Agreement on Trade in Civil Aircraft

TECHNICAL SUB-COMMITTEE

Additional Information on Selected Products

Canada

The following communication has been received from the Delegation of Canada on 10 March 1982.

Accord relatif au commerce des aéronefs civils

SOUS-COMITE TECHNIQUE

Renseignements additionnels concernant certains produits

Canada

La délégation du Canada a fait parvenir au secrétariat la communication ci-après en date du 10 mars 1982.
**PRODUCT:** AIRCRAFT COUNTERWEIGHTS

**CLASSIFICATION:**
- CCCN 81.04
- TSUS 629.50
- CTI 44053-1
- 44062-1

**EXAMPLE OF USE:**
- **Product:** Linked to Aircraft elevator and rudder control surfaces
- **Manufacturer/Part No.:** Eldorado Nuclear Limited/yes
- **Used in:** Boeing 747, DC-10, L1011 aircraft

**TECHNICAL DESCRIPTION:**
- **Principal function:** Inertial tuning
- **Principal technology used:** Mechanical
- **Material:** depleted Uranium
- **Documents annexed:** Drawings [ ] Illustration [x] Description [ ] Other [ ]

**JUSTIFICATION FOR INCLUSION:** The illustrated component (value approx. $600.00) weighs about 20 lbs. Roughly 400 lb. of different sized counterweights are used on the control surfaces of the L-1011 for example.

**OBSTACLES TO DIVERSION:** High cost.
June 9, 1981.

Mr. C. R. Mann,
GATT Division,
Office of General Trade Relations,
Department of Industry, Trade & Commerce,
OTTAWA, Ontario.
K1A 0H3.

Dear Mr. Mann:

Re: Your Ref. 6256-2-1

Eldorado is pleased that the Canadian representatives were able to present our case in applying for duty free status on depleted uranium aircraft counterweights. We wish to supply you with the following information as requested, concerning our product.

1. Our manufacturing process is as follows:

   U.S. origin depleted uranium tetrafluoride powder is received at Eldorado and is reduced with magnesium in a thermit type reduction process. In a secondary melt, the metal is further melted and cast to shape under vacuum. The secondary melting must be carried out under vacuum for the following reasons:

   (a) To eliminate the presence of high oxidation taking place. Uranium is a reactive metal and as such, must be melted in the absence of oxygen.

   (b) To eliminate the presence of high porosity.

   (c) In order to produce metal at maximum density as required by customer.

   The parts are readied for precision machining. Typical machining operations are:

   1. Milling flat surfaces for mounting purposes.
   2. Drilling holes for mounting bolts.
   3. Milling areas for weight control.

2. As there is a wide variation in the physical size of counterweights, we have enclosed a photograph of a typical shape to illustrate a typical part.
3. The counterweights are extensively used on civil aircraft to balance the control surfaces on both wings and also the rear tail rudder section.

4. All counterweights manufactured at Eldorado carry the customer's part number.

5. The counterweights do not require approval from airworthiness authorities in the United States when being shipped from Eldorado's plant in Canada, as the customer has carried out a source inspection and will inspect all parts leaving Eldorado.

6. At this time, we do not have any additional data regarding tariff classification and duty, as the customer is responsible for paying duty.

I have discussed Item 6 with Mr. Ray Rush, Industry, Trade and Commerce, U.S. Division and he has indicated that he will get in touch with you for further discussion.

I hope you find this helpful, and we look forward to the response it receives at the next International Meeting at Geneva.

Yours very truly,

ELDORADO NUCLEAR LIMITED

W. C. Scott,
Marketing Representative,
Metallurgical Products.
PRODUCT: **SYSTEM SPECIFIC TEST EQUIPMENT**  
Example: Direction Finder Test Set

<table>
<thead>
<tr>
<th>CLASSIFICATION:</th>
<th>CCCN</th>
<th>TSUS</th>
<th>CTI</th>
</tr>
</thead>
</table>

**EXAMPLE OF USE:**  
Product: Test set for Aircraft direction finder

Manufacturer/Part No.:  
Rockwell International of Canada Ltd.  
Collins Canada Division/970-V1

Used in test, repair and overhaul of Collins DF-301E direction finder

**TECHNICAL DESCRIPTION:**  
Only **essential** function to test and troubleshoot the Collins DF-301E direction finder

Principal technology used: Electronic/R.F.

Material: Various

Documents annexed: Description [X]  
Illustration [X]

Data provided on test set and direction finder pages 1 to 7

**JUSTIFICATION FOR INCLUSION**  
Required to support airborne equipment. Unit value approximately $10,000.00.

**OBSTACLES TO DIVERSION**  
Dedicated to testing Collins DF-301E direction finder
CONTROL PANEL (BOTTOM HALF)

ANTENNA STAND (TOP HALF)

970V-1 Direction Finder Test Set
Figure 1-1
SECTION 1
INTRODUCTION

1.1 GENERAL.

Included in this manual is the purpose of equipment, equipment specifications, equipment description, theory of operation, operating instructions, and all necessary maintenance instructions for the 970V-1 Direction Finder Test Set (CPN 622-3029401). Refer to figure 1-1 for a view of the 970V-1 Direction Finder Test Set (test set).

1.2 PURPOSE OF EQUIPMENT.

The 970V-1 Direction Finder Test Set is used in testing and troubleshooting the OA-8697/ARD Direction Finder Group (direction finder) and/or the DF-301E/H/J Direction Finder (direction finder). With the appropriate receiver and test equipment, the test set will test the accuracy and sensitivity of the direction finder in the 100- to 400-MHz frequency range. Figure 1-2 illustrates the accessory equipment supplied.

1.3 EQUIPMENT DESCRIPTION.

The 970V-1 Direction Finder Test Set is a portable test set packaged in a watertight case that separates into two halves. The bottom half contains the test set controls, test points, an ammeter, and a bearing indicator. The top half contains the antenna stand, where the direction finder is mounted and fastened by six thumb bolts. A set of interconnecting cables, supplied with the test set, connects the two halves together and to the rest of the associated test equipment. The test set also can be mounted in a standard 19-inch rack when removed from the case.

The test set provides the signal and switching necessary to test the direction finder. Primary power to operate the test set is either 115 V ac, 230 V ac, or 28 V dc. A switch, located on the control panel, selects ac or dc power. Primary power to the test set (using cable assembly W3 for ac operation or cable assembly W4 for dc operation) is applied to the unit under test through a switch on the control panel. Current supplied to the unit under test is monitored by an ammeter located on the control panel.

Also located on the control panel are the antenna drive line, power supply, audio, and bearing test points. The test set has three 9-position switches controlling phase delay compensation, antenna bearing, and simulated bearing information to the unit under test.

There are nine interconnecting cables provided with the test set. The cables provide power and signal connections between the test set, the unit under test, and test equipment. Cable assemblies W3, W4, or W9 connect the primary power (ac or dc) to the test set. The unit under test is connected to the test set with cable assembly W1, and the antenna is connected to the test set with cable assembly W2. The vhf/uhf receiver is connected to the test set with cable assembly W6 and to the unit under test with cable assembly W7. Cable assembly W8 connects the rf signal generator to the antenna stand. Cable assembly W5 connects the on-top indicator (bearing indicator) to the test set control panel. The cables, when not in use, are stored in a compartment adjacent to the transmitting antenna.

Internally the test set contains 400-Hz, 6-V ac; 28-V dc; and 28/5-V dc power supplies. A transmitting antenna and audio synthesizer circuit provides audio and bearing signals to the test set control panel and unit under test.

1.4 EQUIPMENT SPECIFICATIONS AND CAPABILITIES.

Power source ............... 28 V dc, 110 W; 115 V ac, 60 Hz, 150 VA; or 230 V ac, 50 Hz, 150 VA.

Ambient temperature range ............... -20 to +55 °C (-4 to 131 °F).

Ambient humidity ............... Up to 95%.

Altitude .................. 0 to 3,048 m (0 to 10,000 ft).

Service .................. Continuous.
Bearing indicator .......... 3-inch dial with 2-degree graduations.

Simulated bearing audio .0 to 315 degrees in 45-degree increments within ±0.1 degree.

Phase delay compensation ............ 0 to 315 degrees in 45-degree increments.

Transmitting antenna bearing .............. 0 to 315 degrees in 45-degree increments, accuracy 3.5-degree rms.

Weight ............ 9.072 kg (20 lb).

Dimensions ............ 40 x 25 x 48 cm (16 x 10 x 19 in).

1.5 TOOLS AND TEST EQUIPMENT.

Test equipment required for maintenance of the test set is listed in table 5-3. A special tool, CT11-8566 (CPN 630-1462-001), is required when P8 is to be removed.

1.6 WARRANTY.

For information on warranty on the test set, contact the contracting officer of the procuring agency.

1.7 SAFETY PRECAUTIONS.

The following are general safety precautions that personnel should understand and apply during operation and maintenance.

**Warning**

- KEEP AWAY FROM LIVE CIRCUITS. Operating personnel should at all times observe safety regulations. Do not replace components or make adjustments inside the equipment with primary power turned on. Under certain conditions, dangerous potentials exist when the power is turned off, due to charges retained by capacitors. Remove power, and discharge and ground a circuit before touching it.

- HIGH VOLTAGES. High voltages capable of causing death are used in this equipment. Primary power to the test set can be 115 V ac, 60 Hz; 230 V ac, 50 Hz; or +28 V dc. Personnel working with or near high voltages should be familiar with methods of resuscitation. Personnel should always be working in the presence of someone who is capable of rendering aid.
Collins DF-301E Direction Finder  
*(OA-8697/ARD)*

The DF-301E is the next generation automatic direction finder. Utilizing current solid-state techniques, Collins has developed a new DF system to improve performance, reliability, and maintainability. A significant improvement in bearing accuracy and stability has been achieved through the use of digital electronic circuitry rather than large mechanical rotating components. Bearing acquisition speed has also been increased. Vhf/uhf ADF capability is now available within one unit, thereby reducing installation cost, space, and weight.
DF-301E direction finder

OPERATING FEATURES

- Electronic antenna rotation
- Single-unit ADF system
- Low noise preamplifier (100-400 MHz)
- Lightweight
- Low power
- High reliability
- Increased range
- More stable bearing indication

Watertight package

- Fits same mounting as AS909/ARA-48/50
- Compatible with standard AM radios such as ARC-27, ARC-34, ARC-51, ARC-84, ARC-109, ARC-116, ARC-150, ARC-159, ARC-160, and 618M-1/2/3
- Fewer Interconnections

The DF-301E has been designed to fulfill the requirement in new aircraft for smaller more reliable avionics systems. The electronically rotated antenna permits the use of microelectronics to their best advantage in lowering power requirements and heat generation. The result is a new concept in DF systems with greater reliability as well as improved performance. The DF-301E includes a wideband low noise preamplifier which enhances the sensitivity and reduces the susceptibility to noise pick-up on the coax to the companion receiver. Logical functional organization of the modules enables rapid isolation of a failure for minimal MTTR.

OPERATION

The incoming signal is therefore modulated at the 5.68-kHz rotation rate so that the phase of 5.68-kHz component is dependent on the relative bearing to the signal source. The output of the antenna is routed through a broadband low-noise preamplifier to a companion AM receiver by external coaxial relays. (See block diagram.) In ADF mode the receiver auxiliary audio output is returned to the DF-301E processing section. The relative bearing is then derived from the received audio modulation by phase comparison with the 5.68-kHz reference for each direction of pattern rotation separately, thereby canceling any error due to receiver delay variation.

The bearing output is a standard synchro output driven from an ac servo loop.

MECHANICAL DESCRIPTION

The antenna and processing circuits of the DF-301E system are packaged in a single watertight unit. An aluminum casting constitutes the antenna cavity and the main chassis. The antenna and the lower surface of the unit are covered by a fiber glass reinforced epoxy radome. An O-ring seals the epoxy radome to the aluminum casting. The upper surface and the circuits are enclosed by a gasket sealed cover.

SPECIFICATIONS

Frequency range .......... 100-400 MHz
Vswr (antenna and preamplifier) ............. 3:1
Antenna ................. Solid state

Environmental Limits .......... MIL-E-5400 class 2 from -54 °C to 71 °C intermittent +95 °C random vibration equivalent to or exceeding MIL-E-5400 curve IV

Antenna Specification

Type ................. Slot antenna
Receiving pattern ........ Cardioid with F/B ratio of not less than 3:1 solid-state segment rotation, 5.68-kHz rotation frequency
DF-301E direction finder

Reversal rate .......... 142.1 Hz
Preamplifier
System gain .......... Not less than 17 dB
Noise figure .......... Not greater than 6 dB
Blocking .......... No blocking to 50-mV input

PHYSICAL CHARACTERISTICS

Size
Height .......... 8.82 cm (3.6 inches)

Width .......... 28.1 cm (11.63 inches)
Weight .......... 3.402 kg (7.5 pounds)
Mounting .......... Same hole pattern as AS-909/ARA-48 antenna adapter available for AS-578/ARA-25 antenna

POWER REQUIREMENTS

Primary power .......... 27.5 V dc, 700 mA
Indicator power .......... 26 V ac, 400 Hz, 300 mA

Functional Block Diagram.
DF-301E direction finder

PIN DESIGNATIONS

<table>
<thead>
<tr>
<th>PIN</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>AUDIO IN HIGH</td>
</tr>
<tr>
<td>K</td>
<td>AUDIO IN LOW</td>
</tr>
<tr>
<td>L</td>
<td>27 VDC IN</td>
</tr>
<tr>
<td>M</td>
<td>57 VAC 400 HZ IN</td>
</tr>
<tr>
<td>N</td>
<td>DC GROUND</td>
</tr>
<tr>
<td>A</td>
<td>BGND CONNECTION</td>
</tr>
<tr>
<td>B</td>
<td>SGND CONN. SUPPLY</td>
</tr>
<tr>
<td>D</td>
<td>SGND CONN. SUPPLY</td>
</tr>
<tr>
<td>G</td>
<td>SGND CONNECTION</td>
</tr>
<tr>
<td>E</td>
<td>PHASE DELAY SELECTOR 'C'</td>
</tr>
<tr>
<td>H</td>
<td>PHASE DELAY SELECTOR 'B'</td>
</tr>
<tr>
<td>W</td>
<td>PHASE DELAY SELECTOR 'A'</td>
</tr>
</tbody>
</table>

Electronic Systems Group/Rockwell International
Cedar Rapids, Iowa

555-57029237-08111J
Printed in USA
# AGREEMENT ON TRADE IN CIVIL AIRCRAFT
## PROPOSAL FOR EXTENDED COVERAGE

<table>
<thead>
<tr>
<th>PRODUCT:</th>
<th>BELLows ASSEMBLY - Part of Fuel Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASSIFICATION:</td>
<td>CCCN</td>
</tr>
<tr>
<td>EXAMPLE OF USE:</td>
<td>DPF and DPL Engine Fuel Controls</td>
</tr>
<tr>
<td>Manufacturer/Part No.</td>
<td>Aviation Electric Limited/Yes</td>
</tr>
<tr>
<td>Used in</td>
<td>Cessna Citation &amp; Corvair; Aerospatiale Corvette, L-1011; Mitsubishi Diamond; Dornier Skyservant, Ayres Turbo Thrush, Beech 90 &amp; 200 Series; 1Al Arava; Piper Cheyenne, Bell 212 &amp; 412, Shorts 330; Embraer EMB 120,121,312, DHC Twin Otter &amp; Dash 7, etc.</td>
</tr>
</tbody>
</table>

## TECHNICAL DESCRIPTION:
- **Principal function**: Conversion of pressure to force
- **Principal technology used**: Pneumatic
- **Material**: Copper-Beryllium or Stainless Steel

Documents annexed: Illustration

## JUSTIFICATION FOR INCLUSION
- Required for repair and overhaul. 1 per control, 1 control per engine. Unit value: $3000.00 (subject to discount)

## OBSTACLES TO DIVERSION
- Proprietary item suitable only for use in DPF & DPL Fuel Controls.
FIGURE 2.1
BELLOWS ASSEMBLIES
**PRODUCT:** TORQUE TUBE ASSEMBLY - PART OF FUEL CONTROL

**CLASSIFICATION:**

<table>
<thead>
<tr>
<th></th>
<th>CCCN</th>
<th>TSUS</th>
<th>CTI</th>
</tr>
</thead>
</table>

**EXAMPLE OF USE:**

<table>
<thead>
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</tr>
</tbody>
</table>

**TECHNICAL DESCRIPTION:**

<table>
<thead>
<tr>
<th>Principal function</th>
<th>Transmission of force from a high pressure area to a low pressure area.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal technology used</td>
<td>Hydro-Mechanical</td>
</tr>
<tr>
<td>Material</td>
<td>Stainless Steel</td>
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</table>

<table>
<thead>
<tr>
<th>Documents annexed</th>
<th>Drawings</th>
<th>Illustration</th>
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<table>
<thead>
<tr>
<th>Description</th>
<th>Other</th>
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<tbody>
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<td></td>
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</tbody>
</table>

**JUSTIFICATION FOR INCLUSION**

Component part of an aircraft engine fuel control.

Unit value approx. $2,000.00

**OBSTACLES TO DIVERSION**

Proprietary item suitable only for use in DPF & DPL fuel controls.
**PRODUCT:** METERING VALVE & SLEEVE - PARTS OF FUEL CONTROL

<table>
<thead>
<tr>
<th>CLASSIFICATION:</th>
<th>CCCN</th>
<th>TSUS</th>
<th>CTI</th>
</tr>
</thead>
</table>

**EXAMPLE OF USE:**
- **Product:** DPF and DPL Engine Fuel Controls
- **Manufacturer/Part No.:** Aviation Electric Limited/Yes
- **Used in:** Cessna Citation, Corvair, Aerospatiale Corvette, L-1011, Mitsubishi Diamond, Dornier Skyservant, Ayres Turbo Thrush, Beech 90 & 200 series, 1A1 Arava, Piper Cheyenne, Bell 212 & 412, Shorts 330, Embraer EMB 120, 121, 312, DHC Twin Otter & Dash 7, etc.

**TECHNICAL DESCRIPTION:**
- **Principal function:** Non linear variation of orifice size with linear displacement.
- **Principal technology used:** Hydro-Mechanical
- **Material:** Speciality Steels
- **Documents annexed:**
  - [ ] Illustration
  - [ ] Description
  - [ ] Other

**JUSTIFICATION FOR INCLUSION:** Required for Repair and Overhaul. One per control. One control per engine. Unit Value: $1,800.00 (subject to discount)

**OBSTACLES TO DIVERSION:** Proprietary item suitable only for use in DPF & DPL fuel controls.
FIGURE 2.2

METERING VALVE ASSEMBLY
PRODUCT: Parts of Fuel Controls.

MANUFACTURED BY: Joseph Lucas, General Electric, Hamilton Standard, Bendix, Aviation Electric, Smith's Industries, etc.

USED ON: Every gas turbine powered civil aircraft.

DESCRIPTION: The attached illustration (Fig. 1) shows the wide diversity of component parts incorporated in the hydromechanical control system for the Pratt and Whitney JT9D engine fitted to the 747 and some DC10's and A300's. The illustration caption states that there are 2,716 components parts to one of control.

Examples of component parts are: check valves, seals, plugs, orifices, diaphragms, levers, housings, springs, push rods, gears, gaskets, bellows, pressure control valves, servo-mechanisms, cams, pins, bearings, bushings, restrictors, temperature actuators etc. Materials would range from rubber, through steel.

Though a protracted task, it would be possible to submit detailed information on each and every component. However, technological advances have already occasioned significant changes in engine fuel controls. Many now incorporate substantial elements of electronics in their systems. This trend to electronics is receiving added impetus from operator's desire for full authority systems. Thus detailed analysis, component by component, of a fuel control system is likely to provide the basis for negotiating duty free treatment whilst the parts are becoming obsolete.

CONCLUSION: The CCCN and TSUS Annexes include, for example, 'Parts of automatic, flight control instruments and apparatus and other navigational instruments, and parts thereof'. This latter category would presumably include an Inertial Navigation system such as that to be found in the DC10. Figures 2 to 9 show some of the sub-assemblies included in such an inertial system.

It is difficult to escape the conclusion that reluctance to accept parts of fuel controls as part of an extended coverage list is primarily due to the lack of a specific description in either the CCCN or the USUS for fuel controls and the administrative inconvenience which such an inclusion would cause.
the throttle position remains unchanged.

Besides simplifying manual operation of the engine controls, there is also a simplification of the autothrottle control logic. Instead of adjusting the actual value of the thrust-setting parameter to a target value as defined by the thrust-control or flight management computer, now only the command value must be assigned. The constant throttle sensitivity and the linear relationship between throttle travel and thrust developed will result in improved control dynamics.

The first electronically-supervised engine control systems will enter airline service in 1982/83, with the introduction of the General Electric CF6-80A/A1 with Power Management Control (PMC) and the Pratt & Whitney JT-9D-7R4 with Electronic Engine Control (EEC); these two powerplants are destined for the Airbus Industrie A310 and the Boeing 767.

Full Authority Digital Engine Control (FADEC)

Unlike the electronic supervisory systems, FADEC systems assume full responsibility for control circuit logic computation, and also the adjustment of regulatory variables. Transmission of the throttle signals to the engine control system is performed entirely by digital electronic means. The essential elements of the FADEC include microelectronic pressure sensors, switching units for signal conditioning, multiplexing and analog/digital conversion of all input signals, together with microprocessors having a wide variety of types of memory (RAM, ROM, EAROM, etc). The FADEC is mounted on the engine fan casing, being protected by a housing designed to withstand severe thermal and mechanical loads. It will incorporate a high degree of redundancy in order to raise its reliability to a value superior to that of HMC systems. Two identical, totally independent control channels, each with its own sensors and power supplies, remain active all the time, being controlled by means of a supervisory logic system which determines the channel in command at any time. In the event of partial data loss in one channel, the corresponding signals can be 'borrowed' from the second channel, or else synthesized from other parameters.

The capability and flexibility of advanced microelectronic components permit extensive optimization and extension of engine functions, unlike the situation obtaining with HMC systems. The advantages of controlling powerplants by means of a FADEC system can be summarized as follows:

- Thrust setting characteristics similar to
- Automatic starting with minimal thermal load (incorporation of HP compressor exit temperature as an additional control parameter);
- Active protection against exceeding permitted limits (temperature, pressure, revs/min) in all operating ranges;
- Optimum acceleration and deceleration characteristics;
- Constant idle speed even with varying loads (bled air, generator);
- Automatic modulation of reverse thrust ("throttle-back" drive);
- Regulation of bleed air supply according to demand ("economic bleed");
- Optimised setting of variable compressor stators for stationary and non-stationary operating conditions (high-performance or high-stability schedules);
- Metering of the air used for controlling the temperature of the engine casing for active especially, the freedom from mechanical hysteresis in the signal transmission system all help to minimize throttle activity during automatic operation, thus limiting wear and reducing fuel consumption.

Operational requirements

In the early 1970s, the rapid advances in microelectronics triggered off various new approaches to flight deck design for the next generation of civil transport aircraft. In order to define desirable design criteria at an early stage, a team of pilots and engineers questioned 1,336 Lufthansa flight-deck crew personnel in 1976, and then produced a statistical analysis of their comments.

Questions relating to airliner powerplants were addressed to personnel with experience on B.737, B.727, B.707, B.747, especially.
Figure 2  Platform Gimbal Assemblies
Figure 3. Control/Display Panel
Figure 4. DC Cross-Track Card and Reference Amplifier Card
Figure 5. Transformer Rectifier Unit
Figure 6  Input (Analog-to-Digital) Converter
Figure 7.
Figure 8  Power Supply Assembly
FIGURE 9. INERTIAL PLATFORM