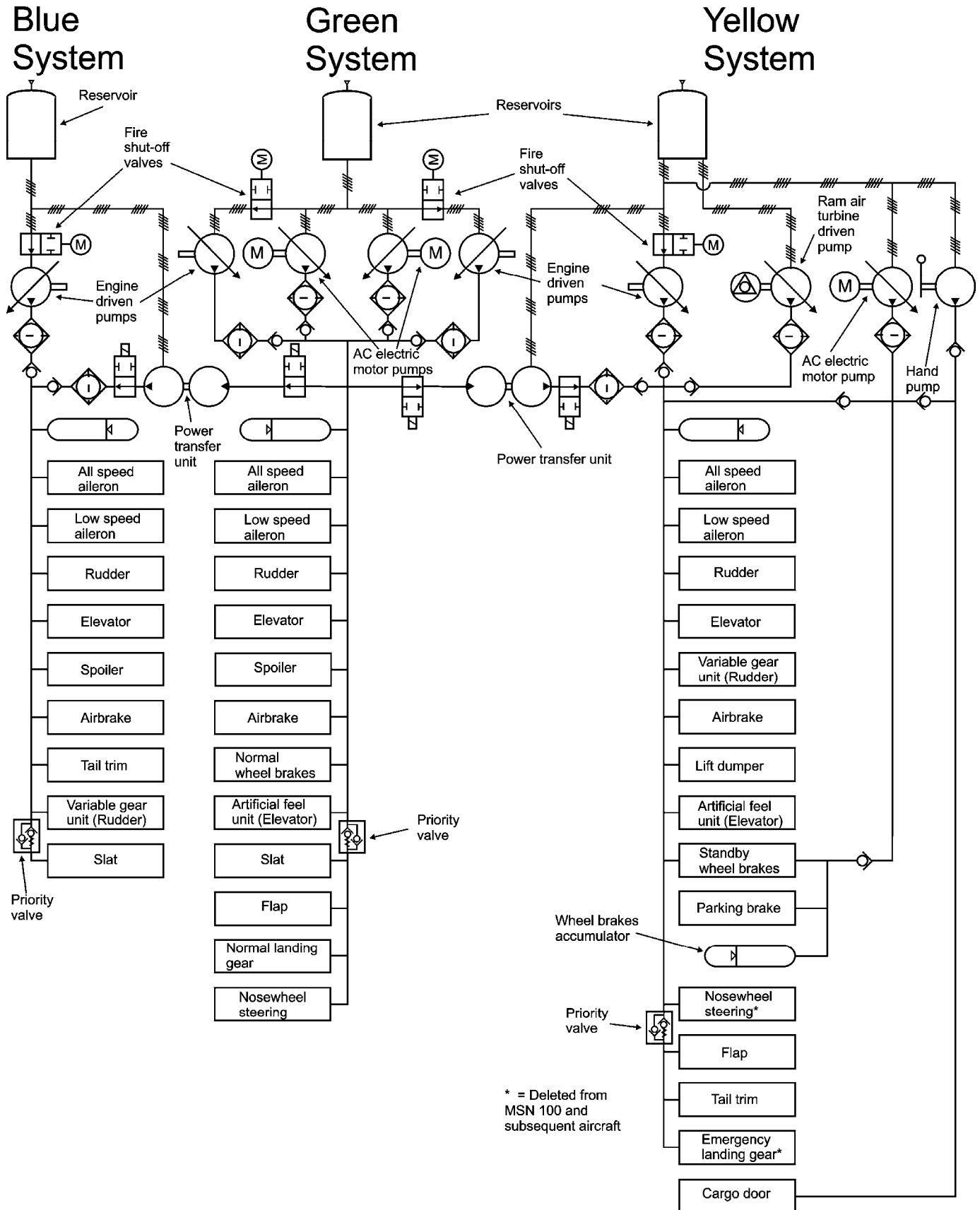


FIGURE 3.1.1 - AIRBUS A300B HYDRAULIC SYSTEM SCHEMATIC

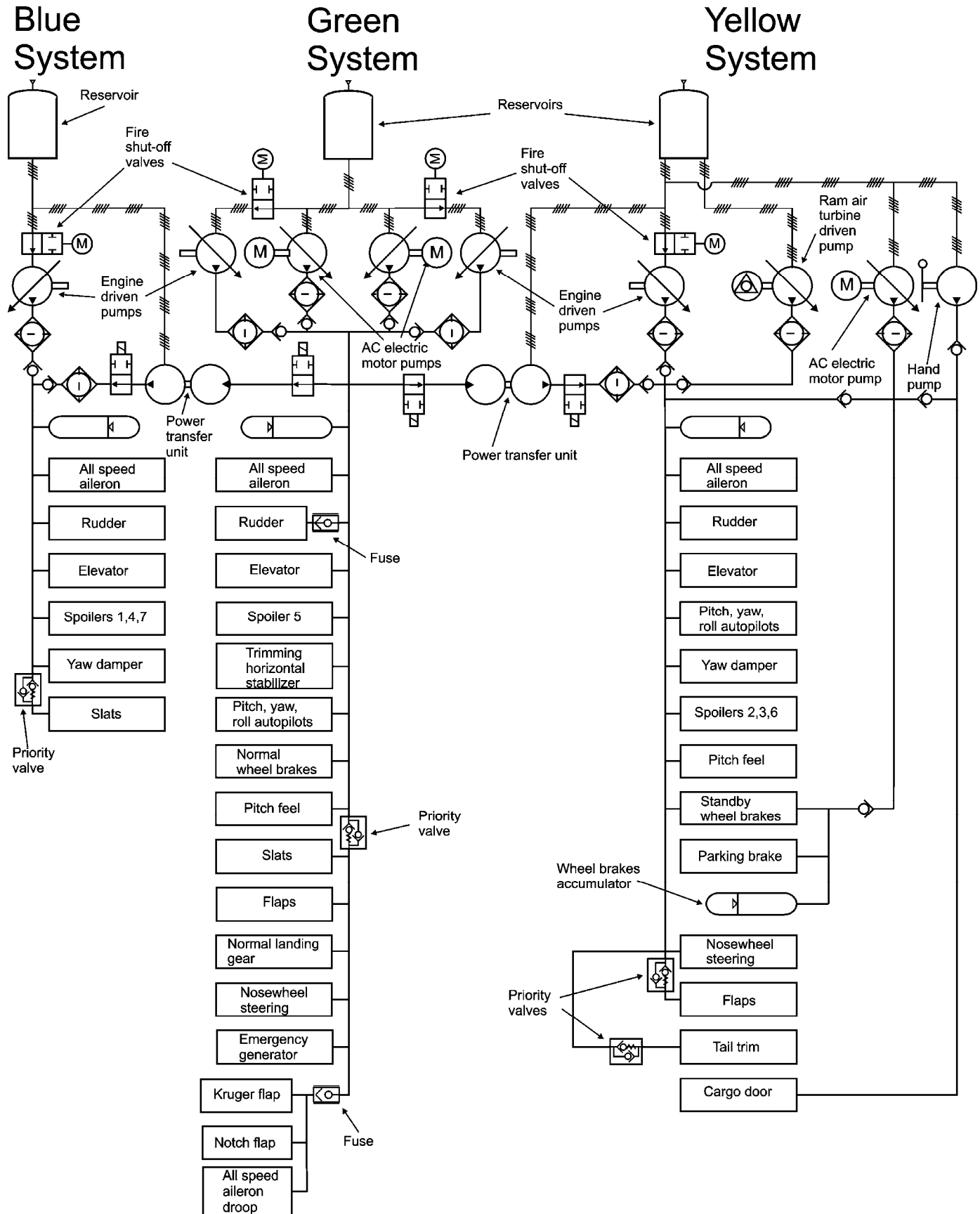


FIGURE 3.1.2 - AIRBUS A300-600 HYDRAULIC SYSTEM SCHEMATIC



3.2 Airbus A310-200/300

3.2.1 Design Requirements: 14CFR Part 25/JAR 25 requirements

3.2.2 System Pressure: 3000 psi (20 690 kPa)

3.2.3 Hydraulic Fluid: AS1241

3.2.4 Number of Hydraulic Systems: 3 – Blue System, Yellow System, Green System

3.2.5 System Temperature: -58 to +194 °F (-50 to +90 °C)

3.2.6 Main Hydraulic Pump Data

3.2.6.1 Engine Driven Pump: 4 per aircraft; 2 in Green System, 1 in Blue System, 1 in Yellow System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 37.5 gpm (142 L/min) at 2950 psi (20 345 kPa)

Displacement: 2.40 in³/rev (39.3 mL/rev)

Rated Speed: 3750 rpm

Rotation from Shaft End: Clockwise

3.2.7 Back-up Pump Data

3.2.7.1 AC Electric Motor Pump: 2 in Green System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 8.0 gpm (30.3 L/min) at 2950 psi (20 345 kPa)

Displacement: 0.253 in³/rev (4.15 mL/rev)

Rated Speed: 7200 rpm

3.2.7.2 AC Electric Motor Pump: 1 in Yellow System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 3.65 gpm (13.8 L/min) at 2950 psi (20 345 kPa)

Displacement: 0.052 in³/rev (0.85 mL/rev)

Rated Speed: 7500 rpm

3.2.7.3 Ram Air Turbine Driven Pump: 1 in Yellow System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 13.6 gpm (51.9 L/min) at 2950 psi (20 345 kPa)

Displacement: 0.75 in³/rev (12.2 mL/rev)

Rated Speed: 5200 rpm

3.2.7.4 Power Transfer Unit: 2 per aircraft; 1 in Green System to power Yellow System, 1 in Green System to power Blue System

Type: Unidirectional fixed displacement hydraulic motor driving a fixed displacement pump

Rated Flow: 31.5 gpm (119 L/min)

Displacement: Motor - 1.519 in³/rev (24.89 mL/rev), pump - 1.318 in³/rev (21.6 mL/rev)

Rated Speed: 5600 rpm

3.2.7.5 Hand Pump: 1 in Yellow System to open cargo door

Pressure - Displacement: 725 - 3000 psi (5000 - 20 690 kPa); 0.6 in³ (10 mL)/cycle

3.2.7.6 Hand Pump: 1 to fill hydraulic systems

Pressure - Displacement: 500 - 725 psi (3448 - 5000 kPa); 1.8 in³ (30 mL)/cycle

3.2.8 Hydraulic Motor Data

- 3.2.8.1 Constant Speed Motor Electrical Generator: 1 per aircraft (not fitted to all aircraft)
Type: Variable displacement
Displacement: 0.5 in³/rev (8.19 mL/rev)
Running Speed: 12 000 rpm
Flow at Rated Electrical Load/Pressure Differential: 16.6 gpm (62.5 L/min) at 2100 psi (14 483 kPa)
- 3.2.8.2 Flap Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.91 in³/rev (14.91 mL/rev)
Running Speed: 6370 rpm
Flow at Rated Pressure Differential: 25.0 gpm (95 L/min)
- 3.2.8.3 Slat Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.91 in³/rev (14.91 mL/rev)
Running Speed: 2360 rpm
Flow at Rated Pressure Differential: 11.5 gpm (44 L/min)
- 3.2.8.4 Tailplane Trim Actuator: 2 per aircraft
Type: Fixed displacement
Displacement: 0.91 in³/rev (14.91 mL/rev)
Running Speed: 2360 rpm
Flow at Rated Pressure Differential: 9.3 gpm (35.2 L/min)

3.2.9 Accumulator Data

- 3.2.9.1 Power Generation System: 3 per aircraft; 1 per system
Type: Spherical, membrane separator, gas charged
Volume: 60 in³ (1.0 L)
Precharge Pressure: 1450 psi (10 000 kPa)
- 3.2.9.2 Braking System: 2 in Yellow System
Type: Spherical, membrane separator, gas charged
Volume: 195 in³ (3.2 L)
Precharge Pressure: 1450 psi (10 000 kPa)

3.2.10 Reservoir Data

- 3.2.10.1 Green System
Type: Air pressurized
Volume: 10.6 gal (40 L)
Pressure: 51 psig (352 kPa)
- 3.2.10.2 Yellow System
Type: Air pressurized
Volume: 7.4 gal (28 L)
Pressure: 51 psig (352 kPa)
- 3.2.10.3 Blue System
Type: Air pressurized
Volume: 5.8 gal (22 L)
Pressure: 51 psig (352 kPa)

3.2.11 Relief Valve Data

- 3.2.11.1 Main System Relief Valve: 3 per aircraft; 1 per system
Cracking Pressure: 3400 - 3500 psi (23 448 - 24 1388 kPa)
Reseat Pressure: 3200 psi (22 069 kPa)
Rated Flow: 31.0 gpm (117 L/min)
- 3.2.11.2 Thermal Relief Valve: 1 per aircraft on alternate braking system
Cracking Pressure: 3800 psi (26 207 kPa)
Reseat Pressure: 3500 psi (24 138 kPa)
Rated Flow: 0.02 gpm (0.08 L/min)
- 3.2.11.3 Cargo Door System Relief Valve: 1 per aircraft
Cracking Pressure: 3450 psi (23 793 kPa)
Reseat Pressure: 3200 psi (22 069 kPa)
Rated Flow: 0.22 gpm (0.83 L/min)

3.2.12 Filtration

- 3.2.12.1 Pressure Filtration: 10 per aircraft
Location: 1 in each main pump, electric motor pump, power transfer unit and ram air turbine driven pump delivery line
Filtration Rating: 15 µm
- 3.2.12.2 Case Drain Filtration: 4 per aircraft
Location: 1 in each main pump line
Filtration Rating: 15 µm
- 3.2.12.3 Return Filtration: 3 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 3 µm

3.2.13 Tubing Data

- 3.2.13.1 High Pressure Lines
Material Specification: 21-6-9 CRES per AMS5561
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.35/0.508 mm), 0.5/0.026 in (12.7/0.66 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (9.53/0.991 mm), 1.0/0.052 in (25.4/1.321 mm), 1.5/0.024 in (38.1/0.609 mm)
- 3.2.13.2 Low Pressure Lines
Material Specification: 6061-T6 Aluminum alloy per AMS4083
Diameters/Wall Thicknesses: 0.25/0.035 in (6.35/0.889 mm), 0.375/0.035 in (9.35/0.889 mm), 0.5/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (9.53/0.889 mm), 1.0/0.048 in (25.4/1.219 mm), 1.5/0.035 in (38.1/0.889 mm)

3.2.14 Fitting Data

- 3.2.14.1 Separable Type: 24 degree flareless
Material: Stainless steel for high pressure, Aluminum alloy for low pressure
End Connections: Internal swage, external pressure swage
- 3.2.14.2 Permanent Type
Externally pressure swaged
Material: Stainless steel for high pressure, Aluminum alloy for low pressure

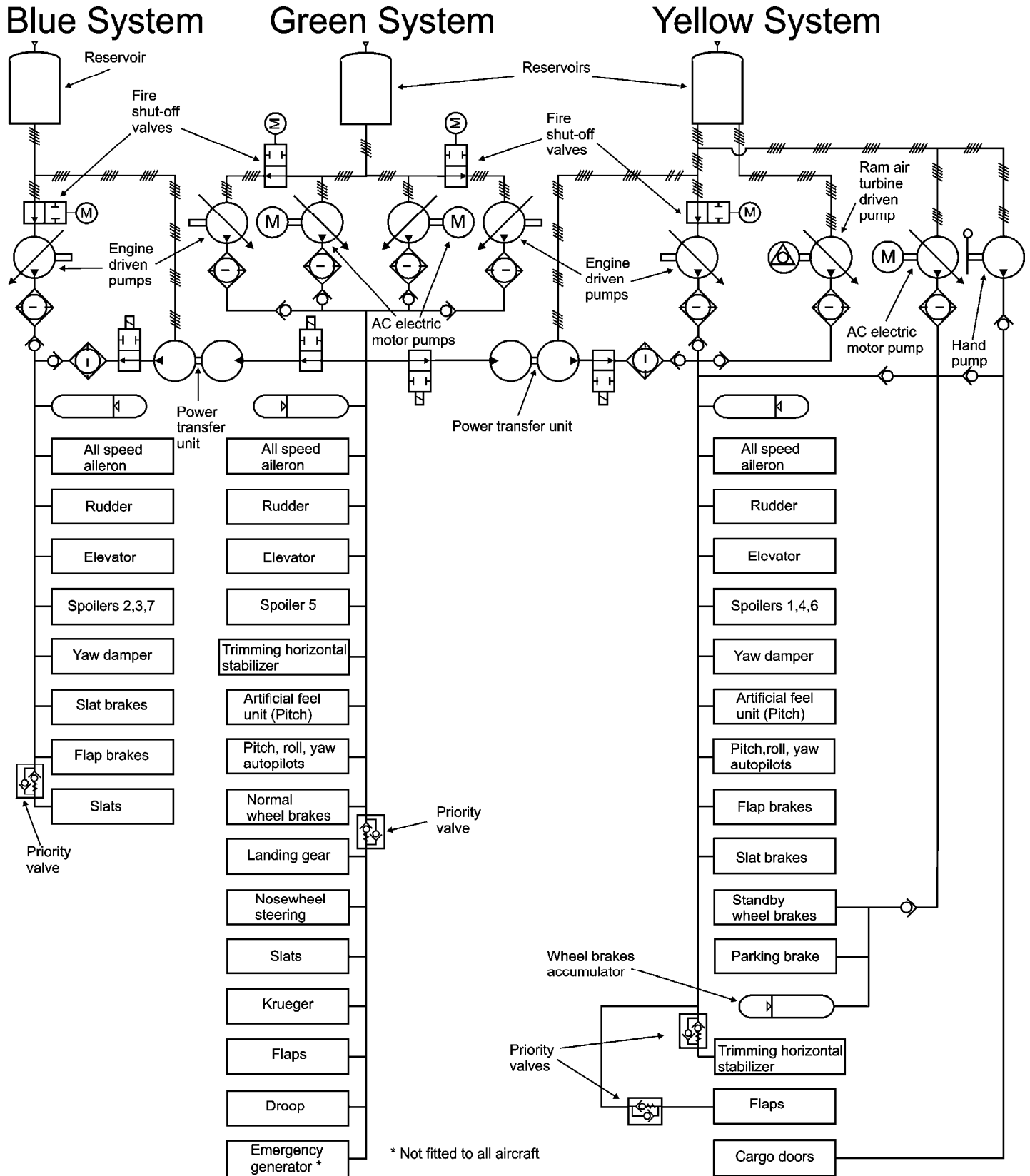


FIGURE 3.2 - AIRBUS A310-200/300 HYDRAULIC SYSTEM SCHEMATIC

3.3 Airbus A330-200/300/Airbus A340-200/300

3.3.1 Design Requirements: 14CFR Part 25/JAR 25 requirements

3.3.2 System Pressure: 3000 psi (20 690 kPa)

3.3.3 Hydraulic Fluid: AS1241

3.3.4 Number of Hydraulic Systems: 3 – Blue System, Yellow System, Green System

3.3.5 System Temperature: -65 to +224 °F (-54 to +107 °C)

3.3.6 Main Hydraulic Pump Data

3.3.6.1 Engine Driven Pump: 4 per aircraft; 2 in Green System, 1 in Yellow System, 1 in Blue System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 46.2 gpm (175 L/min) at 2950 psi (20 345 kPa)

Displacement: 3.0 in³/rev (49.2 mL/rev)

Rated Speed: 3720 rpm

Rotation from Shaft End: Clockwise

3.3.7 Back-up Pump Data

3.3.7.1 AC Electric Motor Pump: 3 per aircraft; 1 in Green System, 1 in Yellow System, 1 in Blue System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 6.1 gpm (23 L/min) at 2840 psi (19 586 kPa); 8.5 gpm (32 L/min) at 2175 psi (15 000 kPa)

Displacement: 0.263 in³/rev (4.30 mL/rev)

Rated Speed: 7600 rpm

3.3.7.2 Ram Air Turbine Driven Pump: 1 in Green System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 21.3 gpm (80.0 L/min) at 2610 psi (18 000 kPa)

Displacement: 1.0 in³/rev (16.38 mL/rev)

Rated Speed: 5100 to 6350 rpm

3.3.7.3 Hand Pump: 1 in Yellow System to open cargo door

Pressure - Displacement: 2840 psi (19 600 kPa); 0.6 in³ (10 mL)/cycle

3.3.7.4 Hand Pump: 1 to fill hydraulic systems

Pressure - Displacement: 65 psi (450 kPa); 3.8 in³ (62 mL)/cycle

3.3.8 Hydraulic Motor Data

3.3.8.1 Flap Motor: 2 per aircraft

Type: Fixed displacement

Displacement: 0.91 in³/rev (14.91 mL/rev)

Running Speed: 5890 rpm

Flow at Rated Pressure Differential: 23.5 gpm (89 L/min)

3.3.8.2 Slat Motor: 2 per aircraft

Type: Fixed displacement

Displacement: 0.91 in³/rev (14.91 mL/rev)

Running Speed: 6370 rpm

Flow at Rated Pressure Differential: 25.0 gpm (95 L/min)

- 3.3.8.3 Trimming Horizontal Stabilizer Actuator: 2 per aircraft
Type: Fixed displacement
Displacement: 0.64 in³/rev (10.5 mL/rev)
Running Speed: 3800 rpm
Flow at Rated Pressure Differential: 12.9 gpm (49 L/min)
- 3.3.8.4 A330 Constant Speed Motor Electrical Generator: 1 per aircraft
Type: Variable displacement
Displacement: 0.49 in³/rev
Running Speed: 8000 rpm
Flow at Rated Electrical Load/Pressure Differential: 10.6 gpm (40 L/min) at 2160 psi (18 000 kPa)
- 3.3.8.5 A340 Constant Speed Motor Electrical Generator: 1 per aircraft
Type: Variable displacement
Displacement: 0.22 in³/rev
Running Speed: 12 000 rpm
Flow at Rated Electrical Load/Pressure Differential: 7.7 gpm (35 L/min) at 2465 psi (17 000 kPa)
- 3.3.9 Accumulator Data
- 3.3.9.1 Power Generation System: 3 per aircraft; 1 per system
Type: Spherical, bladder separator, gas charged
Volume: 61 in³ (1.0 L)
Precharge Pressure: 1885 psi (13 000 kPa)
- 3.3.9.2 Braking System: 2 in Blue brake system
Type: Spherical, bladder separator, gas charged
Volume: 366 in³ (6.0 L)
Precharge Pressure: 1450 psi (10 000 kPa)
- 3.3.9.3 Braking System: 4 per aircraft; 2 in Green System Brake return; 2 in Yellow System Brake return
Type: Bladder, gas charged
Volume: 8 in³ (0.13 L)
Precharge Pressure: 174 psi (1200 kPa)
- 3.3.10 Reservoir Data
- 3.3.10.1 Green System
Type: Air pressurized
Volume: 13.8 gal (52 L)
Pressure: 51 psig (352 kPa)
- 3.3.10.2 Yellow System
Type: Air pressurized
Volume: 10.0 gal (38 L)
Pressure: 51 psig (352 kPa)
- 3.3.10.3 Blue System
Type: Air pressurized
Volume: 6.2 gal (23.5 L)
Pressure: 51 psig (352 kPa)

3.3.11 Relief Valve Data

- 3.3.11.1 Main System Relief Valve: 3 per aircraft; 1 per system
Cracking Pressure: 3437 psi (23 700 kPa)
Reseat Pressure: 3190 psi (22 000 kPa)
Rated Flow: 46.2 gpm (175 L/min)
- 3.3.11.2 Thermal Relief Valve: 1 per aircraft on alternate braking system
Cracking Pressure: 3800 psi (26 207 kPa)
Reseat Pressure: 3500 psi (24 138 kPa)
Rated Flow: 0.02 gpm (0.08 L/min)

3.3.12 Filtration

- 3.3.12.1 Pressure Filtration: 4 per aircraft
Location: 2 in Green System, 1 in Blue System, 1 in Yellow System delivery line
Filtration Rating: 15 µm
- 3.3.12.2 Case Drain Filtration: 4 per aircraft
Location: 1 in each main pump line
Filtration Rating: 15 µm
- 3.3.12.3 Return Filtration: 3 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 3 µm

3.3.13 Tubing Data

- 3.3.13.1 High Pressure Lines
Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.53/0.483 mm), 0.5/0.025 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.0/0.05 in (25.4/1.295 mm)
- 3.3.13.2 Low Pressure Lines
 - 3.3.13.2.1 Material Specification: 6061-T6 Aluminum alloy per AMS4083
Diameters/Wall Thicknesses: 0.25/0.035 in (6.35/0.889 mm), 0.375/0.035 in (9.35/0.889 mm), 0.5/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (9.53/0.889 mm), 1.0/0.048 in (25.4/1.219 mm), 1.5/0.035 in (38.1/0.889 mm)
 - 3.3.13.2.2 Material Specification: 21-6-9 CRES per AMS5561 (fire zones; tire burst areas, pipe diameter greater than 1 in. (25.4 mm))
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.35/0.508 mm), 0.5/0.026 in (12.7/0.66 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (9.53/0.991 mm), 1.0/0.052 in (25.4/1.321 mm), 1.5/0.024 in (38.1/0.609 mm)
 - 3.3.13.2.3 Material Specification: Ti 3Al, 2.5V Titanium alloy per AMS4945 (nose and main landing gear bay, exposed areas, wing fuel tank)
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.53/0.483 mm), 0.5/0.025 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.0/0.05 in (25.4/1.295 mm)

3.3.14 Fitting Data

- 3.3.14.1 Separable Type: 24 degree flareless
Material: Stainless steel for high pressure, Aluminum alloy for low pressure
End Connections: Internal swage, external pressure swage
- 3.3.14.2 Permanent Type: Externally pressure swaged
Material: Stainless steel for high pressure, Aluminum alloy for low pressure

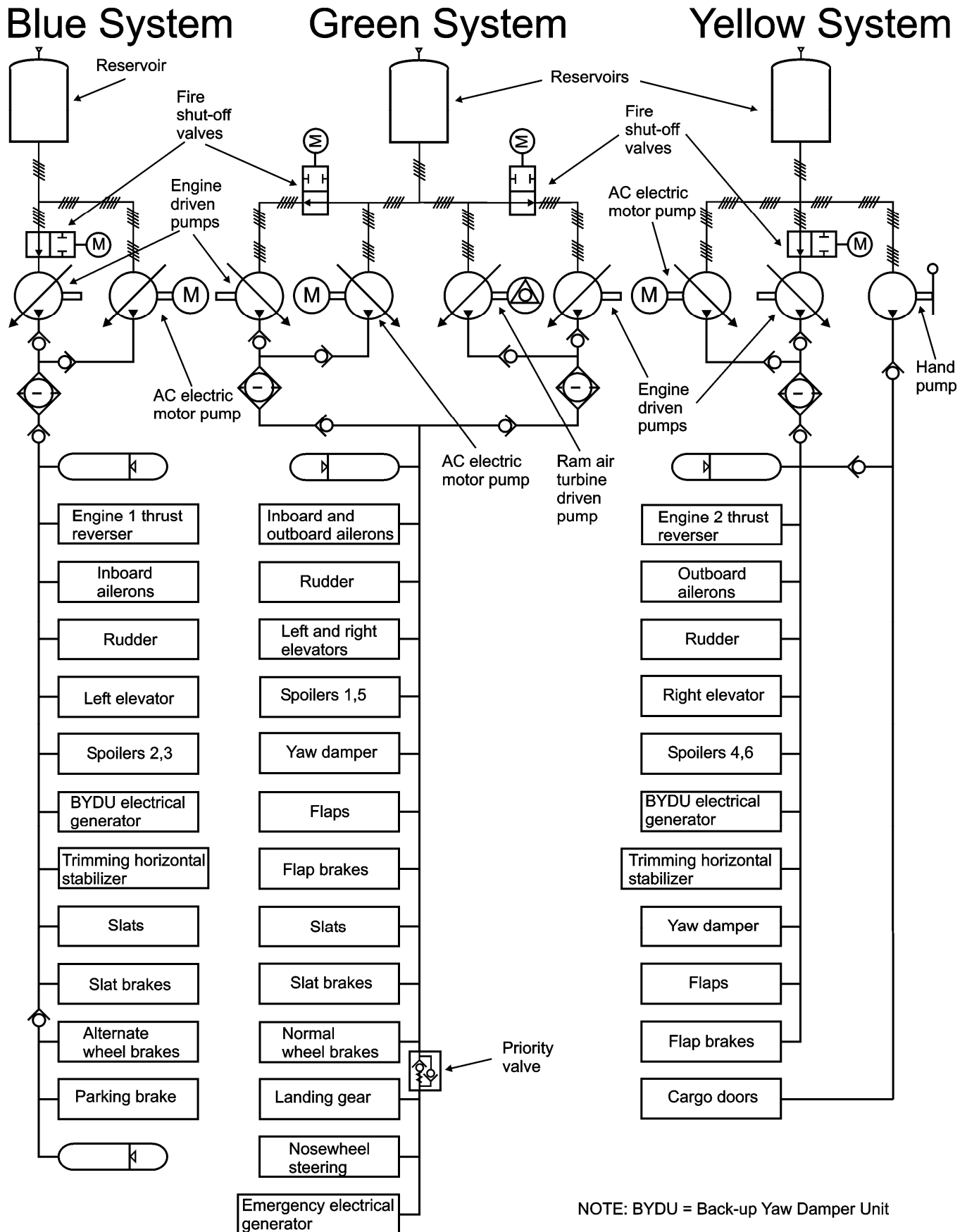


FIGURE 3.3.1 - AIRBUS A330-200/300 HYDRAULIC SYSTEM SCHEMATIC

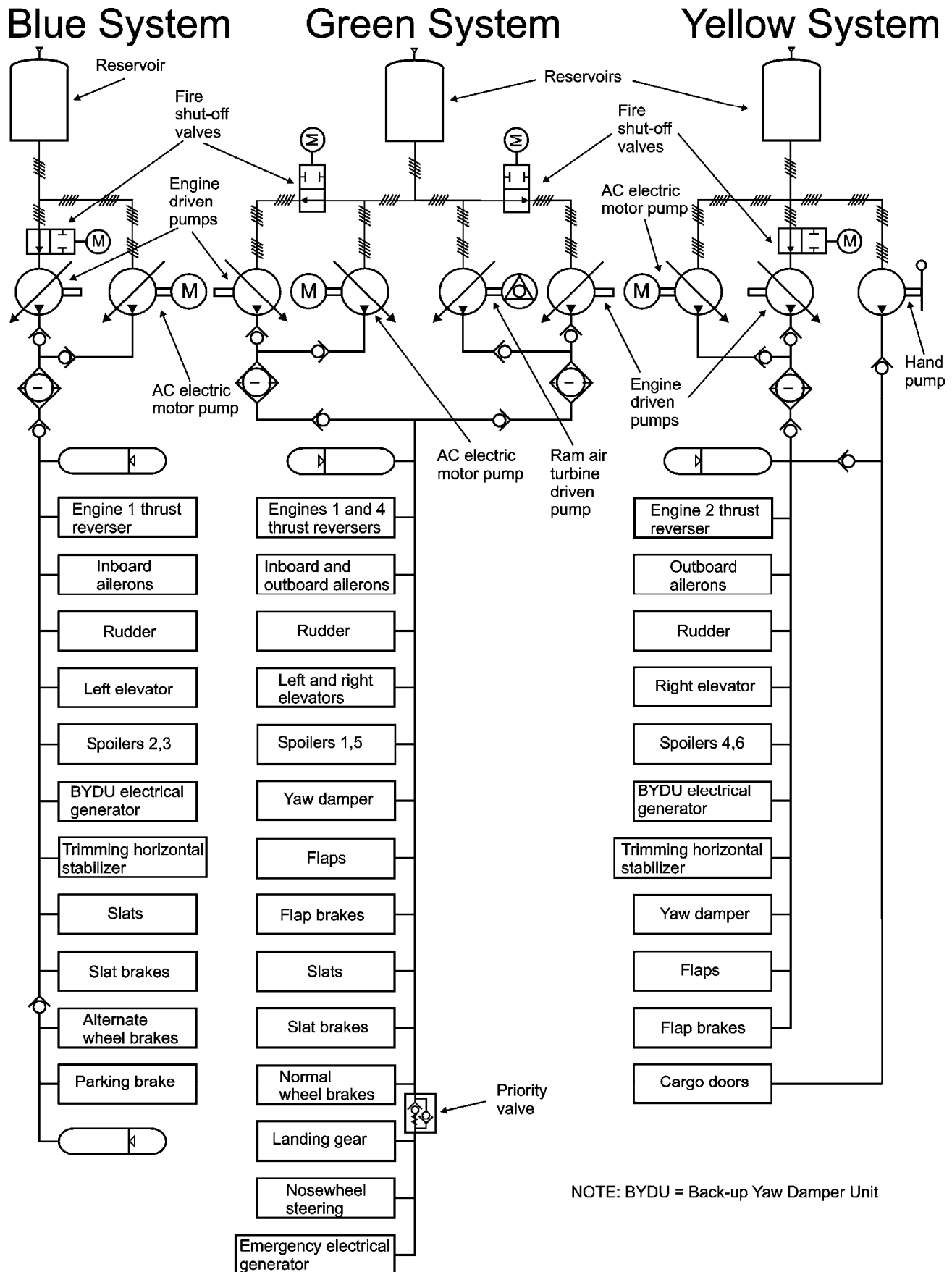


FIGURE 3.3.2 - AIRBUS A340-200/300 HYDRAULIC SYSTEM SCHEMATIC

3.4 Airbus A340-500/600

3.4.1 Design Requirements: 14CFR Part 25/JAR 25 requirements

3.4.2 System Pressure: 3000 psi (20 690 kPa)

3.4.3 Hydraulic Fluid: AS1241

3.4.4 Number of Hydraulic Systems: 3 – Blue System, Yellow System, Green System

3.4.5 System Temperature: -65 to +224 °F (-54 to +107 °C)

3.4.6 Main Hydraulic Pump Data

3.4.6.1 Engine Driven Pump: 4 per aircraft; 2 in Green System, 1 in Yellow System, 1 in Blue System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 46.3 gpm (175 L/min) at 2854 psi (19 683 kPa)

Displacement: 3.0 in³/rev (49.2 mL/rev)

Rated Speed: 4980 rpm

Rotation from Shaft End: Clockwise

3.4.7 Back-up Pump Data

3.4.7.1 AC Electric Motor Pump: 3 per aircraft; 1 in Green System, 1 in Yellow System, 1 in Blue System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 6.1 gpm (23 L/min) at 2840 psi (19 586 kPa); 8.5 gpm (32 L/min) at 2175 psi (15 000 kPa)

Displacement: 0.263 in³/rev (4.30 mL/rev)

Rated Speed: 7600 rpm

3.4.7.2 Ram Air Turbine Driven Pump: 1 in Green System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 36.0 gpm (136.0 L/min) at 2610 psi (18 000 kPa)

Displacement: 1.0 in³/rev (16.38 mL/rev)

Rated Speed: 4850 to 6370 rpm

3.4.7.3 Hand Pump: 1 in Yellow System to open cargo door

Pressure - Displacement: 2840 psi (19 600 kPa); 0.6 in³ (10 mL)/cycle

3.4.7.4 Hand Pump: 1 to fill hydraulic systems

Pressure - Displacement: 65 psi (450 kPa); 3.8 in³ (62 mL)/cycle

3.4.8 Hydraulic Motor Data

3.4.8.1 Flap Motor: 2 per aircraft

Type: Fixed displacement

Displacement: 0.91 in³/rev (14.91 mL/rev)

Running Speed: 5890 rpm

Flow at Rated Pressure Differential: 23.5 gpm (89 L/min)

3.4.8.2 Slat Motor: 2 per aircraft

Type: Fixed displacement

Displacement: 0.91 in³/rev (14.91 mL/rev)

Running Speed: 6370 rpm

Flow at Rated Pressure Differential: 25.0 gpm (95 L/min)

- 3.4.8.3 Trimming Horizontal Stabilizer Actuator: 2 per aircraft
 - Type: Fixed displacement
 - Displacement: 0.68 in³/rev (11.1 mL/rev)
 - Running Speed: 6800 rpm
 - Flow at Rated Pressure Differential: 20.0 gpm (76 L/min)
- 3.4.8.4 Constant Speed Motor Electrical Generator: 1 per aircraft
 - Type: Variable displacement
 - Displacement: 0.22 in³/rev
 - Running Speed: 12 000 rpm
 - Flow at Rated Electrical Load/Pressure Differential: 7.7 gpm (35 L/min) at 2465 psi (17 000 kPa)
- 3.4.9 Accumulator Data
 - 3.4.9.1 Power Generation System: 3 per aircraft; 1 per system
 - Type: Spherical, bladder separator, gas charged
 - Volume: 61 in³ (1.0 L)
 - Precharge Pressure: 1885 psi (13 000 kPa)
 - 3.4.9.2 Braking System: 2 in Blue brake system
 - Type: Spherical, bladder separator, gas charged
 - Volume: 366 in³ (6.0 L)
 - Precharge Pressure: 1450 psi (10 000 kPa)
 - 3.4.9.3 Braking System: 6 per aircraft; 3 in Green System Brake return; 3 in Yellow System Brake return
 - Type: Bladder, gas charged
 - Volume: 8 in³ (0.13 L)
 - Precharge Pressure: 174 psi (1200 kPa)
- 3.4.10 Reservoir Data
 - 3.4.10.1 Green System
 - Type: Air pressurized
 - Volume: 21.4 gal (81 L)
 - Pressure: 51 psig (352 kPa)
 - 3.4.10.2 Yellow System
 - Type: Air pressurized
 - Volume: 9.3 gal (35 L)
 - Pressure: 51 psig (352 kPa)
 - 3.4.10.3 Blue System
 - Type: Air pressurized
 - Volume: 9.3 gal (35 L)
 - Pressure: 51 psig (352 kPa)
- 3.4.11 Relief Valve Data
 - 3.4.11.1 Main System Relief Valve: 3 per aircraft; 1 per system
 - Cracking Pressure: 3437 psi (23 700 kPa)
 - Reseat Pressure: 3190 psi (22 000 kPa)
 - Rated Flow: 46.2 gpm (175 L/min)

3.4.11.2 Thermal Relief Valve: 1 per aircraft on alternate braking system
Cracking Pressure: 3800 psi (26 207 kPa)
Reseat Pressure: 3500 psi (24 138 kPa)
Rated Flow: 0.02 gpm (0.08 L/min)

3.4.12 Filtration

3.4.12.1 Pressure Filtration: 4 per aircraft
Location: 2 in Green System, 1 in Blue System, 1 in Yellow System delivery line
Filtration Rating: 15 µm

3.4.12.2 Case Drain Filtration: 4 per aircraft
Location: 1 in each main pump line
Filtration Rating: 15 µm

3.4.12.3 Return Filtration: 3 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 3 µm

3.4.13 Tubing Data

3.4.13.1 High Pressure Lines
Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.53/0.483 mm), 0.5/0.025 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.0/0.05 in (25.4/1.295 mm)

3.4.13.2 Low Pressure Lines

3.4.13.2.1 Material Specification: 6061-T6 Aluminum alloy per AMS4083
Diameters/Wall Thicknesses: 0.5/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (9.53/0.889 mm), 1.0/0.048 in (25.4/1.219 mm), 1.5/0.035 in (38.1/0.889 mm)

3.4.13.2.2 Material Specification: 21-6-9 CRES per AMS5561 (fire zones; tire burst areas, pipe diameter greater than 1 in. (25.4 mm) in special areas)
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.35/0.508 mm), 0.5/0.026 in (12.7/0.66 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (9.53/0.991 mm), 1.0/0.052 in (25.4/1.321 mm), 1.25/0.024 in (31.75/0.609 mm), 1.5/0.024 in (38.1/0.609 mm)

3.4.13.2.3 Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945*
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.53/0.483 mm), 0.5/0.025 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.0/0.05 in (25.4/1.295 mm)
*0.25 in and 0.375 in – normal applications; all other diameters for pipes used in fuel tanks

3.4.14 Fitting Data

3.4.14.1 Separable Type: 24 degree flareless
Material: Stainless steel and Titanium for high pressure, Aluminum alloy for low pressure
End Connections: Internal swage, external pressure swage

3.4.14.2 Permanent Type: Externally pressure swaged
Material: Stainless steel and Titanium for high pressure, Aluminum alloy for low pressure

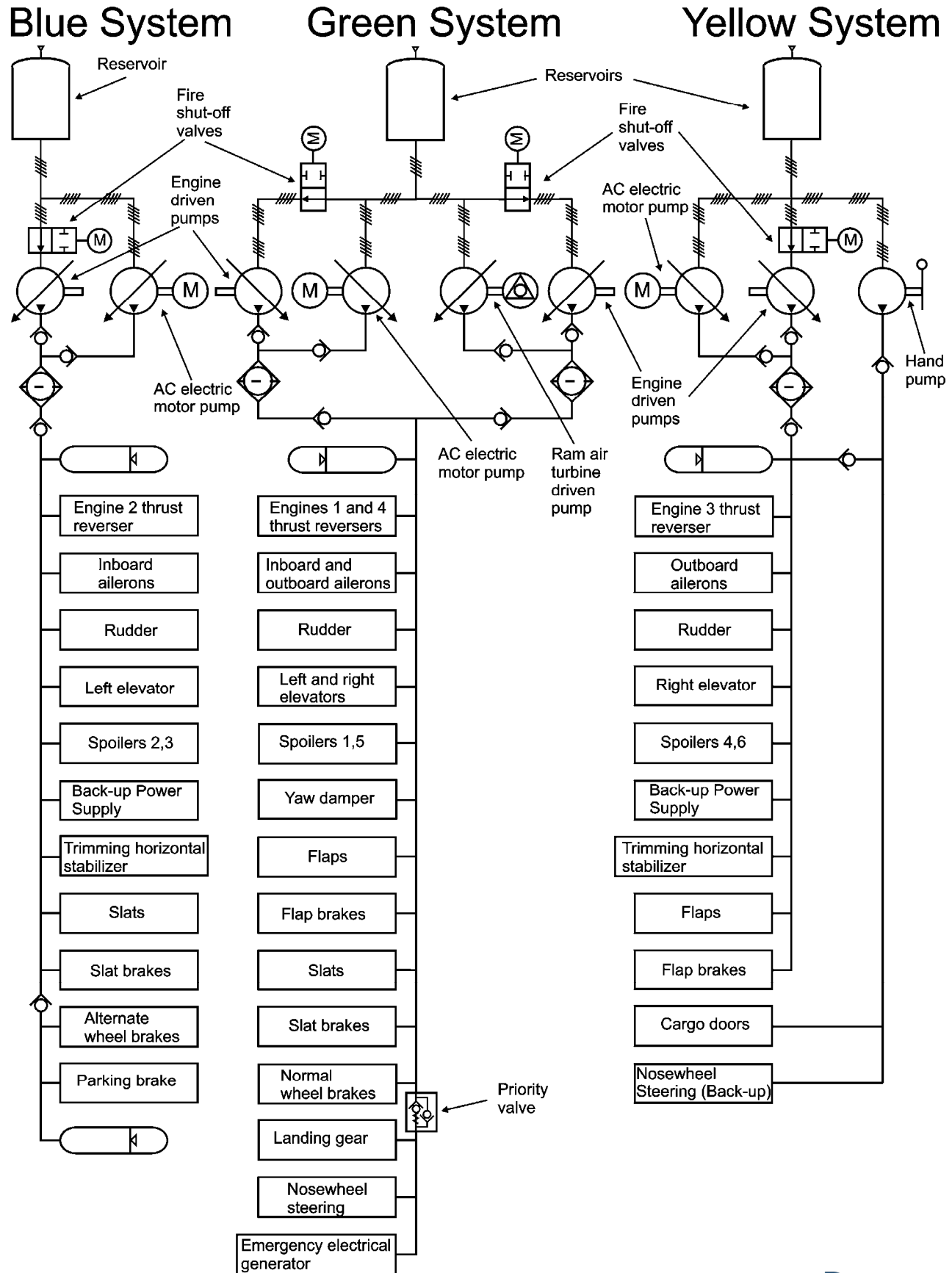


FIGURE 3.4 - AIRBUS A340-500/600 HYDRAULIC SYSTEM SCHEMATIC



3.5 Airbus A380-800

3.5.1 Design Requirements: 14CFR/CS-25 requirements

3.5.2 System Pressure: 5080 psi (35 000 kPa)

3.5.3 Hydraulic Fluid: AS1241

3.5.4 Number of Hydraulic Systems: 2 – Green System, Yellow System

3.5.5 System Temperature: -65 to +224 °F (-54 to +107 °C)

3.5.6 Main Hydraulic Pump Data

- 3.5.6.1 Engine driven pump: 8 per aircraft; 4 in Green System, 4 in Yellow System
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 42.8 gpm (162 L/min) at 4780 psi (33 000 kPa)
Displacement: 2.9 in³/rev (47.0 mL/rev)
Rated Speed: 3775 rpm
Rotation from Shaft End: Clockwise

3.5.7 Back-up Pump Data

- 3.5.7.1 AC Electric Motor Pump: 4 per aircraft; 2 in Green System, 2 in Yellow System
Type: Variable displacement, pressure compensated, inline piston
Flow-Pressure: 6.0 gpm (22.5 L/min) at 4800 psi (33 000 kPa)
9.9 gpm (37.5 L/min) at 2900 psi (20 000 kPa)
Displacement: 0.35 in³/rev (5.73 mL/rev)
Rated Speed: 8000 rpm
- 3.5.7.2 DC Electric Motor Pump – Braking System: 2 per aircraft; 1 in Green System, 1 in Yellow System:
Type: Variable speed, fixed displacement, bent-axis piston
Rated Flow-Pressure: 2.0 gpm (7.6 L/min) at 4000 psi (27 582 kPa)
Displacement: 0.06 in³/rev (1.0 mL/rev)
Rated Speed: Up to 8000 rpm
- 3.5.7.3 DC Electric Motor Pump – Steering System: 1 per aircraft in Green System
Type: Variable speed, fixed displacement, bent-axis piston
Rated Flow-Pressure: 3.0 gpm (11.4 L/min) at 3500 psi (24 138 kPa)
Displacement: 0.06 in³/rev (1.0 mL/rev)
Rated Speed: Up to 12 000 rpm
- 3.5.7.4 Hand Pump: 1 in Yellow System to open cargo door
Pressure - Displacement: 2840 psi (19 600 kPa); 0.6 in³ (10 mL)/cycle
- 3.5.7.5 Hand Pump: 1 to fill hydraulic systems
Pressure - Displacement: 65 psi (450 kPa); 3.8 in³ (62 mL)/cycle

3.5.8 Hydraulic Motor Data

- 3.5.8.1 Flap motor: 2 per aircraft
Type: Variable displacement
Displacement: 1.71 in³/rev (28 mL/rev)
Running Speed: 5895 rpm
Flow at Rated Pressure Differential (peak at maximum operating torque): 21.1 gpm (80 L/min)
- 3.5.8.2 Slat motor: 1 per aircraft
Type: Variable displacement
Displacement: 0.75 in³/rev (12.28 mL/rev)
Running Speed: 4944 rpm
Flow at Rated Pressure Differential (peak at maximum operating torque): 13.2 gpm (50 L/min)
- 3.5.8.3 Horizontal Stabilizer Actuator Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.80 in³/rev (13.1 mL/rev)
Running Speed: 5060 rpm
Flow at Rated Pressure Differential: 16.4 gpm (62 L/min)

3.5.9 Accumulator Data

- 3.5.9.1 Power Generation System: 2 per aircraft; 1 per system
Type: Factory pre-charged, welded bellows
Volume: 1281 in³ (2.1 L)
Precharge Pressure: 2610 psi (17 995 kPa)
- 3.5.9.2 Braking System: 4 per aircraft; 2 per system
2 in Green brake system
Type: Factory pre-charged, welded bellows
Volume: 366 in³ (6.0 L)
Precharge Pressure: 2494 psi (17 200 kPa)
- 2 in Yellow brake system
Type: Factory pre-charged, welded bellows
Volume: 579 in³ (9.0 L)
Precharge Pressure: 2567 psi (17 700 kPa)
- 3.5.9.3 Braking System: 8 per aircraft; 4 in Green System Brake return; 4 in Yellow System Brake return
Type: Bladder, gas charged
Volume: 8 in³ (0.13 L)
Precharge Pressure: 174 psi (1200 kPa)
- 3.5.9.4 Nosewheel Steering System: 1 per aircraft
Type: Factory pre-charged, welded bellows
Volume: 500 in³ (8.2 L)
Precharge Pressure: 2755 psi (19 000 kPa)

3.5.10 Reservoir Data

- 3.5.10.1 Green System
Type: Air pressurized
Volume: 31.7 gal (120 L)
Pressure: 51 psig (352 kPa)

3.5.10.2 Yellow System

Type: Air pressurized

Volume: 10.0 gal (38 L)

Pressure: 51 psig (352 kPa)

3.5.10.3 Braking System: 2 per aircraft; 1 per system

Type: Factory pre-charged, welded bellows

Volume: 2.2 gal (8.5 L)

Precharge Pressure: 43.5 psi (300 kPa)

3.5.10.4 Nosewheel Steering System

Type: Factory pre-charged, welded bellows

Volume: 1.5 gal (5.5 L)

Precharge Pressure: 43.5 psi (300 kPa)

3.5.11 Relief Valve Data

3.5.11.1 Main System Relief Valve: 2 per aircraft; 1 per system

Cracking Pressure: 5662 psi (39 038 kPa)

Reseat Pressure: 5511 psi (37 997 kPa)

Rated Flow: 46.2 gpm (175 L/min)

3.5.11.2 Braking and Steering Sub-system Relief Valve: 3 per aircraft; 1 per system

Cracking Pressure: 5800 psi (40 000 kPa)

Reseat Pressure: 4901 psi (33 800 kPa)

Rated Flow: 3.2 gpm (12 L/min)

3.5.12 Filtration

3.5.12.1 Pressure Filtration

Location: 13 per aircraft; 5 in Green System, 5 in Yellow System; 1 in each Braking and Steering Sub-system delivery line

Filtration Rating: 15 µm

3.5.12.2 Case Drain Filtration

Location: 10 per aircraft; 1 for each engine driven pump, 1 for the two EMP's per system

Filtration Rating: 15 µm

3.5.12.3 Return Filtration

3.5.12.3.1 Main System:

Location: 2 per aircraft; 1 in each system return line upstream of each main system reservoir

Filtration Rating: 3 µm

3.5.12.3.2 Braking and Steering Sub-system:

Location: 1 in each return line upstream of the sub-system reservoir

Filtration Rating: 5 µm

3.5.13 Tubing Data

3.5.13.1 High Pressure Lines

Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945

Diameters/Wall Thicknesses: 0.25/0.025 in (6.35/0.64 mm), 0.375/0.03 in (9.53/0.76 mm), 0.5/0.04 in (12.7/1.02 mm), 0.625/0.05 in (15.875/1.27 mm), 0.75/0.059 in (19.05/1.5 mm), 1.0/0.79 in (25.4/2.01 mm), 1.25/0.098 in (31.75/2.49 mm)

3.5.13.2 Low Pressure Lines

3.5.13.2.1 Material Specification: 6061-T6 (normal) Aluminum alloy per AMS4083

Diameters/Wall Thicknesses: 0.5/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (19.05/0.889 mm), 1.0/0.048 in (25.4/1.219 mm), 1.25/0.06 in (31.75/1.523 mm), 1.5/0.035 in (38.1/0.889 mm)

3.5.13.2.2 Material Specification: 21-6-9 CRES per AMS5561

Diameters/Wall Thicknesses: 1.25/0.024 in (31.75/0.609 mm), 1.5/0.024 in (38.1/0.609 mm)

3.5.13.2.3 Material Specification: Ti 3Al, 2.5V Titanium alloy per AMS4945

Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.525/0.483 mm), 0.5/0.026 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.0/0.051 in (25.4/1.295 mm)

3.5.14 Fitting Data

3.5.14.1 Separable Type

24 degree flareless

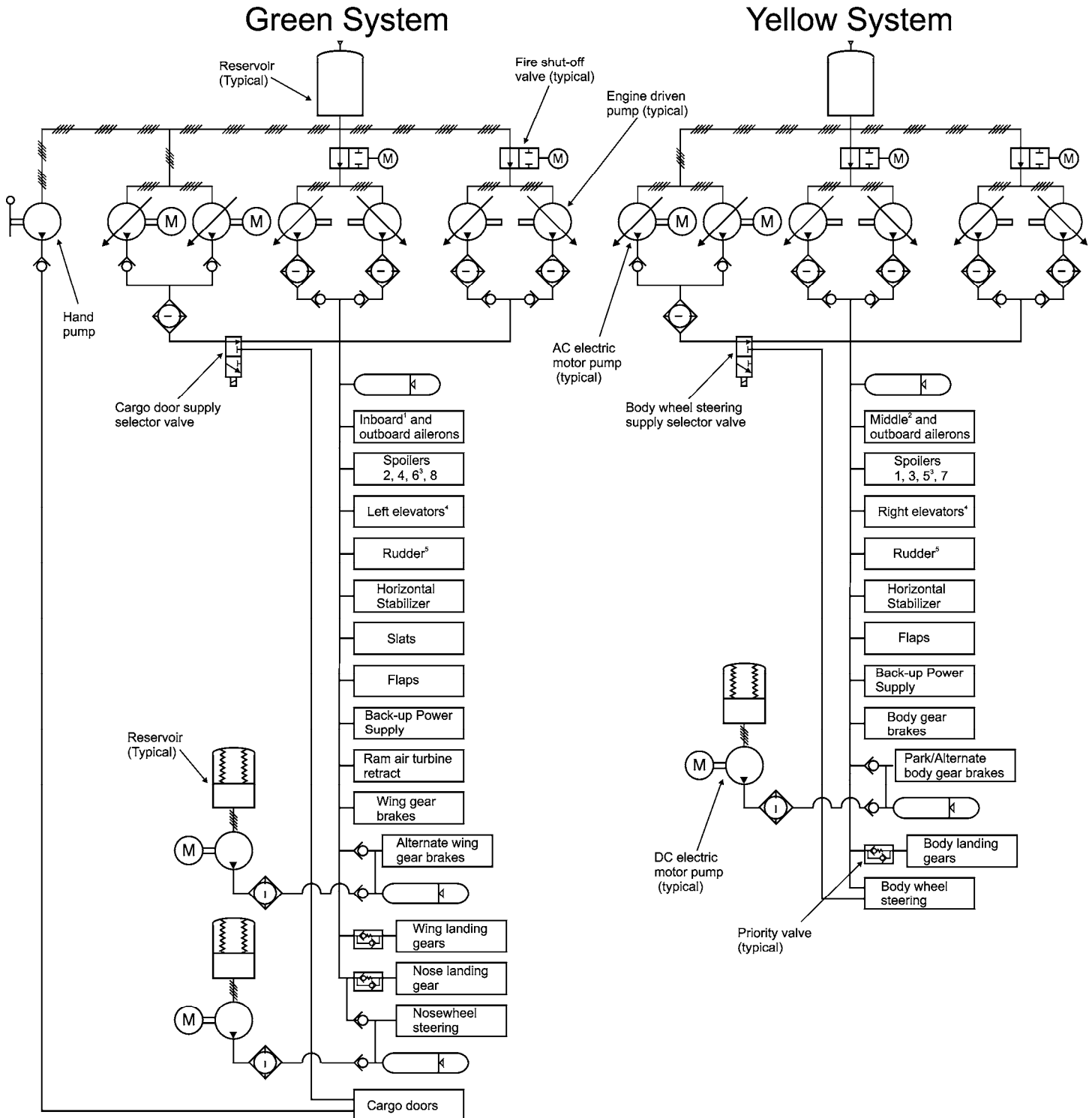
Material: Titanium or stainless steel for high pressure, Aluminum alloy for low pressure

End Connections: Internal swage, external pressure swage

3.5.14.2 Permanent Type

Externally pressure swaged

Material: Titanium for high pressure, Aluminum alloy or stainless steel for low pressure



Notes:

1. Inboard ailerons are backed up by EHA's
2. Middle ailerons are backed up by EHA's
3. Spoilers 5 and 6 are EHBA's
4. Inboard and outboard elevators are backed up by EHA's
5. All rudder actuators are EHBA's

FIGURE 3.5 - AIRBUS A380-800 HYDRAULIC SYSTEM SCHEMATIC

3.6 Boeing 747-100/200/300

3.6.1 Design Requirements: 14CFR Part 25 requirements

3.6.2 System Pressure: 3000 psi (20 690 kPa)

3.6.3 Hydraulic Fluid: AS1241

3.6.4 Number of Hydraulic Systems: 4 – System 1, System 2, System 3, System 4

3.6.5 System Temperature: -65 to +225 °F (-54 to +107 °C)

3.6.6 Main Hydraulic Pump Data

- 3.6.6.1 Engine Driven Pump: 4 per aircraft; 1 in each system
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 37.5 gpm (142 L/min) at 2850 psi (19 655 kPa)
Displacement: 2.40 in³/rev (39.3 mL/rev)
Rated Speed: 3750 rpm
Rotation from Shaft End: Counter clockwise

3.6.7 Back-up Pump Data

- 3.6.7.1 Air Turbine Driven Pump: 4 per aircraft; 1 in each system
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 32.0 gpm (121 L/min) at 2850 psi (19 655 kPa)
Displacement: 2.40 in³/rev (39.3 mL/rev)
Rated Speed: 3250 rpm
- 3.6.7.2 AC Electric Motor Pump: 1 in System 4
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 6.0 gpm (22.7 L/min) at 2850 psi (19 655 kPa); 12.0 gpm (45.5 L/min) at 1200 psi (8276 kPa)
Displacement: 0.48 in³/rev (7.87 mL/rev)
Rated Speed: 8000 rpm
- 3.6.7.3 Power Transfer Unit: 1 in System 1 to drive Auxiliary Stabilizer Drive (Alternate source) in System 3
Type: Unidirectional fixed displacement bent axis piston motor and a fixed displacement bent axis piston pump
Rated Flow: 1.0 gpm (3.8 L/min) outlet flow with an input flow of 1.27 gpm (4.81 L/min)
Displacement: Motor - 0.095 in³/rev (1.56 mL/rev); pump - 0.080 in³/rev (1.31 mL/rev)
Rated Speed: 3000 rpm

3.6.8 Hydraulic Motor Data

- 3.6.8.1 Outboard Flap Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 1.52 in³/rev (24.91 mL/rev)
Running Speed: 3706 rpm for outboard flaps
Flow at Rated Pressure Differential: 25.8 gpm (97.7 L/min) at 3000 psi (20 690 kPa)
- 3.6.8.2 Inboard Flap Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 2.35 in³/rev (38.511 mL/rev)
Running Speed: 3424 rpm
Flow at Rated Pressure Differential: 36.8 gpm (139.3 L/min) at 3000 psi (20 690 kPa)

- 3.6.8.3 Stabilizer Drive Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.803 in³/rev (13.4 mL/rev)
Running Speed: 2320 rpm
Flow at Rated Pressure Differential: 8.8 gpm (33.3 L/min) at 3000 psi (20 690 kPa)

3.6.9 Accumulator Data

- 3.6.9.1 Braking System: 1 in System 4 Brake System
Type: Piston, gas charged
Volume: 200 in³ (3.48 L)
Precharge Pressure: 750 psi (5172 kPa)

- 3.6.9.2 Braking System: 3 in System 4 Brake Return
Type: Piston, gas charged
Volume: 25 in³ (0.41 L)
Precharge Pressure: 150 psi (1034 kPa)

3.6.10 Reservoir Data

- 3.6.10.1 System 1 and System 4
Type: Air pressurized
Full Volume: 10.6 gal (40.2 L)
Total Volume: 12.35 gal (46.8 L)
Pressure: 45 psig (310 kPa)

- 3.6.10.2 System 2 and System 3
Type: Air pressurized
Full Volume: 7.00 gal (26.5 L)
Total Volume: 8.00 gal (30.3 L)
Pressure: 45 psig (310 kPa)

3.6.11 Relief Valve Data

- 3.6.11.1 Main System Relief Valve: 4 per aircraft; 1 per system
Relief Pressure: 3400 - 3600 psi (23 448 - 24 828 kPa)
Reseat Pressure: Not known
Rated Flow: Not known

3.6.12 Filtration

- 3.6.12.1 Pressure Filtration: 9 per aircraft
Location: 1 in each main and auxiliary pump delivery line
Filtration Rating: 15 µm
- 3.6.12.2 Case Drain Filtration: 9 per aircraft
Location: 1 in each main and auxiliary pump line
Filtration Rating: 25 µm
- 3.6.12.3 Return Filtration: 4 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 15 µm

3.6.13 Tubing Data

3.6.13.1 High Pressure - Non-Fire Zones Lines

Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945

Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.53/0.483 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.051 in (25.4/1.295 mm), 1.25/0.058 in (31.75/1.47 mm)

3.6.13.2 High Pressure - Fire Zones Lines

Material Specification: 21-6-9 CRES per AMS5561

Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.53/0.508 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.052 in (25.4/1.321 mm), 1.25/0.070 in (31.75/1.778 mm)

3.6.13.3 Low Pressure Lines

Material Specification: 6061-T6 Aluminum alloy per AMS4083

Diameters/Wall Thicknesses: 0.375/0.035 in (9.53/0.889 mm), 0.50/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (19.05/0.889 mm), 1.00/0.035 in (25.4/0.889 mm), 1.25/0.049 in (31.75/1.245 mm)

3.6.14 Fitting Data

3.6.14.1 Separable Type: 24 degree flareless

End Connections: Internal swage

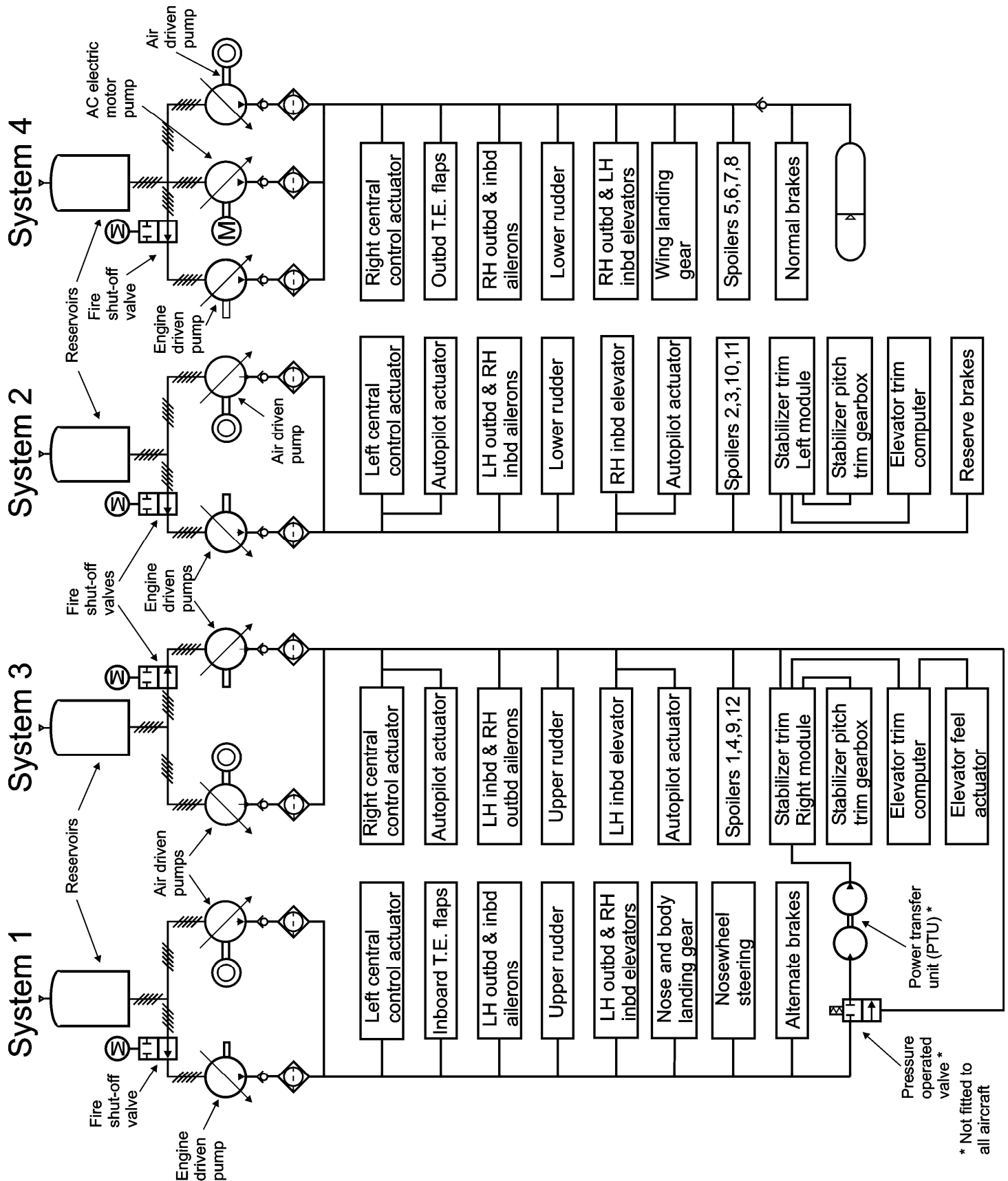


FIGURE 3.6 - BOEING 747-100/200/300 HYDRAULIC SYSTEM SCHEMATIC

3.7 Boeing 747-400

3.7.1 Design Requirements: 14CFR Part 25 requirements

3.7.2 System Pressure: 3000 psi (20 690 kPa)

3.7.3 Hydraulic Fluid: AS1241

3.7.4 Number of Hydraulic Systems: 4 - System 1, System 2, System 3, System 4

3.7.5 System Temperature: -65 to +225 °F (-54 to +107 °C)

3.7.6 Main Hydraulic Pump Data

- 3.7.6.1 Engine Driven Pump: 4 per aircraft; 1 in each system
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 37.5 gpm (142 L/min) at 2850 psi (19 655 kPa)
Displacement: 2.40 in³/rev (39.3 mL/rev)
Rated Speed: 3750 rpm
Rotation from Shaft End: Counter clockwise

3.7.7 Back-up Pump Data

- 3.7.7.1 Air Turbine Driven Pump: 2 per aircraft; 1 in System 1 and 1 in System 4
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 32.0 gpm (121 L/min) at 2850 psi (19 655 kPa)
Displacement: 2.40 in³/rev (39.3 mL/rev)
Rated Speed: 3250 rpm
- 3.7.7.2 AC Electric Motor Pump: 1 in System 4
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 6.0 gpm (22.7 L/min) at 2850 psi (19 655 kPa); 12.0 gpm (45.5 L/min) at 1200 psi (8276 kPa)
Displacement: 0.48 in³/rev (7.87 mL/rev)
Rated Speed: 8000 rpm
- 3.7.7.3 AC Electric Motor Pump: 2 per aircraft; 1 in System 2 and 1 in System 3
Type: Variable displacement, pressure compensated, inline piston
Rated Flow-Pressure: 7.0 gpm (26.5 L/min) at 2850 psi (19 655 kPa); 13.5 gpm (51.1 L/min) at 1500 psi (10 345 kPa)
Displacement: 0.56 in³/rev (9.18 mL/rev)
Rated Speed: 6000 rpm

3.7.8 Hydraulic Motor Data

- 3.7.8.1 Outboard Flap Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 1.52 in³/rev (24.91 mL/rev)
Running Speed: 3706 rpm for outboard flaps
Flow at Rated Pressure Differential: 25.8 gpm (97.7 L/min) at 3000 psi (20 690 kPa)
- 3.7.8.2 Inboard Flap Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 2.35 in³/rev (38.511 mL/rev)
Running Speed: 3424 rpm
Flow at Rated Pressure Differential: 36.8 gpm (139.3 L/min) at 3000 psi (20 690 kPa)



- 3.7.8.3 Stabilizer Drive Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.803 in³/rev (13.4 mL/rev)
Running Speed: 2320 rpm
Flow at Rated Pressure Differential: 8.8 gpm (33.3 L/min) at 3000 psi (20 690 kPa)

3.7.9 Accumulator Data

- 3.7.9.1 Braking System: 1 in System 4 Brake System
Type: Piston, gas charged
Volume: 200 in³ (3.58 L)
Precharge Pressure: 750 psi (5172 kPa)

- 3.7.9.2 Braking System: 3 in System 4 Brake Return
Type: Piston, gas charged
Volume: 25 in³ (0.41 L)
Precharge Pressure: 150 psi (1034 kPa)

3.7.10 Reservoir Data

- 3.7.10.1 System 1 and System 4
Type: Air pressurized
Full Volume: 10.6 gal (40.2 L)
Total Volume: 12.35 gal (46.8 L)
Pressure: 45 psig (6.5 kPa)

- 3.7.10.2 System 2 and System 3
Type: Air pressurized
Full Volume: 7.00 gal (26.5 L)
Total Volume: 8.00 gal (30.3 L)
Pressure: 45 psig (6.5 kPa)

3.7.11 Relief Valve Data

- 3.7.11.1 Main System Relief Valve: 4 per aircraft; 1 per system
Relief Pressure: 3400 - 3600 psi (23 448 - 24 828 kPa)
Reseat Pressure: Not known
Rated Flow: Not known

3.7.12 Filtration

- 3.7.12.1 Pressure Filtration: 9 per aircraft
Location: 1 in each main and auxiliary pump delivery line
Filtration Rating: 15 µm
- 3.7.12.2 Case Drain Filtration: 9 per aircraft
Location: 1 in each main and auxiliary pump line
Filtration Rating: 25 µm
- 3.7.12.3 Return Filtration: 4 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 15 µm

3.7.13 Tubing Data

3.7.13.1 High Pressure - Non-Fire Zones Lines

Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945

Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.019 in (9.53/0.483 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.051 in (25.4/1.295 mm), 1.25/0.058 in (31.75/1.47 mm)

3.7.13.2 High Pressure - Fire Zones Lines

Material Specification: 21-6-9 CRES per AMS5561

Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.53/0.508 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.052 in (25.4/1.321 mm), 1.25/0.070 in (31.75/1.778 mm)

3.7.13.3 Low Pressure Lines

Material Specification: 6061-T6 Aluminum alloy per AMS4083

Diameters/Wall Thicknesses: 0.375/0.035 in (9.53/0.889 mm), 0.50/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (19.05/0.889 mm), 1.00/0.035 in (25.4/0.889 mm), 1.25/0.049 in (31.75/1.245 mm)

3.7.14 Fitting Data

3.7.14.1 Separable Type: 24 degree flareless

End Connections: Internal swage

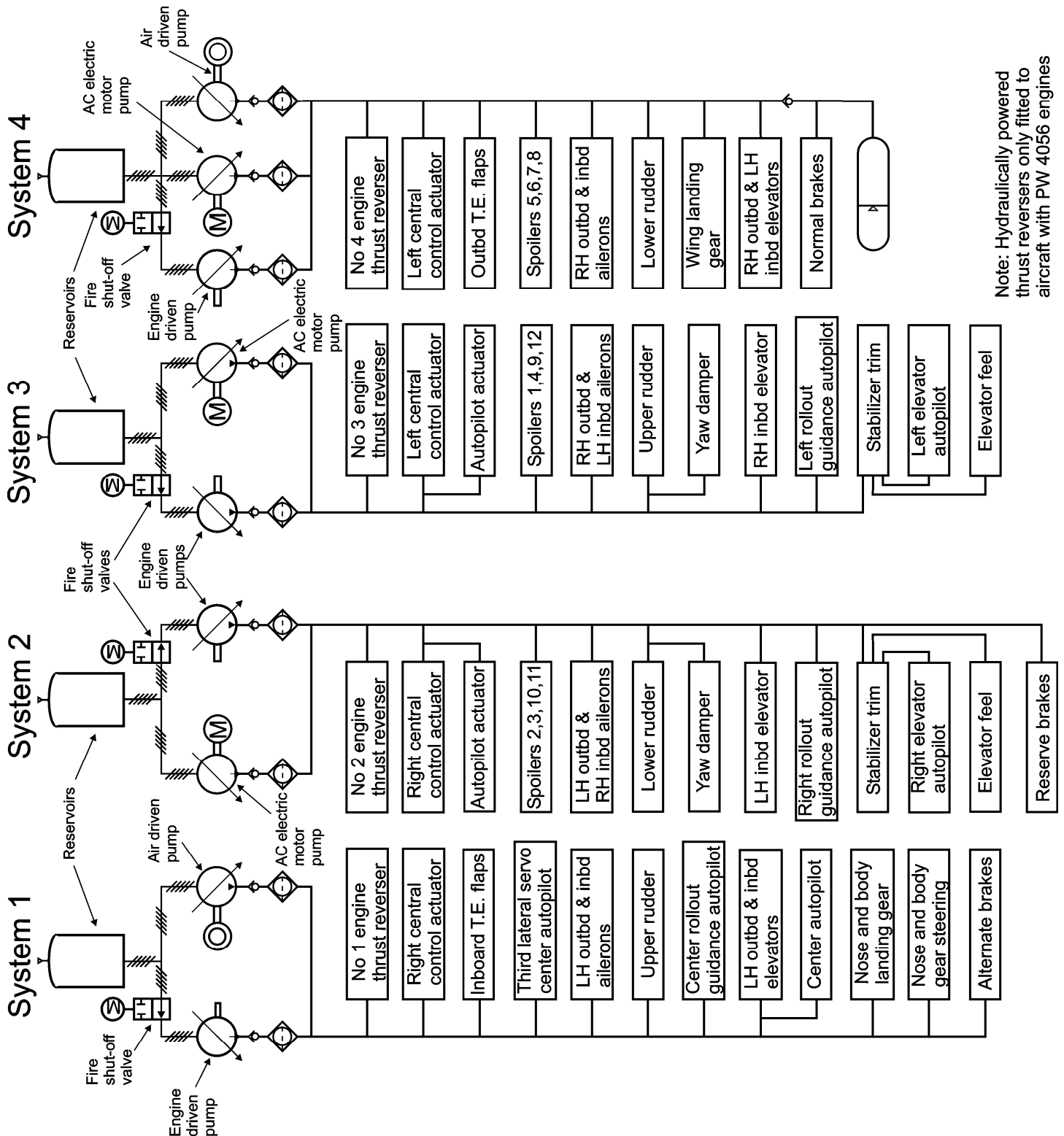


FIGURE 3.7 - BOEING 747-400 HYDRAULIC SYSTEM SCHEMATIC



Documents

Document Sharing Hub

3.8 Boeing 767-200/300/400

3.8.1 Design Requirements: 14CFR Part 25 requirements

3.8.2 System Pressure: 3000 psi (20 690 kPa)

3.8.3 Hydraulic Fluid: AS1241

3.8.4 Number of Hydraulic Systems: 3 - Left System, Center System, Right System

3.8.5 System Temperature: -65 to +225 °F (-54 to +107 °C)

3.8.6 Main Hydraulic Pump Data

3.8.6.1 Engine Driven Pump: 2 per aircraft; 1 in Left System, 1 in Right System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 37.5 gpm (142 L/min) at 2850 psi (19 655 kPa)

Displacement: 2.40 in³/rev (39.3 mL/rev)

Rated Speed: 3750 rpm

Rotation from Shaft End: Counter clockwise

3.8.6.2 AC Electric Motor Pump: 2 in Center System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 7.0 gpm (26.5 L/min) at 2850 psi (19 655 kPa); 13.6 gpm (51.1 L/min) at 1500 psi (10 345 kPa)

Displacement: 0.56 in³/rev (9.18 mL/rev)

Rated Speed: 6000 rpm

3.8.7 Back-up Pump Data

3.8.7.1 AC Electric Motor Pump: 2 per aircraft; 1 in Left System, 1 in Right System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 7.0 gpm (26.5 L/min) at 2850 psi (19 655 kPa); 13.6 gpm (51.1 L/min) at 1500 psi (10 345 kPa)

Displacement: 0.56 in³/rev (9.18 mL/rev)

Rated Speed: 6000 rpm

3.8.7.2 Air Turbine Driven Pump: 1 in Center System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 37.0 gpm (140.2 L/min) at 2850 psi (19 655 kPa)

Displacement: 1.60 in³/rev (26.22 mL/rev)

Running Speed: 5000 rpm

3.8.7.3 Ram Air Turbine Driven Pump: 1 in Center System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 11.3 gpm (42.8 L/min) at 2140 psi (14 759 kPa)

Displacement: 0.78 in³/rev (12.78 mL/rev)

Running Speed: 4165 rpm

3.8.7.4 Power Transfer Unit: 1 in Right System to drive Trimming Horizontal Stabilizer (Alternate source)

Type: Unidirectional fixed displacement bent axis piston motor and a fixed displacement bent axis piston pump
Rated Flow: 2.7 gpm (10.3 L/min) outlet flow at 1250 psi (8261 kPa) with an input flow of 3.2 gpm (12.1 L/min) at 1600 psi (11 034 kPa)

Displacement: Motor - 0.095 in³/rev (1.557 mL/rev); Pump - 0.080 in³/rev (1.311 mL/rev)

Rated Speed: 7800 rpm

3.8.8 Hydraulic Motor Data

- 3.8.8.1 Flap Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 1.50 in³/rev (24.58 mL/rev)
Running Speed: 3500 rpm
Flow at Rated Pressure Differential: 22.7 gpm (85.9 L/min) at 2850 psi (19 655 kPa)
- 3.8.8.2 Outboard Leading Edge Slat Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 1.50 in³/rev (24.58 mL/rev)
Running Speed: 3500 rpm
Flow at Rated Pressure Differential: 22.7 gpm (85.9 L/min) at 2850 psi (19 655 kPa)
- 3.8.8.3 Inboard Leading Edge Slat Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 0.365 in³/rev (5.98 mL/rev)
Running Speed: 2600 rpm
Flow at Rated Pressure Differential: 3.9 gpm (14.8 L/min) at 2850 psi (19 655 kPa)
- 3.8.8.4 Stabilizer Drive Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.365 in³/rev (5.98 mL/rev)
Running Speed: 2600 rpm
Flow at Rated Pressure Differential: 3.9 gpm (14.8 L/min) at 2850 psi (19 655 kPa)

3.8.9 Accumulator Data

- 3.8.9.1 Braking System: 1 in Right System Brake System
Type: Piston, gas charged
Volume: 200 in³ (3.68 L)
Precharge Pressure: 1300 psi (8966 kPa)
- 3.8.9.2 Braking System: 2 in Right Brake Return System
Type: Piston, gas charged
Volume: 25 in³ (0.41 L)
Precharge Pressure: 150 psi (1034 kPa)

3.8.10 Reservoir Data

- 3.8.10.1 Left and Right Systems
Type: Air pressurized
Full Volume: 4.8 gal (18.8 L)
Total Volume: 6.8 gal (25.8 L)
Pressure: 40 psig (275 kPa)
- 3.8.10.2 Center System
Type: Air pressurized
Full Volume: 8.6 gal (32.6 L)
Total Volume: 12.3 gal (46.6 L)
Pressure: 40 psig (275 kPa)

3.8.11 Relief Valve Data

- 3.8.11.1 Main System Relief Valve: 3 per aircraft; 1 per system
Relief Pressure: 3400 - 3600 psi (23 448 - 24 828 kPa)
Reseat Pressure: Not known
Rated Flow: Not known

3.8.12 Filtration

- 3.8.12.1 Pressure Filtration: 7 per aircraft
Location: 1 in each main and auxiliary pump delivery line, except for Ram Air Turbine
Filtration Rating: 15 µm
Location: 1 in Ram Air Turbine delivery line
Filtration Rating: 25 µm
- 3.8.12.2 Case Drain Filtration: 8 per aircraft
Location: 1 in each main and auxiliary pump line, and in Ram Air Turbine line
Filtration Rating: 25 µm
- 3.8.12.3 Return Filtration: 3 per aircraft
Location: 1 in each system return line upstream of the reservoir
Filtration Rating: 15 µm

3.8.13 Tubing Data

- 3.8.13.1 High Pressure - Non-Fire Zones Lines
Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.051 in (25.4/1.295 mm), 1.25/0.058 in (31.75/1.47 mm)
- 3.8.13.2 High Pressure - Fire Zones Lines
Material Specification: 21-6-9 CRES per AMS5561
Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.375/0.020 in (9.53/0.508 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.033 in (15.875/0.838 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.052 in (25.4/1.321 mm), 1.25/0.070 in (31.75/1.778 mm)
- 3.8.13.3 Low Pressure Lines
Material Specification: 6061-T6 Aluminum alloy per AMS4083
Diameters/Wall Thicknesses: 0.375/0.035 in (9.53/0.889 mm), 0.50/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (19.05/0.889 mm), 1.00/0.035 in (25.4/0.889 mm), 1.25/0.035 in (31.75/0.889 mm)

3.8.14 Fitting Data

- 3.8.14.1 Separable Type: 24 degree flareless
Material: Al, CRES and Titanium
End Connections: Internal swage, welded

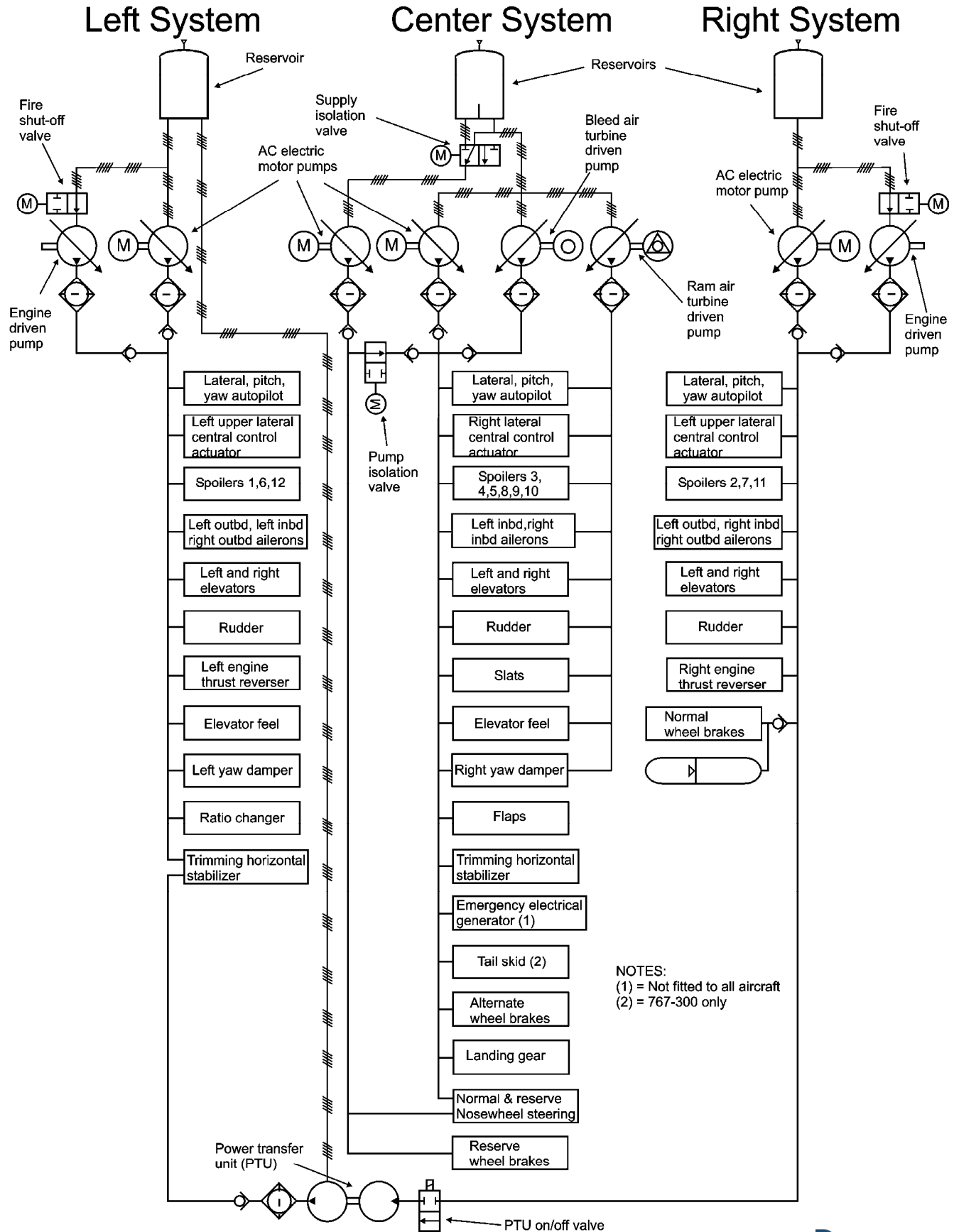


FIGURE 3.8 - BOEING 767-200/300/400 HYDRAULIC SYSTEM SCHEMATIC



3.9 Boeing 777-200/300

3.9.1 Design Requirements: 14CFR Part 25/JAR 25 requirements

3.9.2 System Pressure: 3000 psi (20 690 kPa)

3.9.3 Hydraulic Fluid: AS1241

3.9.4 Number of Hydraulic Systems: 3 – Left System, Center System, Right System

3.9.5 System Temperature: -65 to +225 °F (-54 to +107 °C)

3.9.6 Main Hydraulic Pump Data

3.9.6.1 Engine Driven Pump: 2 per aircraft; 1 in Left System; 1 in Right System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 48.0 gpm (142 L/min) at 2850 psi (19 655 kPa)

Displacement: 3.00 in³/rev (49.16 mL/rev)

Rated Speed: 3900 rpm

Rotation from Shaft End: Counter clockwise

3.9.6.2 AC Electric Motor Pump: 2 in Center System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 6.0 gpm (22.7 L/min) at 2850 psi (19 655 kPa); 12.0 gpm (45.4 L/min) at 1200 psi (8276 kPa)

Displacement: 0.38 in³/rev (6.23 mL/rev)

Rated Speed: 8000 rpm

3.9.7 Back-up Pump Data

3.9.7.1 AC Electric Motor Pump: 2 per aircraft; 1 in Left System; 1 in Right System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 6.0 gpm (22.7 L/min) at 2850 psi (19 655 kPa)

12.0 gpm (45.4 L/min) at 1200 psi (8276 kPa)

Displacement: 0.38 in³/rev (6.23 mL/rev)

Rated Speed: 8000 rpm

3.9.7.2 Air Turbine Driven Pump: 2 in Center System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 53.0 gpm (200.0 L/min) at 2850 psi (19 655 kPa)

Displacement: 3.00 in³/rev (49.16 mL/rev)

Running Speed: 4315 rpm

3.9.7.3 Ram Air Turbine Driven Pump: 1 in Center System

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 10.0 gpm (37.9 L/min) at 2850 psi (19 655 kPa)

20.0 gpm (75.8 L/min) at 1500 psi (10 345 kPa)

Displacement: 1.15 in³/rev (18.85 mL/rev)

Running Speed: 4500 rpm

3.9.8 Hydraulic Motor Data

- 3.9.8.1 Flap Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 2.35 in³/rev (38.52 mL/rev)
Running Speed: 2500 rpm
Flow at Rated Pressure Differential: 25 gpm (94.6 L/min)
- 3.9.8.2 Slat Motor: 1 per aircraft
Type: Fixed displacement
Displacement: 2.35 in³/rev (38.52 mL/rev)
Running Speed: 3450 rpm
Flow at Rated Pressure Differential: 35 gpm (132.5 L/min)
- 3.9.8.3 Stabilizer Drive Motor: 2 per aircraft
Type: Fixed displacement
Displacement: 0.80 in³/rev (1.31 mL/rev)
Running Speed: 2320 rpm
Flow at Rated Pressure Differential: 8.8 gpm (33.3 L/min)

3.9.9 Accumulator Data

- 3.9.9.1 Braking System: 1 in Right System Brake System
Type: Piston, gas charged
Volume: 400 in³ (6.56 L)
Precharge Pressure: 1300 psi (8966 kPa)
- 3.9.9.2 Braking System: 2 in Right System Brake Return
Type: Piston, gas charged
Volume: 25 in³ (0.41 L)
Precharge Pressure: 150 psi (1034 kPa)

3.9.10 Reservoir Data

- 3.9.10.1 Left and Right Systems
Type: Air pressurized
Full Volume: 7.4 gal (26.0 L)
Total Volume: 12.6 gal (47.7 L)
Pressure: 50 psig (345 kPa)
- 3.9.10.2 Center System
Type: Air pressurized
Full Volume: 11.0 gal (41.6 L)
Total Volume: 25.6 gal (96.9 L)
Pressure: 50 psig (345 kPa)

3.9.11 Relief Valve Data

- 3.9.11.1 Main System Relief Valve: 3 per aircraft; 1 per system
Relief Pressure: 3400 - 3600 psi (23 448 - 24 828 kPa)
Reseat Pressure: Not known
Rated Flow: Not known

3.9.12 Filtration

3.9.12.1 Pressure Filtration: 9 per aircraft

Location: 1 in each main, auxiliary pump and Ram Air Turbine delivery line

Filtration Rating: 15 µm

3.9.12.2 Case Drain Filtration: 9 per aircraft

Location: 1 in each main, auxiliary pump and Ram Air Turbine line

Filtration Rating: 25 µm

3.9.12.3 Return Filtration: 3 per aircraft

Location: 1 in each system return line upstream of the reservoir

Filtration Rating: 15 µm

3.9.13 Tubing Data

3.9.13.1 High Pressure Lines

Material Specification: Ti 3Al 2.5V Titanium alloy per AMS4945

Diameters/Wall Thicknesses: 0.25/0.016 in (6.35/0.406 mm), 0.50/0.026 in (12.7/0.660 mm), 0.625/0.032 in (15.875/0.813 mm), 0.75/0.039 in (19.05/0.991 mm), 1.00/0.051 in (25.4/1.295 mm), 1.25/0.070 in (31.75/1.78 mm)

3.9.13.2 Low Pressure Lines

Material Specification: 6061-T6 Aluminum alloy per AMS4083

Diameters/Wall Thicknesses: 0.375/0.035 in (9.53/0.889 mm), 0.50/0.035 in (12.7/0.889 mm), 0.625/0.035 in (15.875/0.889 mm), 0.75/0.035 in (19.05/0.889 mm), 1.00/0.035 in (25.4/0.889 mm), 1.25/0.035 in (31.75/0.889 mm), 1.50/0.049 in (38.1/1.245 mm)

3.9.14 Fitting Data

3.9.14.1 Separable Type: 24 degree flareless

Material: Al, CRES and Titanium

End Connections: Internal swage, welded

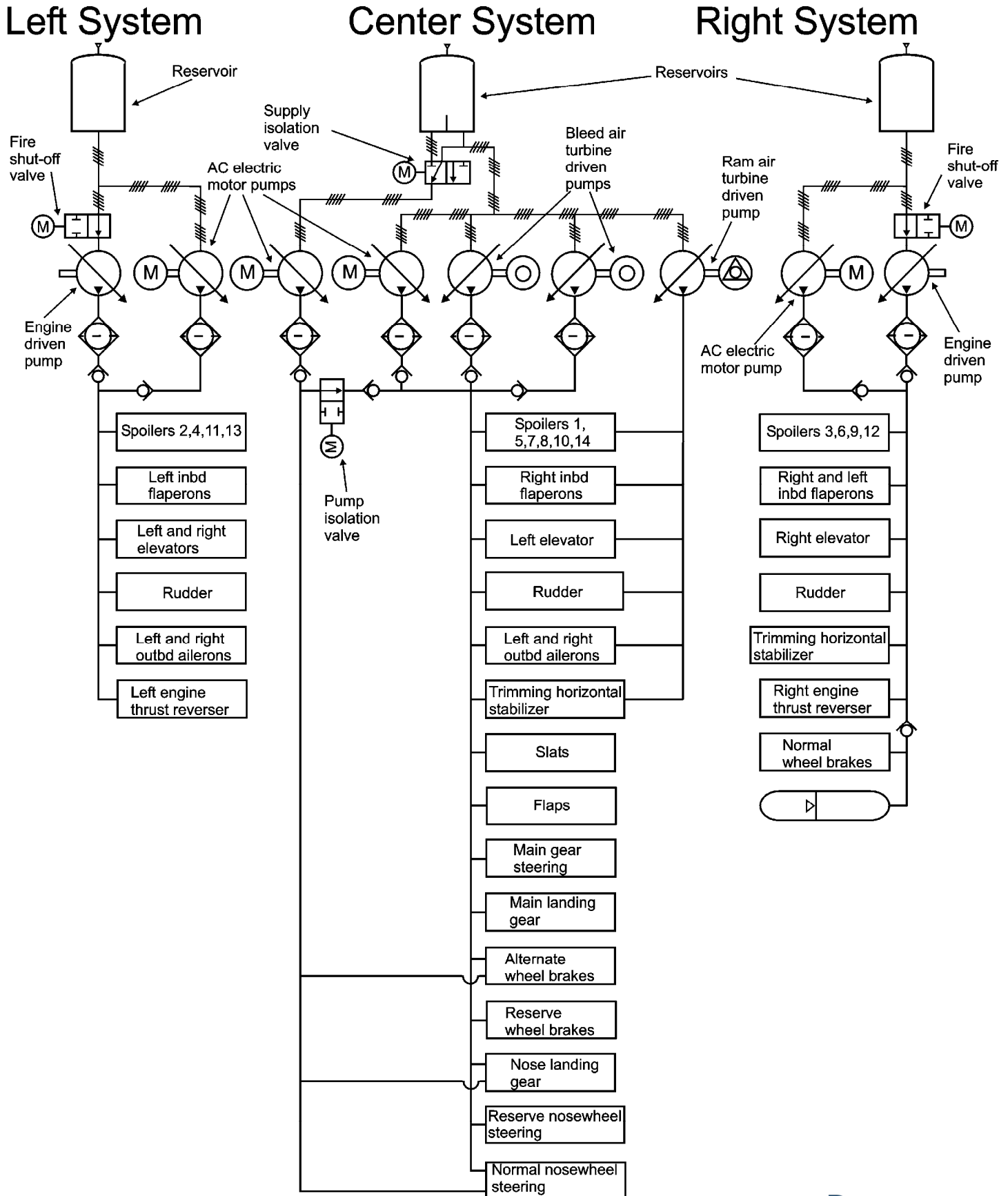


FIGURE 3.9 - BOEING 777-200/300 HYDRAULIC SYSTEM SCHEMATIC



3.10 Boeing MD-11

3.10.1 Design Requirements: 14CFR Part 25 requirements

3.10.2 System Pressure: 3000 psi (20 690 kPa)

3.10.3 Hydraulic Fluid: AS1241

3.10.4 Number of Hydraulic Systems: 3 - System 1, System 2, System 3

3.10.5 System Temperature: -65 to +225 °F (-54 to +107 °C)

3.10.6 Main Hydraulic Pump Data

3.10.6.1 Engine Driven Pump: 6 per aircraft; 2 in System 1, 2 in System 2, 2 in System 3

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 37.5 gpm (142 L/min) at 2850 psi (19 651 kPa)

Displacement: 2.40 in³/rev (39.3 mL/rev)

Rated Speed: 3750 rpm

Rotation from Shaft End: Clockwise

3.10.7 Back-up Pump Data

3.10.7.1 AC Electric Motor Pump: 2 in System 3

Type: Variable displacement, pressure compensated, inline piston

Rated Flow-Pressure: 8.0 gpm (30.3 L/min) at 2200 psi (15 172 kPa)

6.0 gpm (22.7 L/min) at 2750 psi (18 966 kPa)

Displacement: 0.26 in³/rev (4.26 mL/rev)

Rated Speed: 7600 rpm

3.10.7.2 Power Transfer Unit: 2 per aircraft; 1 in System 1 to drive System 3 and vice-versa; 1 in System 2 to drive System 3 and vice-versa

Type: Bi-directional, fixed displacement inline axial piston motor pump driving/driven by a variable displacement inline axial piston motor pump

Rated Flow-Pressure: 28.0 gpm (106 L/min) at 2800 psi (19 310 kPa) to System 3

18.0 gpm (68.1 L/min) at 2700 psi (18 621 kPa) to System 1 or System 2

3.10.7.3 Power Transfer Unit: 2 per aircraft; 1 in System 3 to drive System 2 lower rudder; 1 in System 2 to drive System 1 trimming horizontal stabilizer

Type: Unidirectional, fixed displacement inline axial piston motor driving a fixed displacement inline axial piston pump

Rated Flow-Pressure: 8.0 gpm (30.3 L/min) at 2520 psi (17 379 kPa)

Displacement: 0.43 in³/rev (7.05 mL/rev)

Rated Speed: 4600 rpm

3.10.8 Hydraulic Motor Data

3.10.8.1 Horizontal Stabilizer Motor: 2 per aircraft

Type: Dual displacement inline piston

Displacement: High - 0.82 in³/rev (13.44 mL/rev), Low - 0.32 in³/rev (5.24 mL/rev)

Running Speed: At maximum displacement - 3460 rpm; at minimum displacement - 8600 rpm

Flow at Rated Pressure Differential: 13.1 gpm (49.6 L/min) at 2600 psid (17 931 kPad)