AEROSPACE INFORMATION REPORT

AIR6052™	REV. A
Issued 2011-09 Revised 2022-02 Superseding AIR6052	

(R) Trimmable Horizontal Stabilizer Actuator Descriptions

RATIONALE

Revision A provides an update including some trimmable horizontal stabilizer actuator descriptions used on civil aircraft recently entered in service.

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1. SCOPE

This SAE Aerospace Information Report (AIR) provides descriptions of trimmable horizontal stabilizer actuators that are installed on a variety of transport and business aircraft systems.

1.1 Field of Application

The main focus is on mechanical systems which may be actuated hydraulically or electrically.

1.2 Purpose

The document is intended as an overview for those specifying or designing horizontal stabilizer trim actuators by providing information on existing solutions.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and 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 RTCA Documents

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO160 Environmental Conditions and Test Procedures for Airborne Equipment

2.1.2 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

MIL-PRF-23827 Performance Specification, Grease, Aircraft and Instrument, Gear and Actuator Screw

2.2 Terminology

Actuators, or set of actuators, or subsystems driving the entire horizontal stabilizer (HS) of fixed wing aircraft are referenced according to different terminologies, depending on the original equipment manufacturer (OEM). The most common descriptions and acronyms are:

- Trimmable horizontal stabilizer actuator (THSA)
- Horizontal stabilizer trim actuator (HSTA)
- Horizontal stabilizer actuator (HSA)
- Horizontal stabilizer trim system (HSTS)
- Tailplane trim actuator (TTA)
- Pitch trim actuator (PTA)

2.3 Abbreviations

A/C	Aircraft
AC	Alternating current
CH	Channel
CRES	Corrosion resistant steel
DC	Direct current
HSTECU	Horizontal stabilizer electronic control unit
MCU	Motor control unit
STECM	Electronic control and motor power
VAC	AC voltage
VDC	DC voltage

3. DESCRIPTION CONTENTS

Section 4 includes available data on a number of units, ideally covering all the following aspects:

3.1 Schematic Diagrams

Each schematic diagram illustrates the general arrangement of the THSA in terms of its structural layout and control functions principles.

3.2 Design Loads

These are the limit and ultimate tensile and compressive loads applicable to primary and secondary load paths.

3.3 Operating Requirements

These are the maximum operating loads with their associated rates or other performance points, with one or two motors operating.

3.4 Strokes

These are the horizontal stabilizer maximum deflection angles with the aircraft in the nose up and the nose down directions, and the associated actuator linear strokes.

3.5 Primary Actuation Components

This includes a brief description of the primary actuation components, such as:

- The ball screw
- The ACME screw
- The pair of interconnected ACME screws
- The cylinder and piston assemblies
- Other miscellaneous components

3.6 Safety Requirements

This includes the fail-safe/fail-operational requirements, such as:

- The horizontal stabilizer uncontrolled movement allowed within a given range after the first failure
- The horizontal stabilizer controlled movement required, possibly within a restricted range after the first failure
- The immobilization of the horizontal stabilizer requires a secondary load path after the first failure

3.7 Structural Redundancy Concept

This includes the main features of the primary and secondary load path arrangement, such as:

- The loaded or unloaded secondary load path
- The full life or limited life secondary load path
- The monitored or checkable primary load path
- The monitored or checkable secondary load path
- The locking mechanisms used and if they are passive or active

3.8 Explosion Proofness

Is it required or not required; if it is required, the applicable RTCA/DO160 category when it is known.

3.9 Power Sources

The applicable power source information is provided for each HSTA application, as follows:

- Fully mechanical, i.e., pilot actuated
- Hydraulically powered, 3000/5000 psi (20690/34500 kPa)
- Electrically powered, 28 VDC, three-phase 115 VAC, fixed or variable frequency, the power voltage value, etc.

3.10 Motors

This includes:

- The number and type of motors used (where applicable)
- If the hydraulic motor is a fixed or variable displacement type
- If the electric motor is an AC motor or a DC brushed or DC brushless type

3.11 Gearbox General Arrangement

- This provides the main features of the power gear train, such as:
- The torque or speed summing arrangement
- If it has a single or dual load path

- The torque limiter or elastic shock absorbing devices
- The use of carbon steel or CRES gears

3.12 Gearbox Housing

This provides the main features of the housing, such as:

- If it is sealed or vented
- The material used such as aluminum, magnesium, or composite
- If it has sight glasses or boroscope inspection provisions

3.13 Gear Lubrication

This provides information on the lubrication of the gears, such as:

- The type of oil, grease, or semi-fluid (with or without a pump)
- If it has lubricating pump(s) or not
- The servicing interval

3.14 Screw

This provides information on the screw, such as:

- If it has one start or two starts
- If it has shock absorbing end stops
- The screw material

3.15 Nut

This provides information on the nut, such as:

- The nut material
- The number of ball circuits
- The loaded balls and unloaded spacers arrangement
- The grease type and servicing interval
- The secondary nut description and life
- The seals and ice scrapers that are used

3.16 Irreversibility

This provides information on the irreversibility arrangements, such as if it uses:

- An irreversible ACME screw, on its own, or assisted with additional devices
- A friction no-back device
- A skewed roller no-back device
- Power-off brakes
- Simple or dual coil electrical brakes

3.17 Position Control

This provides information on the position control systems, including:

- Open loop (velocity) control
- Full closed loop control
- Hydromechanical position servoloop control
- Electrohydraulic servoloop control
- Electric servoloop control
- Mechanical reversion control
- Valve jamming protection means

3.18 Weight

This provides information on the weight of the trimmable horizontal stabilizer actuators system, including:

- The wet or dry weight
- If hydraulic control modules included or not
- If power electronics included or not

4. UNIT DESCRIPTIONS

4.1 Airbus A220-100/-300

NOTE: No system schematic diagram is available.

Table 1 provides the detailed data of the Airbus A220 trimmable horizontal stabilizer actuator.

Table 1 - Airbus A220-100/-300 technical data

Table 1A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Information not available	15000 pounds at 0.1 in/s (66.7 kN at 3 mm/s) 800 pounds at 0.62 in/s (3.5 kN at 15.7 mm/s)	Total horizontal stabilizer deflection: 17 degrees for 16 inches (406 mm) A/C nose up: -12 degrees A/C nose down: +5 degrees	One ballscrew Gimbal assembly for upper attachment Gimbal assembly for lower attachment	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) After the failure of the primary load path, the secondary stalls the actuator	Not required	Two three-phase 115 VAC variable frequency electrical systems

Table 1B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two 270 VDC brushless type electrical motors	Torque summing gear train The brake assembly is located on a second independent geartrain Speed-reducing multi-stage spur gear train	Sealed Aluminum hog-out	Grease: MIL-PRF-23827 Type 1 and MIL-H-5606	Resistant corrosion ball screw Non-jamming hard stops Grease: MIL-PRF-23827	Corrosion resistant Inverted thread secondary nut	Bi directional no-back brake assembly The brake is a dual coil, spring energized, power-off brake Two dual coil electro brake	Full electrical closed servoloop	Total wet weight: 162 pounds (73.5 kg)

4.2 Airbus A300B

NOTE: No system schematic diagram is available.

Table 2 - Airbus A300B technical data

Table 2A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression - tension: 70 to 56 klb (310 to 250 kN) Ultimate load: Compression - tension: 105 to 84 klb (465 to 375 kN) Secondary load path ultimate load: Compression tension: 70 to 56 klb (310 to 250 kN)	Three hydraulic motors:10.8 klb (48.3 kN) at 1.5 deg/s Two hydraulic motors: 28.2 klb (125.6 kN) at 1.3 deg/s One hydraulic motor: 21.2 klb (94.2 kN) at 0.9 deg/s	Total horizontal stabilizer deflection: 15 degrees for 21.26 inches (540 mm) A/C nose up: -12 degrees A/C nose down: +3 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) checkable load path	Not required	Three 3000 psi (20690 kPa) hydraulic systems 28 VDC

Table 2B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Three fixed displacement hydraulic motors	Torque summing Dual load path	Vented Aluminum casting	Oil without pump	One start Shock absorbing end stops Chrome plated carbon steel	Chrome plating nut Four ball circuits Only loaded balls Steel balls Grease Inverted thread secondary nut	Friction no-back Power-off brakes	Position servoloop Valve jamming protection	Total wet weight: 302 pounds (137 kg)

4.3 Airbus A310/A300-600

See Figure1.

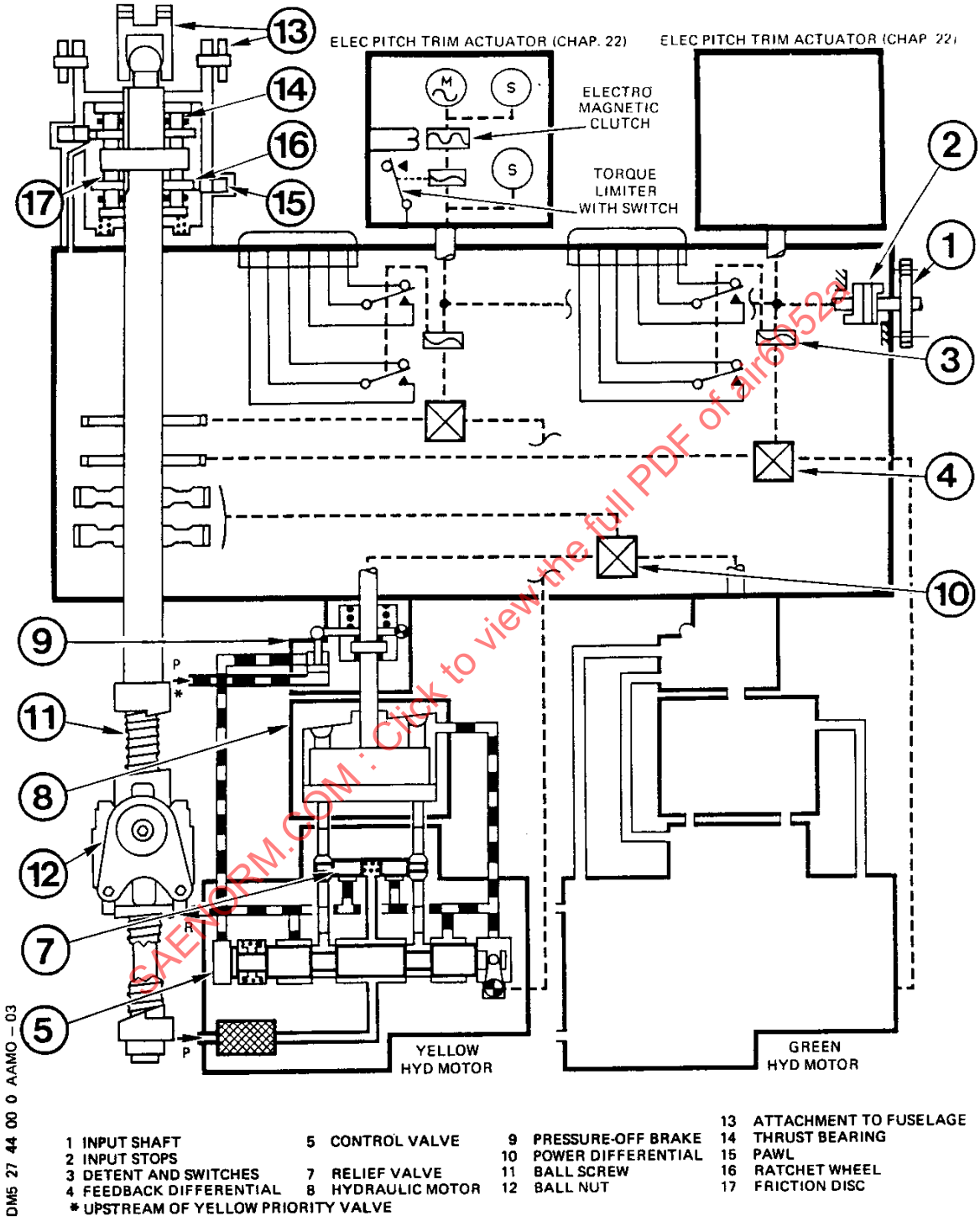


Figure 1 - Airbus A310/A300-600 trimmable horizontal stabilizer actuator system schematic diagram

Table 3 - Airbus A310/A300-600 technical data

Table 3A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension: 70 to 58 klb (310 to 256 kN) Ultimate load: Compression tension: 104 to 86 klb (465 to 384 kN) A/C attachment secondary load path ultimate load: Compression tension: 70 to 58 klb (310 to 256 kN)	One hydraulic motor: 31 klb (137 kN) at 0.4 deg/s 18 klb (80 kN) at 1 deg/s	Total horizontal stabilizer deflection: 17 degrees for 24.1 inches (612 mm) A/C nose up: -15 degrees A/C nose down: +2 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) checkable load path	Not required	Two 3000 psi (20690 kPa) hydraulic systems 28 VDC

Table 3B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two fixed displacement hydraulic motors	Speed summing dual path gear system	Vented Aluminum casting	Oil without pump	One start Shock absorbing end stops Chrome plated carbon steel	Chrome plating nut Six ball circuits Only loaded balls Steel balls Grease: Inverted thread secondary nut	Friction no-back Power-off brakes	Position servoloop Valve jamming protection	Total wet weight: 218 pounds (99 kg)

4.4 Airbus A318/A319/A320/A321

See Figure 2.

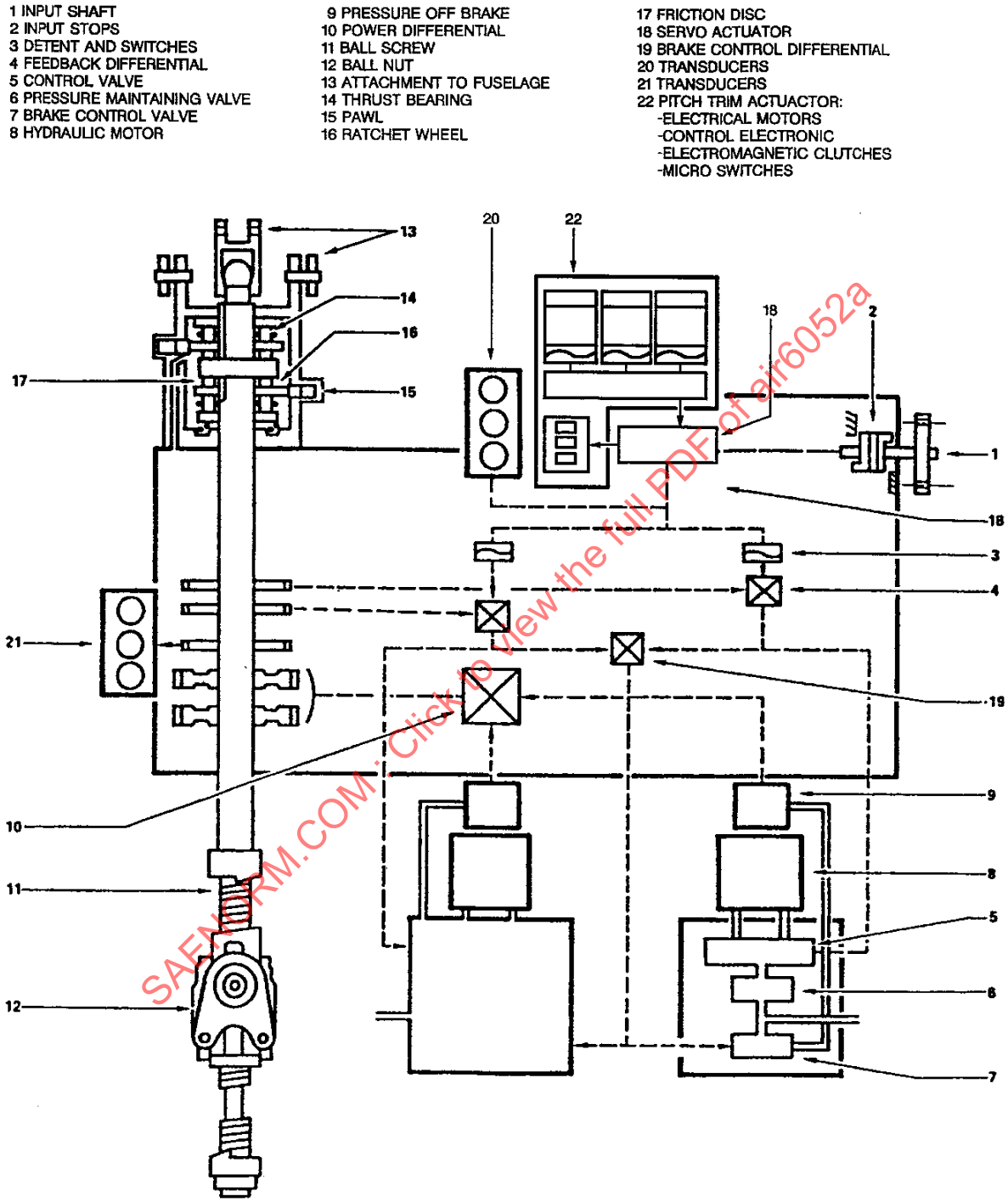


Figure 2 - Airbus A318/A319/A320/A321 trimmable horizontal stabilizer actuator schematic diagram

Table 4 - Airbus A318/A319/A320/A321 technical data

Table 4A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension: 46 to 28.5 klb (205 to 127 kN) Ultimate load: Compression tension: 69 to 43 klb (307 to 190.5 kN) Secondary load path ultimate load: Compression tension: 46 to 28.5 klb (205 to 127 kN)	One hydraulic motor: 11.4 klb (50.8 kN) compressive at 0.4 deg/s 1.9 klb (8.5 kN) tensile at 0.4 deg/s 9 klb (40.4 kN) compressive at 1 deg/s 6.4 klb (28.5 kN) compressive at 1 deg/s	Total horizontal stabilizer deflection: 17.5 degrees for 20.23 inches (513.8 m) A/C nose up: 13.5 degrees A/C nose down: 4 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) Checkable load path	Not required	Two 3000 psi (20690 kPa) hydraulic systems 28 VDC

Table 4B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two fixed displacement hydraulic motors	Speed summing dual path gear system	Vented Aluminum casting	Oil without pump	One start Shock absorbing end stops Chrome plated carbon steel	Chrome plating nut Three ball circuits Only loaded balls Steel ball Grease: Inverted thread secondary nut	Friction no-back Power-off brakes	Position servoloop Valve jamming protection	Total wet weight: 121 pounds (55 kg)

4.5 Airbus A330-200/-300/A340-200/-300

See Figure 3.

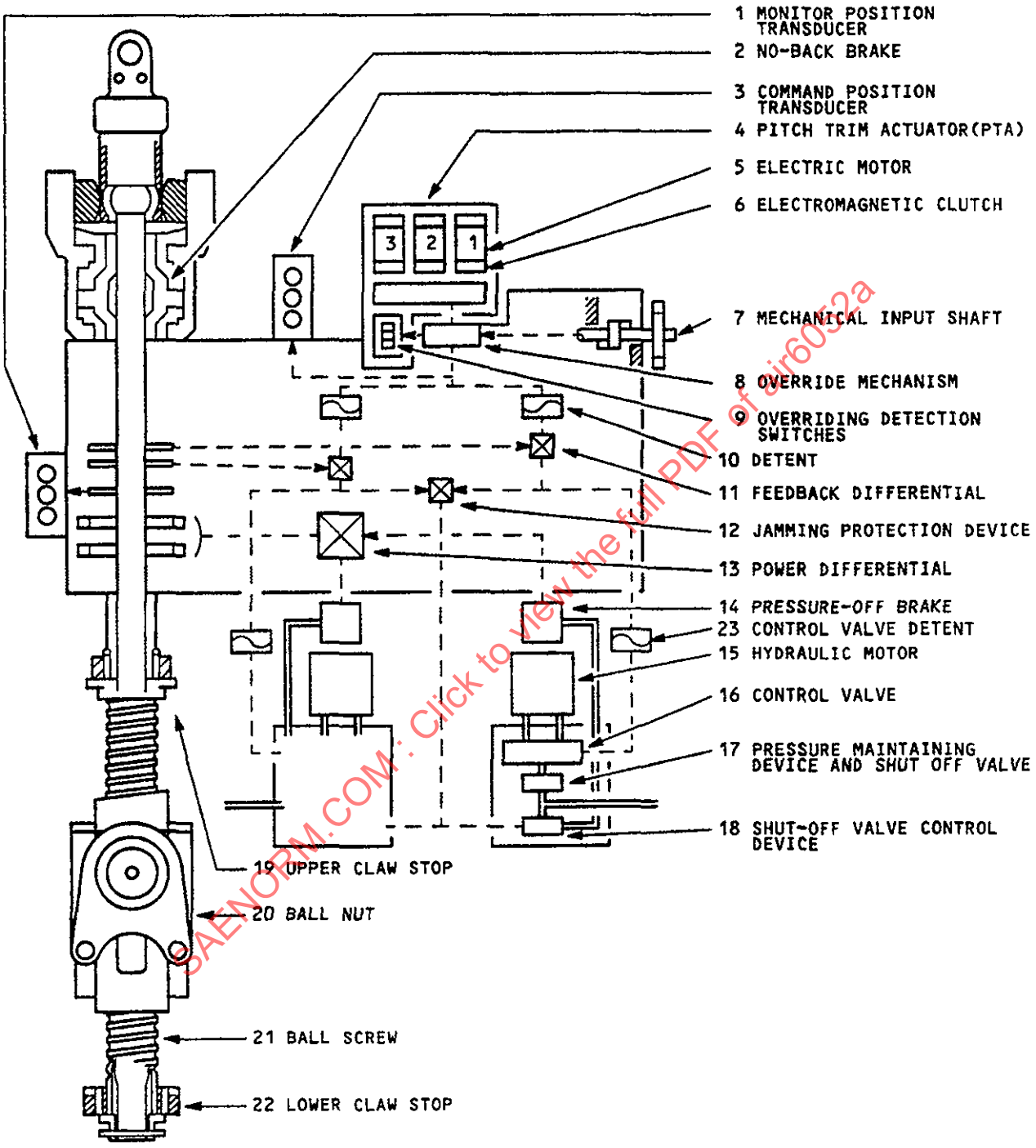


Figure 3 - Airbus A330-200/-300/A340-200/-300 trimmable horizontal stabilizer actuator schematic diagram

Table 5 - Airbus A330-200/-300/A340-200/-300 technical data

Table 5A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension: 73 klb (325 kN) Ultimate load: Compression tension: 110 klb (487.5 kN) Secondary load path ultimate load: Compression tension: 73 klb (325 kN)	One hydraulic motor: 42.6 klb (189.4 kN) at 0.2 deg/s 38 klb (169.5 kN) at 0.5 deg/s 15.2 klb (67.7 kN) at 0.6 deg/s	Total horizontal stabilizer deflection: 16 degrees for 23.11 inches (587 mm) A/C nose up: 14 degrees A/C nose down: 2 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) checkable load path	Not required	Two 3000 psi (20690 kPa) hydraulic systems 28 VDC

Table 5B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two fixed displacement hydraulic motors	Speed summing dual path gear system	Vented Aluminum casting	Oil without pump	One start Shock absorbing end stops Chrome plated carbon steel	Chrome plating nut Three ball circuits loaded and spacer balls Steel balls Grease: Inverted thread secondary nut	Friction no-back Power-off brakes	Position servoloop Valve jamming protection	Total wet weight: 240 pounds (109 kg)

4.6 Airbus A340-500/-600

See Figure 4.

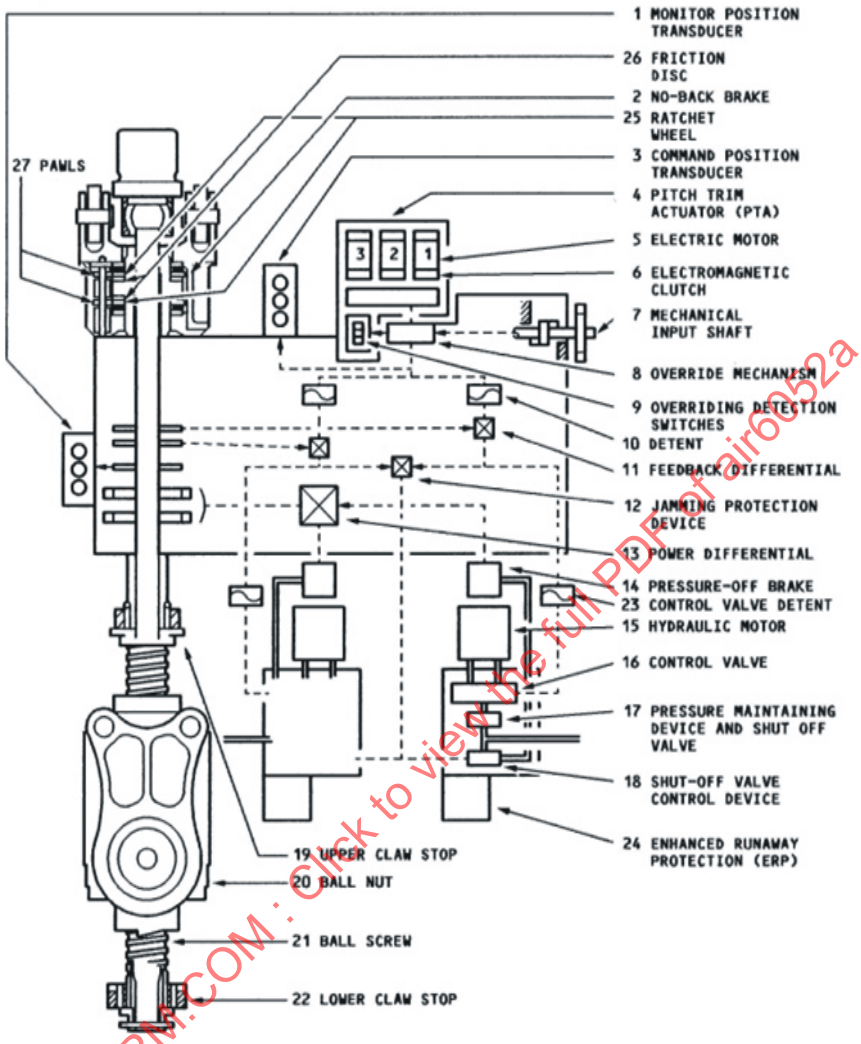


Figure 4 - Airbus A340-500/-600 trimmable horizontal stabilizer actuator schematic diagram

Table 6 - Airbus A340-500/-600 technical data

Table 6A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension: 130 klb (578 kN) Ultimate load: Compression tension: 195 klb (867 kN) Secondary load path ultimate load: Compression tension: 130 klb (578 kN)	One hydraulic motor: 72.2 klb (321.2 kN) at 0.1 deg/s 34.4 klb (153.3 kN) at 0.5 deg/s	Total horizontal stabilizer deflection: 16 degrees for 28.47 inches (723.23 mm) A/C nose up: 14 degrees A/C nose down: 2 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) checkable load path	Not required	Two 3000 psi (20690 kPa) hydraulic systems 28 VDC

Table 6B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two fixed displacement hydraulic motors	Speed summing dual path gear system	Vented Aluminum casting	Oil without pump	One start Shock absorbing end stops Stainless steel	Stainless steel Three ball circuits Loaded and spacer balls Steel balls Grease: Inverted thread secondary nut	Friction no-back Power-off brakes	Position servoloop Valve jamming protection	Total wet weight: 427 pounds (194 kg)

4.7 Airbus A350-900/-1000

See Figure 5.

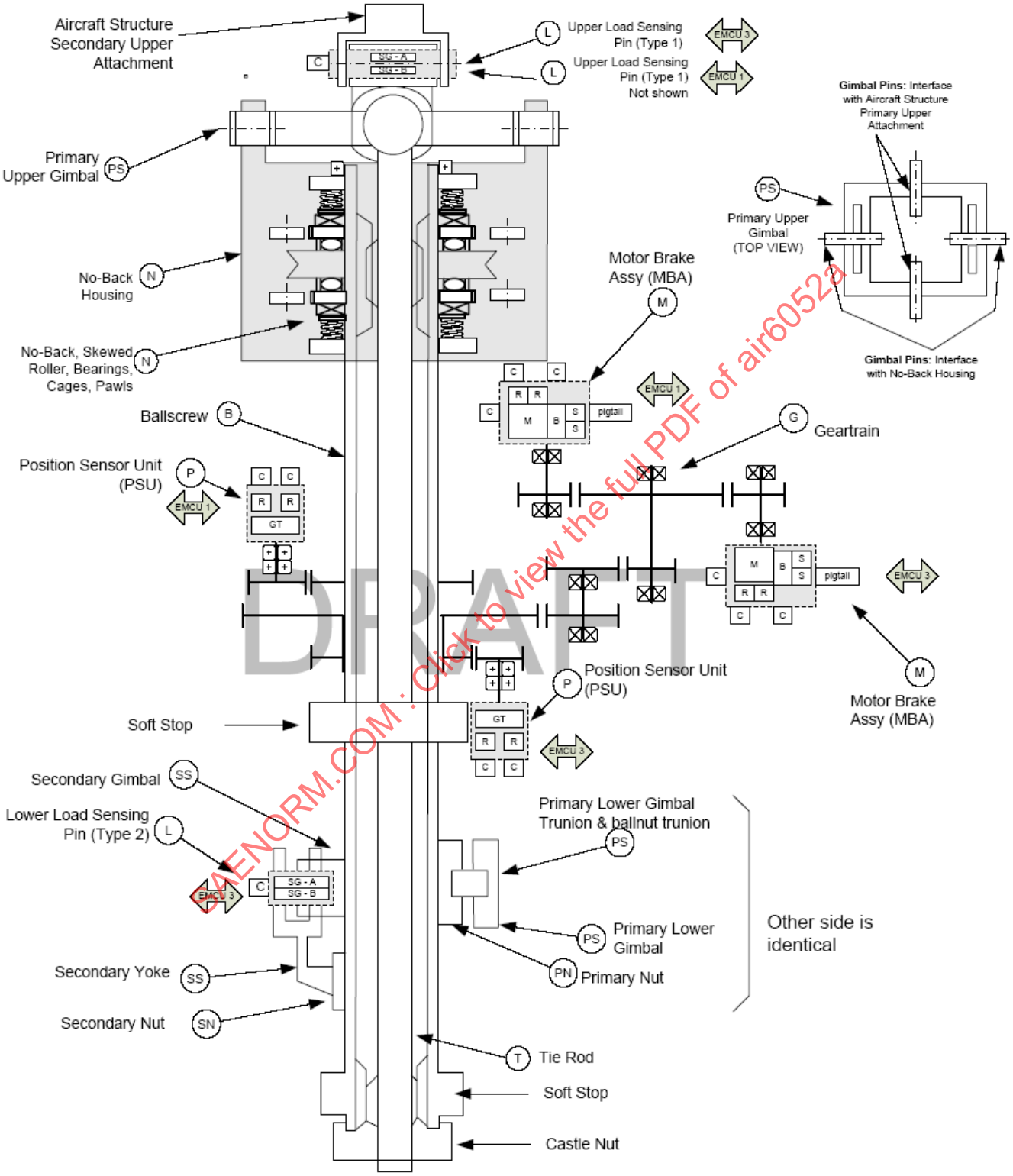


Figure 5 - Airbus A350-900/-1000 trimmable horizontal stabilizer actuator schematic diagram

Table 7 - Airbus A350-900/-1000 technical data

Table 7A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension 77.2 klb (343 kN) Ultimate load Compression tension: 15.9 klb (514.5 kN) Secondary load path ultimate load: Compression tension: 77.2 klb (343 kN)	5840 klbf.inches (660 kN.m) at 0.1 deg/s 1628 klbf.inches (184 kN.m) at 0.8 deg/s	Total horizontal stabilizer deflection: 12.9 degrees for 28.58 inches (726 mm) A/C nose up: 13.7 degrees A/C nose down: 0.8 degrees	One ballscrew Gimbal assembly for the upper attachment Gimbal assembly for the lower attachment	Horizontal stabilizer immobilization required after the first structural failure.	Primary (loaded) and secondary (unloaded) The failure of the secondary load path is detected by load sensing pins devices.	Required	Two three-phase 230 VAC variable frequency electrical systems

Table 7B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two 540 VDC brushless type electrical motors Spine interface with a pinion	Torque summing gear system Speed reducing multistage spur gear train	Aluminum	Grease	Corrosion resistant ball screws Two hard end stop (no jamming type) Grease	Corrosion resistant three or four ball circuits Loaded and spacer balls Steel balls Grease: Inverted thread secondary nut	Bi directional no-back brake assembly Two dual coil electro-mechanical brakes	Full electrical closed servoloop	Total wet weight: 463 pounds (210 kg)

4.8 Airbus A380-800

See Figure 6.

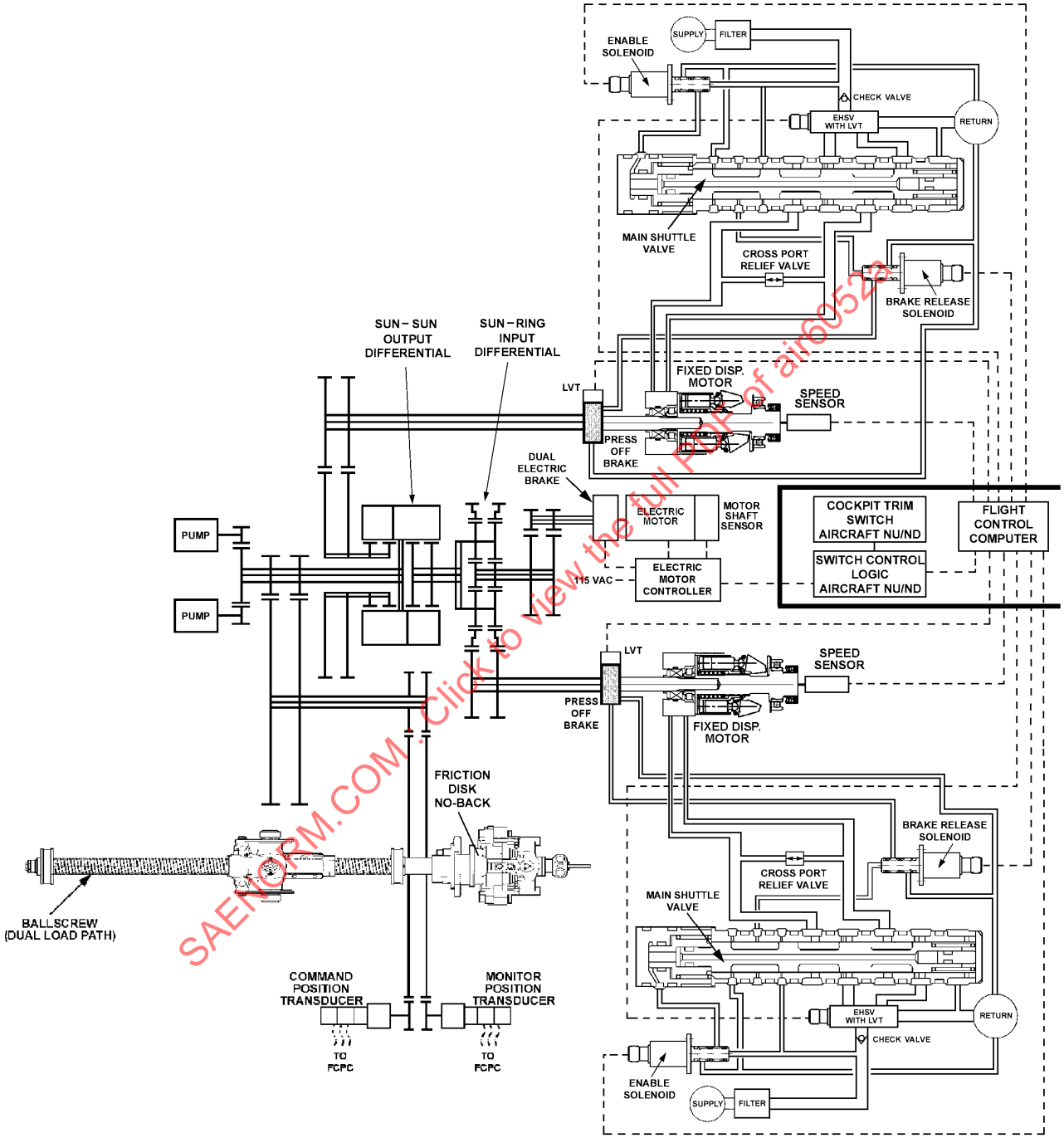


Figure 6 - Airbus A380-800 trimmable horizontal stabilizer actuator schematic diagram

Table 8 - Airbus A380-800 technical data

Table 8A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension: 192/132.6 klb (853.7/590 kN) Ultimate load: Compression tension: 287.6/199 klb (1280.5/885 kN) Secondary load path ultimate load: Compression tension: 192/132.6 klb (853.7/590 kN)	One hydraulic motor: 130 klb (577 kN) at 0.15 deg/s 87 klb (388 kN) at 0.25 deg/s Electrical motor 115 klb (510 kN) at 0.03 deg/s 55 klb (244 kN) at 0.115 deg/s	Total horizontal stabilizer deflection: 12.5 degrees for 46.33 inches (1176.7 mm) A/C nose up: 10 degrees A/C nose down: 2.5 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) checkable load path	Required	Two 5000 psi (34500 kPa) hydraulic systems Three phases 115 VAC variable frequency

Table 8B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two fixed displacement hydraulic motors and 1 AC electric motor	Speed summing dual path gear system	Vented Aluminum casting	Oil with pump	Two starts Shock absorbing end stops Stainless steel	Stainless steel Four ball circuits Loaded and spacer balls Steel balls Grease: Inverted thread secondary nut	Friction no-back Power-off brakes	Electro-hydraulic servoloop	Total wet weight: 868 pounds (394 kg)

4.9 Airbus A400M

See Figure 7.

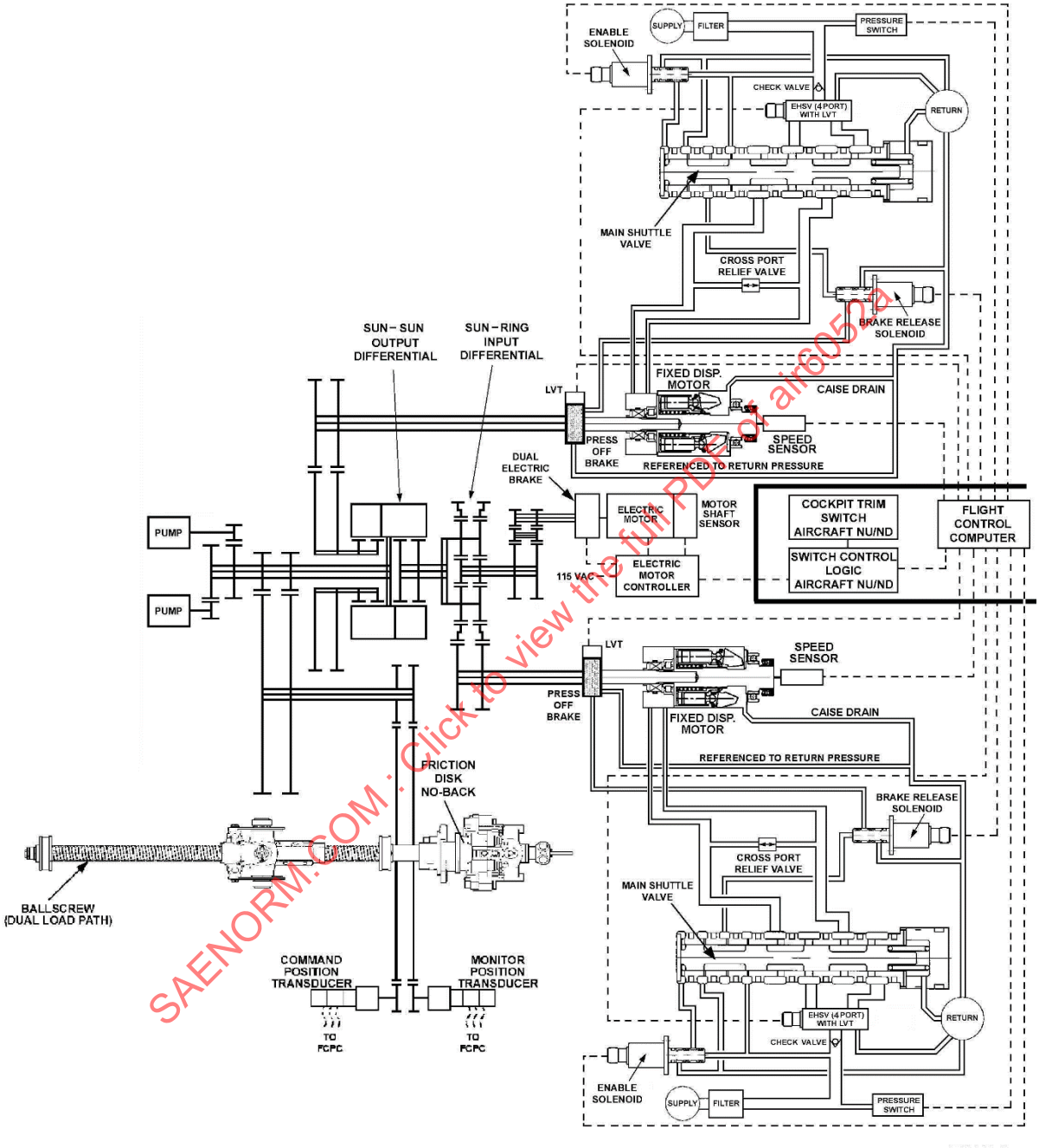


Figure 7 - Airbus A400M trimmable horizontal stabilizer actuator schematic diagram

Table 9 - Airbus A400M technical data

Table 9A - General data

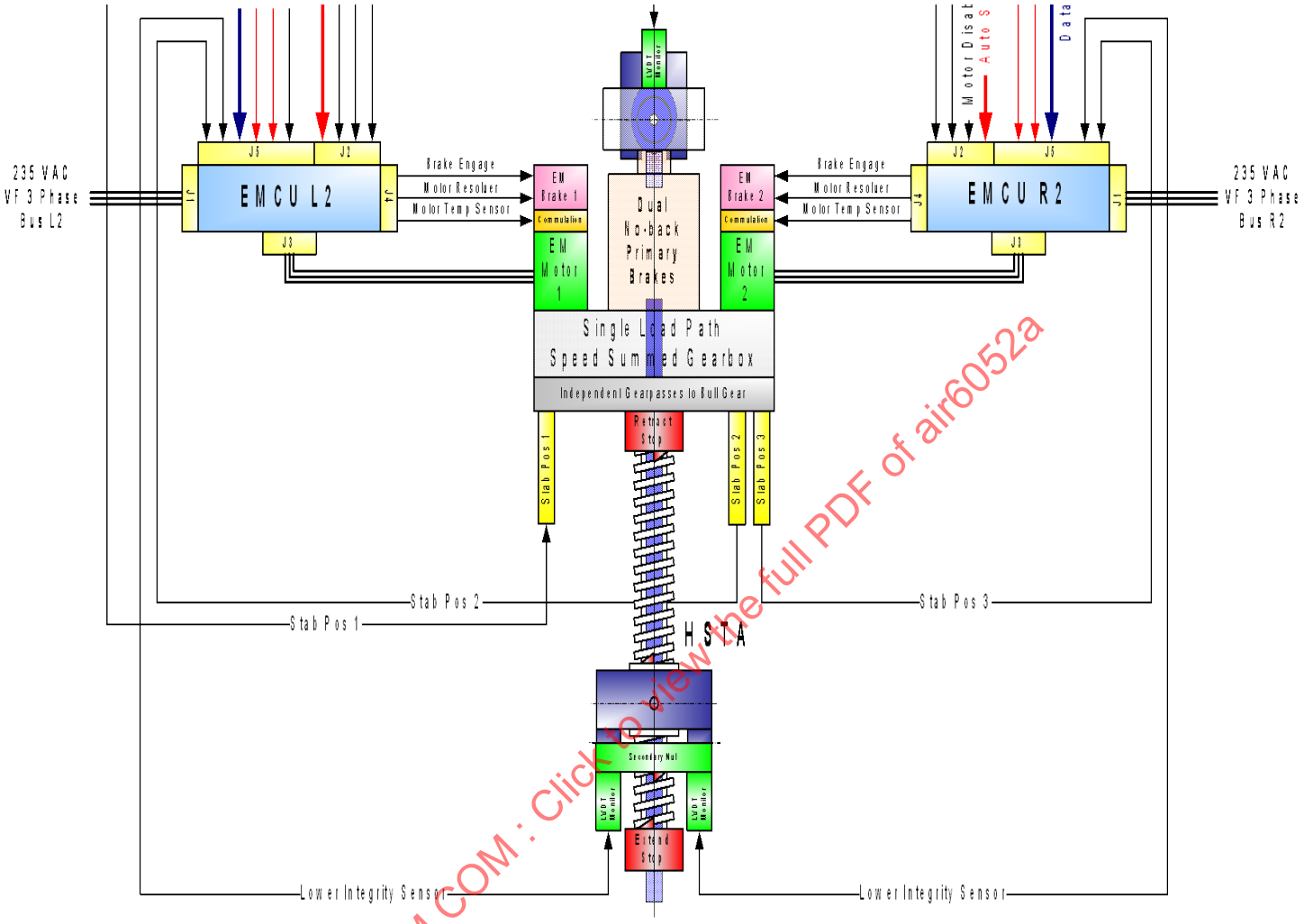
Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: Compression tension: 42/65.5 klb (187.5/291.3 kN) Ultimate load: Compression tension: 63/98.2 klb (281.3/437 kN) Secondary load path ultimate load: Compression tension: 42/65.5 klb (187.5 291.3 kN)	1 hydraulic motor 66.8 klb (297.1 kN) at 0.35 deg/s Electrical motor 35 klb (155 kN) at 0.1 deg/s 57.3 klb (255.4 kN) at 0.07 deg/s	Total horizontal stabilizer deflection: 13 degrees for 20.76 inches (527.3 mm) A/C nose up: 6.5 degrees A/C nose down: 6.5 degrees	One ballscrew	Horizontal stabilizer immobilization required after the first structural failure	Primary (loaded) and secondary (unloaded) checkable load path	Not required	Two 3000 psi (20690 kPa) hydraulic systems Three phases 115 VAC variable frequency

Table 9B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two fixed displacement hydraulic motors and 1 AC motor	Speed summing dual path gear system	Vented Aluminum casting	Oil without pump	Two starts Shock absorbing end stops Stainless steel	Stainless steel Four ball circuits Loaded and spacer balls Steel balls Grease: Inverted thread secondary nut	Friction no-back Power-off brakes	Electro-hydraulic servoloop	Total wet weight: 352 pounds (160 kg)

4.10 Boeing B787-8/-9/-10

See Figure 8.



EMCU L2/R2: Electric Motor Control Unit Left 2/Right 2

Figure 8 - Boeing B787-8/-9/-10 trimmable horizontal stabilizer actuator schematic diagram

Table 10 - Boeing B787-8/-9/-10 technical data

Table 10A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Components	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Not known	Not known	Not known	One ball screw	Indication of failure is required after the first structural failure	Primary load path loaded for full life Integrity monitored with checkable sensors Secondary load path unloaded for normal operation Integrity verified periodically Damage tolerant for inspection interval Finite endurance life	DO160E, Environment II, Category A	Two three-phase 115 VAC variable frequency

Table 10B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two permanent magnet synchronous motors	Speed summing Single load path	Sealed Aluminum	Oil without pump	Two starts Compliant end stops Chrome plated carbon steel	Chrome plated carbon steel Four circuits Carbon steel balls All loadbearing balls Grease: Inverted thread secondary nut/extended life	Skewed roller no-back Power-off brakes: One per motor	Velocity command Closed loop velocity control	Not known

4.11 Bombardier Challenger 300 Series

NOTE: No schematic diagram is available.

See Figure 9.

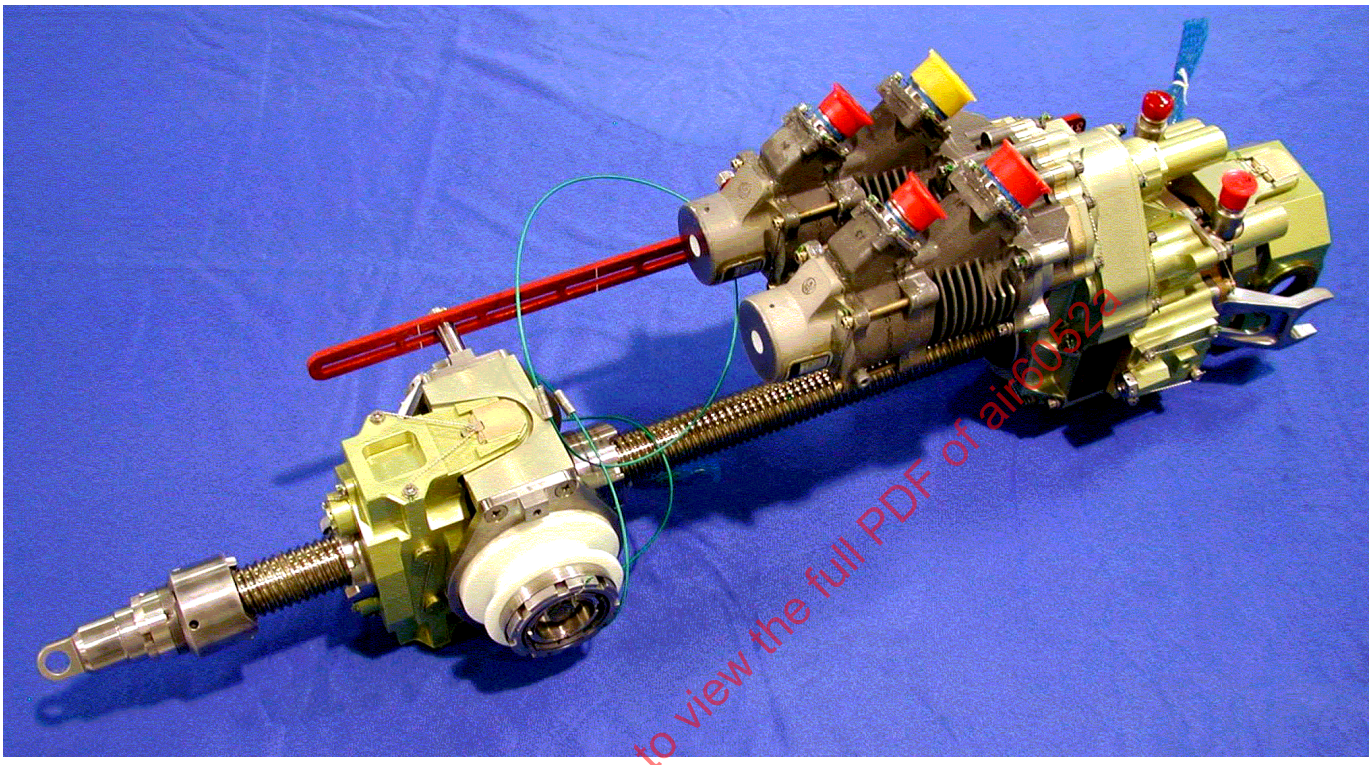


Figure 9 - Bombardier Challenger 300 series trimmable horizontal stabilizer actuator

Table 11 - Bombardier Challenger 300 series technical data

Table 11A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Component	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit: 9.1 klb (40.5 kN)	All performance points for one motor Max load: 6.05 klb (27 kN) at 0.1 deg/s Max rate: 1.05 klb (4.6 kN) at 0.4 deg/s	11.6 inches (295 mm) between mechanical stops (2.4 to 13 degrees)	One ball screw	Horizontal stabilizer immobilization required after the first structural failure	Primary load path loaded for full life Failure indicated by locking devices (not checked on aircraft) Secondary load path unloaded for normal operation Integrity verified periodically Single flight requirement	DO160C, Environment II, Category E	Two 28 VDC

Table 11B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two DC brushless motors	Torque summing Single load path Torque limiter	Vented Aluminum	Grease	Two starts No-jamming end stops CRES	CRES four circuits loaded Ceramic balls/ Unloaded CRES balls Grease: Inverted thread secondary nut/limited life	Skewed roller no-back Power-off brakes: 1 per motor	Velocity command Closed-loop velocity control	48 pounds (22 kg) HSTA without electronics 10 pounds (4.5 kg) MCU (two channels) 14 pounds (6.4 kg) HSTECU

4.12 Bombardier Challenger 600 Series

NOTE: (1) No HSTA picture is available. (2) No schematic diagram is available.

Table 12 - Bombardier Challenger 600 series technical data

Table 12A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Component	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Source
Limit load: 14 klb (62 kN) tensile and compressive for both primary and secondary load path Ultimate load: 21 klb (93 kN) tensile and compressive for both primary and secondary load paths	Rate: 0.5 deg/s under the maximum operating load of 4.75 klb (21 kN) (tensile load) Rate >0.4 deg/s under emergency diving load of 4.75 klb (21 kN) (tensile load) Two electrical motors, one operated at a time, each one capable of providing the full performance.	0 degrees (nose down) to 9 degrees (nose up) HSTA axial stroke: 4.72 inches (120 mm)	One ACME screw	Small (0.1 inch [3 mm]) HSTA Jam allowed, within a given range, after the first failure	Primary and secondary load path Load sharing between primary and secondary load path may exist for some components (secondary load path components are damage tolerant for full A/C life) Locking mechanism, providing a HSTA JAM for the primary screw shaft rupture Popup indicator monitoring primary ACME screw wear (C check interval) Structural integrity inspection mandatory at mid A/C life	DO160B Category E in an environment II	Three phases 115 VAC 400 Hz fixed frequency

Table 12B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Screw	Nut	Irreversibility	Position Control	Weight
Two DC brush less motors	Torque summing Two independent and identical gear trains from motor to actuating screw Two mechanical torque limiters (one per gear train)	Sealed gearbox Aluminum alloy housings	Grease	ACME screw	ACME screw	Irreversibility achieved by ACME screw on its own However, a power-off brake is implemented on each one of the 2 motors	Open loop Only the velocity is controlled	Total weight including power electronics: 42 pounds (19 kg)

4.13 Bombardier CRJ-200

NOTE: (1) No HSTA picture is available. (2) No schematic diagram is available.

Table 13 - Bombardier CRJ-200 technical data

Table 13A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Component	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: 14 klb (62 kN) tensile and compressive for both primary and secondary load path Ultimate load: 21 klb (93 kN) tensile and compressive for both primary and the secondary load path	Rate: 0.5 deg/s under the maximum operating load of 4.5 klb (20 kN) (tensile load) Rate >0.4 deg/s under the emergency diving load of 4.5 klb (20 kN) (tensile load) Two electrical motors, one operated at a time, each one capable providing the full performance.	+2 degrees (nose down) to 13 degrees (nose up) HSTA axial stroke: 7.87 inches (200 mm)	One ACME screw	Small (0.1 inch [3 mm]) HSTA Jam allowed, within a given range, after the first failure	Primary and the secondary load path Load sharing between primary and the secondary load path may exist for some components (secondary load path components are damage tolerant for full A/C life) Locking mechanism, providing a HSTA JAM for primary screw shaft rupture, Popup indicator monitoring primary ACME screw wear (C check interval) Structural integrity inspection mandatory at mid A/C life	DO160B Category E in an environment II	Three phases 115 VAC 400 Hz fixed frequency

Table 13B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Screw	Nut	Irreversibility	Position Control	Weight
Two DC brushless motors	Torque summing Two independent and identical gear trains from motor to the actuating screw Two mechanical torque limiters (one per gear train)	Sealed gearbox Aluminum alloy housings	Grease	ACME screw	ACME screw	Irreversibility achieved by the ACME screw on its own However, a power-off brake is implemented on each one of the 2 motors	Open loop Only the velocity is controlled,	Total weight including power electronics: 42 pounds (19 kg)

4.14 Bombardier CRJ-700/-900/-1000

See Figure 10.

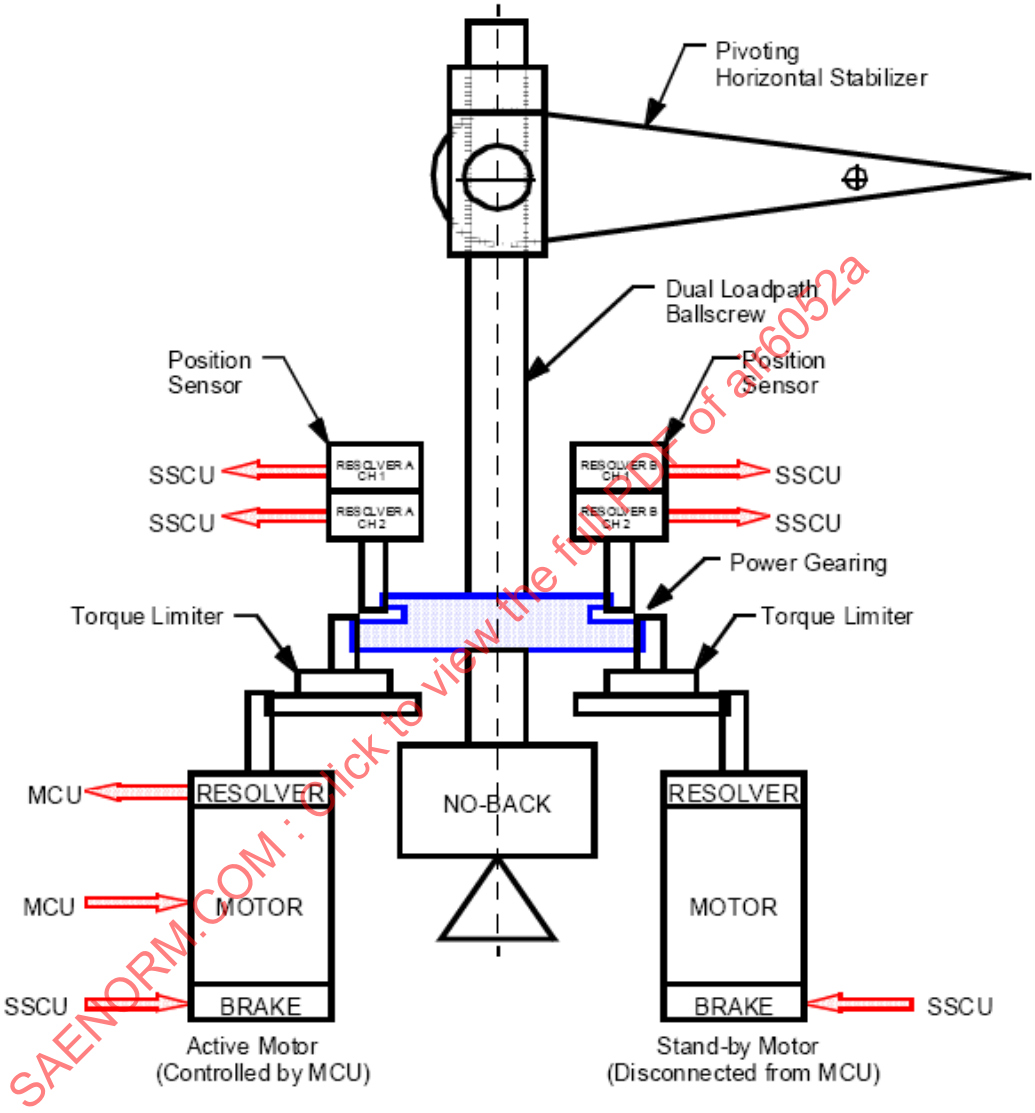


Figure 10 - Bombardier CRJ-700/-900/-1000 trimmable horizontal stabilizer actuator schematic diagram

Table 14 - Bombardier CRJ-700/-900/-1000 technical data

Table 14A - General data

Design Loads	Operating Requirements	Strokes	Primary Actuation Component	Safety Requirements	Structural Redundancy Concept	Explosion Proofness	Power Sources
Limit load: 31.68 klb (141 kN) for primary load path Limit load: 24.165 klb (107.5 kN) tensile 14.995 klb (66.7 kN) compressive For secondary load path ultimate load: 39.6 klb (176 kN) For primary load path ultimate load: 30.2 klb (134.4 kN) tensile 18.745 klb (83.4 kN) compressive	Rate: 0.5 deg/s under maximum operating load of 8.9 klb (39.6 kN) (tensile load) Two electrical motors, one operated at a time, each one capable of full performances	+2 degrees (nose down) to 13 degrees (nose up) HSTA axial stroke: 10.9 inches (277 mm)	One ball screw	Small (<0.25 inch [6 mm]) HSTA jam allowed, within a given range, after the first failure Horizontal stabilizer immobilization required after the first failure.	Primary and secondary load path Secondary load path not loaded in normal operation Locking mechanism providing a HSTA jam in case of primary load path failure Structural integrity inspection mandatory at mid A/C life	DO160B Category E in an environment II	Three phases 115 VAC 400 Hz fixed frequency

Table 14B - Design data

Motors	Gearbox General Arrangement	Gearbox Housing	Gearbox Lubrication	Ball Screw	Ball Nut	Irreversibility	Position Control	Weight
Two DC brushless motors	Torque summing Two independent and identical gear trains from motor to the actuating screw Two mechanical torque limiters (one per gear train) Shock absorbing device (rubber bull gear)	Sealed gearbox Aluminum alloy housings	Grease	One start CRES End of stroke dog stops	CRES carburized in bearing zones Three ball circuits Loaded balls and spacer balls are made of CRES Grease every 2000 FH Secondary nut: Arc gothic thread/split nut Above a certain tensile load, friction torque is high enough to jam the HSTA Not loaded in normal operation	Irreversibility achieved a skewed roller no-back However, a power-off brake is implemented on each one of the two motors	Open loop Only the velocity is controlled	Total weight including power electronics: 77 pounds (35 kg)