SECTION 6

WEIGHT AND BALANCE

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SECTION 6

WEIGHT AND BALANCE

6.1 INTRODUCTION

This Section contains the necessary information and procedures for correct aircraft loading and center of gravity calculation. This section also contains the procedures to establish the weight and balance for flight and describes the arms and weights of all equipment installed on the aircraft at the time of delivery. Weight and Balance limitations specified in Section 2 must never be exceeded and it is a precise responsibility of the pilot in command to ensure that the aircraft is loaded within limits before any flight.

Center of gravity is a determining factor for flight characteristics during take-off and for static longitudinal stability. A properly loaded aircraft will provide good performance within the flight envelope.

Using the basic empty weight and C.G., the pilot can easily determine the weight and C.G. position for the loaded aircraft by computing the total weight and moment and then determining whether they are within the approved envelope.

A weight and balance calculation is necessary to determine how much fuel or baggage can be boarded so as to keep the C.G. within allowable limits. Check calculations before adding fuel to ensure against overloading.

The method for determining take-off weight and C.G., the forms used when weighing the aircraft and determining the basic empty weight, the C.G. position and the useful load, are contained in this Section.

6.2 AIRPLANE WEIGHING PROCEDURE

The aircraft was weighed prior to delivery, and its Basic Empty Weight and Center of Gravity location are recorded in Figure 6-3.

Any change in equipment or aircraft modification can affect the Basic Empty Weight and Center of Gravity.

The following is a weighing procedure to determine the Basic Empty Weight and Center of Gravity location:

(a) Aircraft Preparation

(1) Remove excessive dirt, grease, moisture etc., from the aircraft before weighing.
(2) To prevent scale reading errors, tow the aircraft inside a closed building or into an area free from any wind disturbances.
(3) To determine the center of gravity, place the aircraft in a level attitude. See point (b) below.
(4) When weighing the aircraft, all the equipment included in the certified empty weight must be installed.
(5) Inflate tires to recommended operating pressures.
(6) Defuel the aircraft and drain the sumps. Fuel remaining aboard after drainage is included in the empty weight.
(7) Raise flaps to the retracted position. Place all the controls surfaces in neutral position.
(8) Fill to full capacity with engine oil and brake fluid.

(b) Levelling

(1) Place the scales under the aircraft wheels as appropriate (min. 800 lb beneath each main wheel, and min. 350 lb beneath the nose wheel).
(2) Deflate or inflate the nose wheel tire and/or lower or raise the nose strut as necessary in both instances to properly center the airplane longitudinally.

Longitudinal and lateral: plumb weight hanging from the dedicated plate located on the cabin right roof, down to the target located on the cabin floor.

(c) Aircraft Weighing

(1) Properly calibrate zero and use scales in accordance with the scale manufacturer's instructions.

(2) With the aircraft level and brakes released, record the weight shown on each scale in the Weighing Form (Figure 6-1).

(3) Note any tare when the aircraft is removed from the scales and deduct, if any, from each reading.

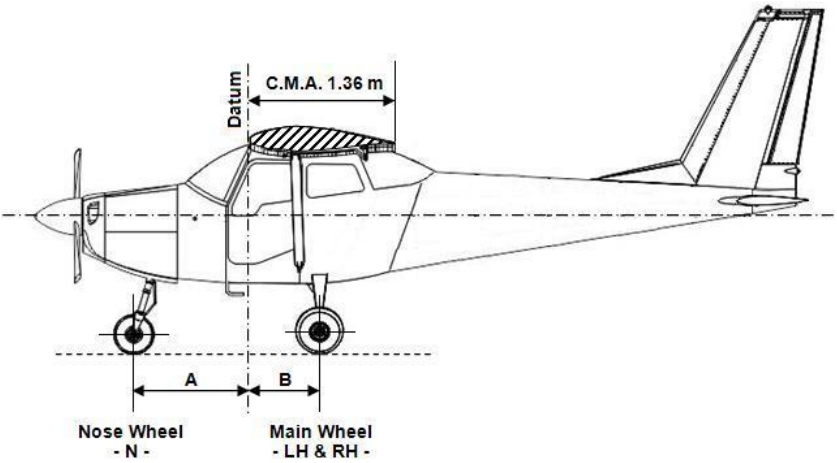
(d) Center of Gravity

(1) Complete the Weighing Form to determine the Center of Gravity arm of the aircraft as weighed.

(e) Basic Empty Weight

(1) In order to determine the Basic Empty Weight and the C.G. location, complete the form in Figure 6-2 by adding items a+b.

WEIGHING ON WHEELS



Obtain measurement A and B measuring horizontally along the aircraft center line.

WEIGHING POINT	1 SCALE READING (kg)	2 TARE (kg)	3 = 1 - 2 NET WEIGHT (kg)	4 ARM (m)	5 = 4 x 3 MOMENT (kg m)
N				**A**	
L				**B**	
R				**B**	
TOTAL			W ……	C.G. ……	M ……
C.G. = M / W % MAC= (C.G./1.360) × (100) = ...%					

Figure 6-1 Weighing Form

ITEM	WEIGHT × ARM = MOMENT		
	kg	m	kg m
a. Weight (as weighed)	-	-	-
b. Unusable Fuel	7.20	0.650	4.680
Basic Empty Weight (a+b)	-	-	-

Figure 6-2 Basic Empty Weight

6.3 WEIGHT AND BALANCE DATA RECORD

The Basic Empty Weight, Center of Gravity Location, and Useful Load listed in Figure 6-3 are for the aircraft as delivered from the factory. These figures apply only to the specific aircraft as identified by the Serial Number and Registration Marks shown.

Figure 6-4 provides a Weight and Balance Record Form which presents the current status of aircraft basic empty weight, and a complete history of previous modifications. Any change to installed equipment or any modification which affects weight or moment must be entered into the Weight and Balance Record.

Aircraft Serial Number _____

Registration Marks _____

AIRCRAFT ACTUAL BASIC EMPTY WEIGHT

ITEM	Weight × C.G. Arm = Moment (Aft of Datum)
Basic Empty Weight (from Figure 6-2)	
Optional Equipment (if not onboard when weighed)	
Actual Basic Empty Weight	

AIRCRAFT USEFUL LOADS

Maximum Take-Off Weight	-	Actual Basic Empty Weight	=	Useful Load
1155 kg	-	kg	=	kg
2546 lb	-	lb	=	lb

THIS ACTUAL BASIC EMPTY WEIGHT, C.G. AND USEFUL LOAD ARE FOR THE AIRCRAFT AS DELIVERED FROM THE FACTORY.

REFER TO WEIGHT AND BALANCE RECORD (Figure 6-4) WHEN ALTERATIONS HAVE BEEN MADE.

Figure 6-3 Weight and Balance data form

WEIGHT AND BALANCE RECORD

SERIAL NUMBER..... REGISTRATION MARKS.....

DATE	ITEM No.	DESCRIPTION OF MODIFICATION	ADDED (+) REMOVED (-)	WEIGHT CHANGE			NEW ACTUAL BASIC EMPTY WEIGHT	
				WT (kg)	ARM (m)	MOMENT/100 (kgm)	WT (kg)	MOMENT/100 (kgm)
	"	Actual basic empty weight as delivered	"	"	"	"		

Figure 6-4 Weight and Balance record

6.4 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

NOTE

It is a precise responsibility of the pilot in command and/or aircraft owner to ensure that the aircraft is properly loaded.

WARNING

When no passengers are present or no baggage is loaded in the baggage compartment, fill the fuel tanks sufficiently to meet approved C.G. limits.

(a) Use the Loading Form (Figure 6-5 sheet 1) and add the weight of all items to be loaded to the Basic Empty Weight.

(b) Use the Loading Graph (Figure 6-5 sheet 2) or perform the concerned calculation to determine the moment of all additional items to be carried in the aircraft.

(c) Add the moment of all items to be loaded to the Basic Empty Weight moment.

(d) By using the figures of previous items (a) and (c) above, locate the Center of Gravity points at the begin and at the end of flight on the Center of Gravity Moment Envelope (Figure 6-6). If the points fall within the envelope, the loading meets weight and balance requirements.

STANDARD CONFIGURATION

ITEM	WEIGHT (kg)	ARM (m)	MOMENT (kg m)
Actual Basic Empty Weight			
Revised Aircraft			
Pilot (seat No.1)		0.360	
Co-pilot or pax (seat No.2)		0.360	
Pax (seat No.3)		1.120	
Pax (seat No.4)		1.120	
Baggage (max 40 kg)		1.600	
Fuel		0.650	
TOTAL WEIGHT		TOTAL MOMENT	

Figure 6-5 Work sheet (sheet 1 of 2)

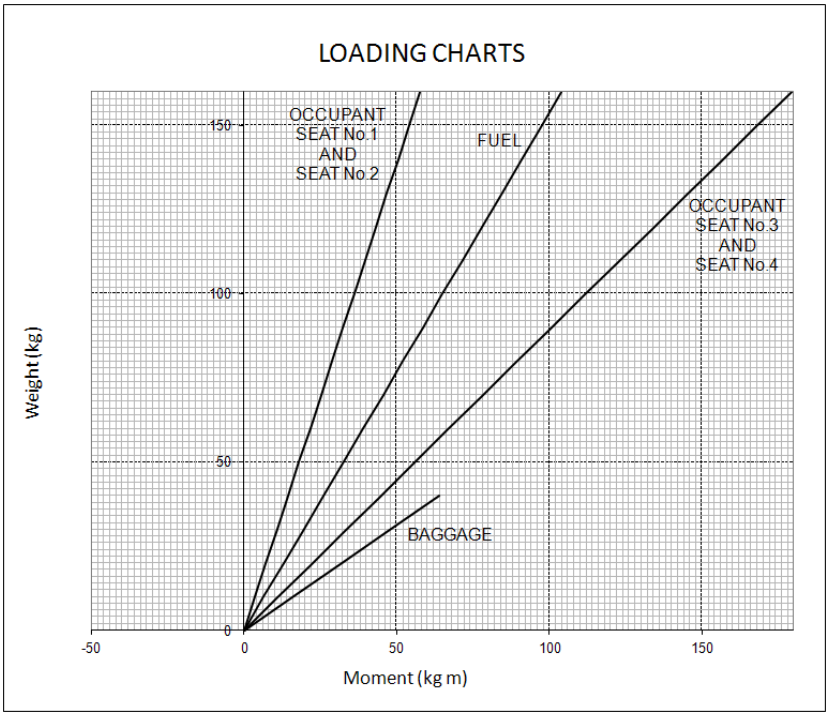


Figure 6-5 Work sheet (sheet 2 of 2)

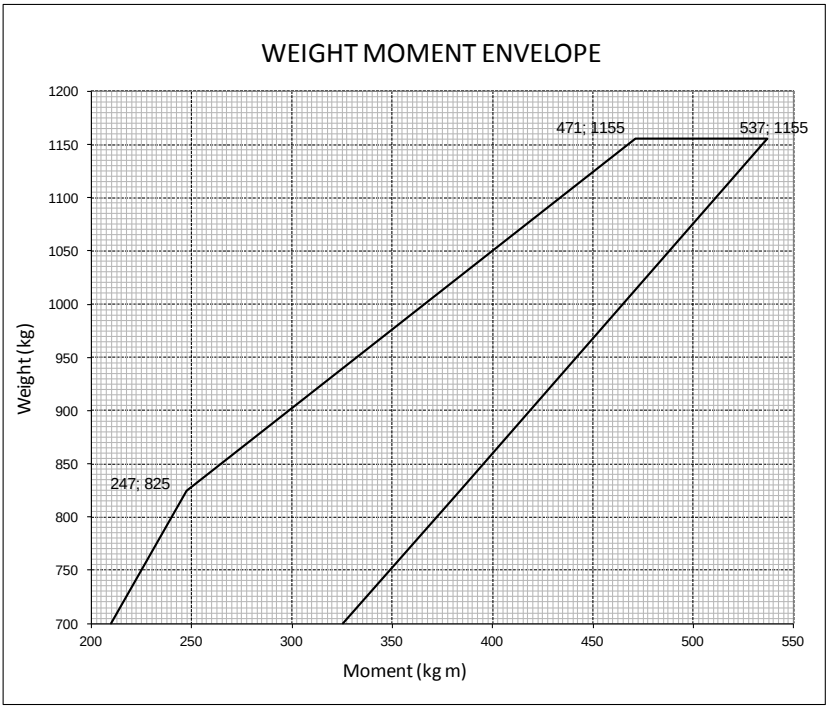


Figure 6-6 Weight-moment envelope

6.5 EQUIPMENT LIST

Depending upon configuration, the following is a list of equipment which must, or may (if marked "Optional"), be installed onboard the V1.0 aircraft model designated by serial number and registration marks reported below.

It consists of those items used for defining the configuration of an airplane when the actual basic empty weight is established at the time of delivery.

Items marked with “X” are those items which were installed on the airplane described below as delivered by the manufacturer.

Items marked with “NO” are those items not installed on the airplane described below at the time of its delivery.

SERIAL NUMBER……...…...

REGISTRATION MARKS…….

DATE……...

COMPILED BY……...

PROPELLER AND PROPELLER ACCESSORIES

No.	Item	Mark	Weight (kg)	Arm (m)
A01	One Propeller, Hartzell Propeller Inc. Model HC-C2YR-1BFP/F7497 Cert. Basis FAA TC P-920	.....	22.05	-1.627
A02	One Hydraulic Propeller Governor Hartzell model S-1-63 Cert. Basis FAA TC P-920	.....	2.00	-1.399
A03	One Propeller Spinner Hartzell p/n 103585 Cert. Basis FAA TC P-920	.....	2.00	-1.640

ENGINE AND ENGINE ACCESSORIES

No.	Item	Mark	Weight (kg)	Arm (m)
B01	One Engine, Lycoming Engines Model IO-360-M1A Cert. Basis FAA TC 1E10	.....	111.22	-1.185
B02	One Engine Starter Skytec model 149NL/ec (Lycoming p/n 31B26554) Cert. Basis FAA TC 1E10	.....	4.30	-1.381
B03	Two Engine Magnetos Slick model 4347 (LH), 4370 (RH) Cert. Basis FAA TC 1E10	.....	2.00 ea.	-0.872
B04	One Oil Cooler Harrison model AP07-AU06-03 Vulcanair dwg NOR7.373-2	.....	1.30	-1.408
B05	One Oil Filter Lycoming p/n LW-13215 Cert. Basis FAA TC 1E10	.....	0.73	-0.774
B06	One Exhaust Assy Vulcanair dwg 6069-401	.....	7.00	-1.008

B07	One Electric Fuel Pump Weldon model C-8100-F Vulcanair dwg 7.1081-1	.....	1.05	-0.849
B08	One Fuel Filter Steve's Aircraft p/n SA3-00-BS Vulcanair dwg NV7.003-45A	.....	0.30	-0.645
B09	Two Fuel Quantity Sensors a. Vulcanair dwg NV7.003-156F b. Vulcanair dwg NV7.003-156K	....	0.12 ea. 0.12 ea.	0.460 0.460
B10	One Engine Magneto Start Booster Champion Aerospace p/n SS1001 Vulcanair dwg NV7.003-234A	.....	0.27	-0.683

LANDING GEAR AND BRAKES

No.	Item	Mark	Weight (kg)	Arm (m)
C01	Two Main Wheel Assemblies Cleveland p/n 40-28 Vulcanair dwg NV7.003-185A-001	.....	2.80 ea.	0.652
C02	Two Main Tires 6.00-6, 6 Ply Michelin p/n 071-314-0 Vulcanair dwg NV7.003-185A-002	.....	4.50 ea.	0.652
C03	Two Main Tubes Vulcanair dwg NOR7.1107-2	.....	0.90 ea.	0.652
C04	One Nose Wheel Assembly Cleveland p/n 40-778 Vulcanair dwg NOR7.1103-1A	.....	1.70	-1.086
C05	One Nose Tire 5.00-5, 6 Ply Vulcanair dwg NOR7.1105-4	.....	1.90	-1.086
C06	One Nose Tube Vulcanair dwg NOR7.1107-1	.....	0.60	-1.086
C07	Two Brake Assemblies Cleveland p/n 30-18 Vulcanair dwg NV7.003-186A	.....	0.80 ea.	0.674
C08	Four Brake Pumps a. Vulcanair dwg NV7.003-188A b. Vulcanair dwg NV7.003-188G	....	0.14 ea. 0.14 ea.	-0.586 -0.586

C09	One Parking Brake Valve			
	a. Vulcanair dwg NOR7.277-4	.....	0.20	0.115
	b. Vulcanair dwg NV7.003-188E	.....	0.20	0.115

ELECTRICAL EQUIPMENT

No.	Item	Mark	Weight (kg)	Arm (m)
D01	One Alternator 24Vdc, 70A Plane Power model AL24-70	.....	4.08	-1.300
D02	One Battery 24V, 11Ah Concorde model RG24-12 Vulcanair dwg NV7.003-149B	.....	12.30	0.960
D03	One Voltage Regulator Plane Power model R1224B Vulcanair dwg NV7.003-130A	.....	0.14	-0.654
D04	One Battery Relay Vulcanair dwg NV7.001-43	.....	0.64	0.960
D05	One Starter Relay Vulcanair dwg NV7.001-43	.....	0.64	-0.693
D06	One External Power Relay Vulcanair dwg NV7.001-43	.....	0.64	-0.693
D07	Landing and Taxi Lights Whelen p/n 01-0771674-00 Vulcanair dwg NV7.003-226B	.....	0.54	0.140
D08	Two Navigation and Strobe Lights a. Aveo p/n AVE-WPSTR-645 Vulcanair dwg NV7.003-143A	.....	0.08 ea.	0.424
	b. Whelen p/n 01-0790725-11/-12 Vulcanair dwg NV7.003-221A/-221B	.....	0.12 ea.	0.424
D09	One Tail Position Light Whelen p/n 01-0771011-02 Vulcanair dwg NV7.003-63A	.....	0.09	5.300
D10	One Tail Anti-Collision (Strobe) Light a. Aveo p/n AVE-POSW-G62A Vulcanair dwg NV7.003-144A	.....	0.05	4.270
	b. Whelen p/n 01-0771774V02 Vulcanair dwg NV7.003-220A	.....	0.13	4.270

D11	One Map Light Aveo p/n AVE-EMB3B-00 Vulcanair dwg NV7.003-129C	.....	0.11	0.426
D12	One Cabin Light Vulcanair dwg NV7.003-210B	.....	0.05	0.800
D13	One Pedestal Light Vulcanair dwg NV7.003-183A	.....	0.01	-0.067
D14	One Flood Light Vulcanair dwg NV7.003-172A	.....	0.05	-0.259
D15	One Loudspeaker Vulcanair dwg NOR7.337-9	.....	0.23	0.630

INSTRUMENTS

No.	Item	Mark	Weight (kg)	Arm (m)
E01	Garmin G500 Avionics System Vulcanair dwg 7303-801			
	a. One GDU 620 Display Garmin p/n 011-01264-50 or -60	.....	3.20	-0.255
	b. One GDC 74A ADC Garmin p/n 010-00336-10	.....	1.04	-0.621
	c. One GRS 77 AHRS Garmin p/n 010-00295-10	.....	1.57	0.340
	d. One GMU 44 Garmin p/n 010-00296-00	.....	0.23	0.486
	e. One GMA 350 Audio Panel Garmin p/n 011-02385-00	.....	1.10	-0.305
	f. One GTX 33 w/ES Transponder Garmin p/n 010-00267-30	.....	1.59	0.014
	g. One GTN 650 NAV/COM Unit Garmin p/n 011-02256-00	.....	3.46	-0.344
	h. One GNC 255 NAV/COM Unit Garmin p/n 011-02719-00	.....	1.80	-0.349
E02	One Standby Attitude Module MidContinent MD302 Vulcanair dwg NV7.003-199B-017	.....	0.73	-0.281

E03	JPI Engine Data Management System Vulcanair dwg NV7.003-194A			
	a. One EDM-930-C Unit JPI p/n 790000-4C Vulcanair dwg NV7.003-194B	.....	1.36	-0.259
	b. One Remote Alarm Display JPI p/n 790749 Vulcanair dwg NV7.003-194C	.....	0.05	-0.200
	c. Fourteen Engine Sensors One Oil Press. [NV7.003-194D or -194X] One MAP [NV7.003-194E or -194W] One Fuel Press. [NV7.003-194F or -194V] One Oil Temperature [NV7.003-194H] Four EGT [NV7.003-194I] Four CHT [NV7.003-194J] One RPM [NV7.003-194L] One Fuel Flow [NV7.003-194M]	.....	1.54	-0.930
E04	One Annunciator Panel			
	a. Vulcanair dwg 7331-401	.....	0.07	-0.220
	b. Vulcanair dwg 7331-402	.....	0.07	-0.220
E05	One Magnetic Compass Vulcanair dwg NV7.003-203A	.....	0.27	-0.257
E06	One Flap Position Indicator UMA model N09-1100-0421-000 Vulcanair dwg NV7.003-227B	.....	0.11	-0.251
E07	One Engine Hour Recorder Honeywell p/n 85094 Vulcanair dwg NV7.003-105A	.....	0.23	-0.244
E08	One Digital Clock Vulcanair dwg NV7.002-82A	.....	0.10	-0.021

MISCELLANEOUS

No.	Item	Mark	Weight (kg)	Arm (m)
F01	One Heated Stall Warning Detector Safe Flight model C-99501-1 Vulcanair dwg NOR7.387-1	.....	0.05	0.000

F02	One Stall Warning Horn Vulcanair dwg NV7.003-202A	.....	0.01	-0.224
F03	One Heated Pitot Tube p/n AN5812-1	.....	0.48	0.424
F04	One Flap Position Transmitter UMA p/n 1H1 Vulcanair dwg NOR7.357-8	.....	0.28	0.655
F05	One Flap Actuator Vulcanair dwg 5326-401	.....	2.27	0.300
F06	One Fire Extinguisher Fire Fighting Enterprise p/n BA51015 Vulcanair dwg NOR7.227-5A	.....	2.10	0.043
F07	Two Pilot's / Copilot's Seats Vulcanair dwg 5274-401	.....	5.90 ea.	0.387
F08	One Rear Seat Bench Vulcanair dwg 5287-401	.....	10.00	1.214
F09	One Emergency Torch Vulcanair dwg NOR7.557-1	.....	0.11	-0.320
F10	One First Aid Box a. Vulcanair dwg NV7.002-21 b. Vulcanair dwg NV7.002-21B	....	1.38 0.80	0.850 0.950

AVIONICS

No.	Item	Mark	Weight (kg)	Arm (m)
G01	One Marker Beacon Antenna Vulcanair dwg NOR7.385-25	.....	0.27	0.022
G02	One XPDR Antenna Vulcanair dwg NOR7.385-17	.....	0.09	-0.505
G03	One VHF/COM 1 Antenna Vulcanair dwg NV7.002-38	.....	0.23	0.777
G04	One VHF/COM 2 Antenna Vulcanair dwg NOR7.385-24	.....	0.34	2.961

G05	One VOR/LOC/GS Antenna Vulcanair dwg NOR7.385-5	.....	0.23	4.787
G06	One GPS Antenna, GA 36 Garmin p/n 013-00244-00	.....	0.21	2.473
G07	One OAT Probe, GTP 59 Garmin p/n 011-00978-00	.....	0.10	0.310

AVIONICS (optional)

No.	Item	Mark	Weight (kg)	Arm (m)
H01	One ADF Receiver, King KR87 p/n 066-01072-0014	.....	1.47	-0.343
H02	One ADF Antenna, King KA44B p/n 071-01234-0000	.....	1.89	2.567
H03	One DME Unit, King KN62A p/n 066-01068-0004	.....	1.18	-0.336
H04	One DME Antenna, King KA60 Vulcanair dwg NOR7.385-17	.....	0.09	0.576
H05	One GTX 345R Transponder Garmin p/n 011-03303-00	.....	1.00	0.014

ELECTRICAL EQUIPMENT (optional)

No.	Item	Mark	Weight (kg)	Arm (m)
I01	Emergency Locator Transmitter System			
	(a.1) Artex ME406 ELT, p/n 453-6603 Cert. Basis TSO C91a, C126, ETSO 2C126	.....	1.036	1.120
	(a.2) Artex ELT Antenna, p/n 110-773 Cert. Basis TSO C91a, C126, ETSO 2C126	.....	0.185	2.717
	(b.1) Artex 345 ELT, p/n A3-06-2880 Cert. Basis TSO C91a, C126, ETSO 2C126	.....	1.007	1.120
	(b.2) Artex ELT Antenna, p/n A3-06-2892-1 Cert. Basis TSO C91a, C126, ETSO 2C126	.....	0.185	2.717
I02	One Taxi/Landing Light Whelen p/n 01-0771125-21 Vulcanair dwg NV7.003-226A	.....	0.14	-1.360

MISCELLANEOUS (optional)

No.	Item	Mark	Weight (kg)	Arm (m)
J01a	One Adjustable Pilot's / Copilot's Seat Vulcanair dwg 8371-401	.....	7.90	0.387
J01b	Two Adjustable Pilot's / Copilot's Seats Vulcanair dwg 8371-401	.....	7.90 ea.	0.387
J02	One Rear Seat Bench with reduced backrest slope Vulcanair dwg 5288-401	.....	9.50	1.214

INSTRUMENTS (optional)

No.	Item	Mark	Weight (kg)	Arm (m)
K01	One Flight Hour Recorder Honeywell p/n 85094 Vulcanair dwg NV7.003-105A	.....	0.23	-0.211
K02	One Digital Clock (in case of T-YOKE control wheels installed) Vulcanair dwg NV7.002-82A	.....	0.10	-0.250