

UNCLASSIFIED

Avro Aircraft Limited

INTER-DEPARTMENTAL MEMORANDUM

Ref 3533/22/J
Date August 19, 1955
To Mr. S. E. Harper - Chief Experimental Engineer.
From John Morris - Assistant Chief Aerodynamicist.
Subject CF-105 - INSTRUMENTATION

American Gyro Corp.

Free Gyro Model F10A-1

Issue 4 of CF-105 Instrumentation, to be installed on aircraft 1, 2 and 3, is attached.

It is requested that all final proposals for instrumentation, to meet the requirements of this list, be submitted to the Aerodynamics Department.

Note: In some cases, sampling rates will be reviewed.

John Morris

John Morris,
Assistant Chief Aerodynamicist.

DRP/rh

cc Messrs: J.C. Floyd G. Hake
 R.N. Lindley I. Craig
 J.A. Chamberlin S. Whiteley
 J.K. Scott F. Mitchell
 J. Millie R. Young.
 F. Brame
 Central Files.

STABILITY AND CONTROL

		<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
— ✓ 1)	Pressure A/C static.	(lb/ft ²) 150-2160	.2%	1/2 sec
— ✓ 2)	Pressure A/C differential.	(lb/ft ²) 0-3000	.2%	1/2 sec
	3) Free air total temperature.	-65 +350°F	.5%	1/2 sec
— ✓ 4)	Angle, elevator, port.*	-30 +20 (-10 + 10)**	0.5% (0.5%)**	10/sec
— ✓ 5)	Angle, elevator, stbd.*	-30 + 20 (-10 +10)	0.5% (0.5%)	10/sec
— ✓ 6)	Angle, aileron, port.*	-19 +19 (-10 +10)	0.5% (0.5%)	10/sec
— ✓ 7)	Angle, aileron, stbd.*	-19 +19 (-10 +10)	0.5% (0.5%)	10/sec
— ✓ 8)	Angle, rudder.*	-30 +30 (-10 +10)	0.5% (0.5%)	10/sec
— ✓ 9)	Angle, pitch.*	-60 +60 (-10 +10)	0.5% (0.5%)	10/sec
— ✓ 10)	Angle, bank.*	-85 +85 (-25 +25)	0.5% (0.5%)	10/sec
— ✓ 11)	Angle, azimuth.*	0-360 (-10 +10)	.1% (0.5%)	10/sec
— ✓ 12)	Angle, attack.	-10 +40	.2%	10/sec
— ✓ 13)	Angle, sideslip.	-15 +15	.5%	10/sec
— ✓ 14)	Angle, airbrake, port.	0-60	3%	5/sec
— ✓ 15)	Angle, airbrake, stbd.	0-60	3%	5/sec
— ✓ 16)	Rate, pitch.	-30 +30°/sec	0.5%	10/sec
— ✓ 17)	Rate, roll.	-300 +300°/sec	0.5%	10/sec
— ✓ 18)	Rate, yaw.	-30 +30°/sec	0.5%	10/sec
— ✓ 19)	Acceleration, normal.	-3 +8g	.5%	10/sec
— ✓ 20)	Acceleration, longitudinal.	-1 +1g	0.1%	10/sec
— ✓ 21)	Acceleration, lateral.	-0.5 +0.5G	0.5%	10/sec

* Not more than 3° phase shift at 15 cps.

** Figures in brackets are for Limited Range.

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		<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
✓22)	Acceleration, yawing.	-50 +50°/sec ²	0.5%	10/sec
✓23)	Acceleration, elevator, port)	-200+200°/sec ²	0.5%	10/sec
✓24)	Acceleration, aileron, port))	Not more than 3° phase shift at 15 cps.	0.5%	10/sec
✓25)	Acceleration, rudder,		0.5%	10/sec
✓26)	Force, elevator, stick.	-80 +120 lb	1%	2/sec
✓27)	Force, aileron, stick.	-30 +30 lb	1%	2/sec
✓28)	Force, rudder, pedal.	-150 +150 lb	1%	2/sec
29)	Position, elevator trimmer.		1%	2/min
30)	Position, aileron trimmer.		1%	2/min
31)	Position, Rudder, trimmer.		1%	2/min
✓32)	Position, damper elevator port)	-0.6 +0.6"	1%	10/sec
✓33)	Position, damper elevator stbd)	Not more than 3° phase shift at 20 cps.	1%	10/sec
✓34)	Position, damper aileron port)		1%	10/sec
✓35)	Position, damper aileron stbd)		1%	10/sec
✓36)	Position, damper rudder)		1%	10/sec
37)	Position, stick, elevator.		2%	10/sec
38)	Position, stick, aileron.		2%	10/sec
39)	Position, pedal, rudder.		2%	10/sec
40)	Position, parallel servos - elevator.		2%	10/sec
41)	Position, parallel servos - aileron.		2%	10/sec
✓42)	Signal damper elevator.		2%	10/sec
✓43)	Signal damper aileron.		2%	10/sec
✓44)	Signal damper rudder.		2%	10/sec
✓45)	Signal damper rudder emergency.		2%	10/sec

* Not more than 3° phase shift at 15 cps.

FLYING CONTROLS HYDRAULICS

		<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
- 1)	Pressure pump inlet - one pump only. B	0-200 psi	3%	10/sec
- 2)	Pressure pump delivery one system only. B	0-5000 psi	2%	10/sec
- 3)	Pressure valve inlet, port aileron. A	0-5000 psi	2%	10/min
- 4)	Pressure valve inlet port aileron. B	0-5000 psi	2%	10/min
- 5)	Pressure jack return, port aileron. B	0-2000 psi	2%	10/min
- 6)	Pressure valve inlet, port elevator. A	0-5000 psi	2%	10/min
- 7)	Pressure valve inlet, port elevator. B	0-5000 psi	2%	10/min
- 8)	Pressure jack return, port elevator. B	0-2000 psi	2%	10/min
- 9)	Pressure valve inlet, rudder. A	0-5000 psi	2%	10/min
- 10)	Pressure valve inlet, rudder. B	0-5000 psi	2%	10/min
- 11)	Pressure jack return, rudder. B	0-2000 psi	2%	10/min
- 12)	Temperature, pump inlet One only. B	-65 +300°F	2%	2/min
- 13)	Temperature, No. 1 heat exchanger inlet. B	-65 +300°F	2%	2/min
- 14)	Temperature, No. 1 heat exchanger outlet. B	-65 +300°F	2%	2/min
- 15)	Temperature, No. 2 heat exchanger outlet. B	-65 +300°F	2%	2/min
16)	Position, accumulator piston. B		1%	10/sec
17)	Position, compensator piston. B		2%	10/min

ENGINE INSTALLATION

	<u>RANGE</u>	<u>ACCURACY</u>	<u>FREQUENCY SAMPLING</u>
1) Engine oil pressure port.	0-50 psig	4%	2/min
2) Engine oil pressure stbd.	0-50 psig	4%	2/min
3) Oil inlet temp to engine, port.	0-500°F	2%	2/min
4) Oil inlet temp to engine, stbd.	0-500°F	2%	2/min
5) Fuel inlet to burner temp, port. (engine)	-65 +300	2%	2/min
6) Fuel inlet to burner temp, stbd. (engine)	-65 +300	2%	2/min
7) Gearbox oil heat exchanger inlet temp.	-65 +500°F	2%	1/min
8) Gearbox oil heat exchanger inlet temp.	-65 +500°F	2%	1/min
9) Cooling air, tunnel skin, etc. temp)	-65 +700°F	1%	1/min)
16) Cooling air, tunnel skin, etc. temp)	-65 +700°F	1%	1/min)
8 off			
17) Intake duct static - port.	0-30 psia	1%	6/min & Cont
18) Intake duct static - stbd.	0-30 psia	1%	6/min & Cont
19) Pressure compressor inlet port.	0-30 psia	1%	12/min
20) Pressure compressor inlet stbd.	0-30 psia	1%	12/min
21) Pressure H.P. compressor discharge port.	0-400 psia	1%	12/min
22) Pressure H.P. compressor discharge stbd.	0-400 psia	1%	12/min
23) R.P.M. L.P. compressor port.	0-100%	0.5%	12/min
24) R.P.M. L.P. compressor stbd.	0-100%	0.5%	12/min
25) R.P.M. H.P. compressor port.	0-100%	0.5%	12/min
26) R.P.M. H.P. compressor stbd.	0-100%	0.5%	12/min
27) Power lever position port.		1%	2/min
28) Power lever position stbd.		1%	2/min
29) Mass flow of fuel to engine port.	0-25,000 lb/hr	0.5%	12/min
30) Mass flow of fuel to engine stbd.	0-25,000 lb/hr	0.5%	12/min
31) Static pressure in engine bay	0-20 psi	1%	6/min & cont
34) Static pressure in engine bay.	0-20 psi	1%	6/min & cont

4 off

6/min & cont

6/min & cont

FUEL SYSTEM

	<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
1) Mass flow to engine/AB combination - port.	0-100,000 lb/hr	1%	1/sec
2) Mass flow to engine/AB combination - stbd.	0-100,000 lb/hr	1%	1/sec
3) Fuel temp. to engine/AB combination stbd. only.	-65 +250°F	2%	1/min
4) Pressure fuselage tank No. 2.	0-30 psia	2%	1/min
5) Pressure wing tank No. 7 stbd. only.	0-30 psia	2%	1/min
6) Fuel pressure at engine inlet port.	0-75 psia	2%	2/min
7) Fuel pressure at engine inlet stbd.	0-75 psia	2%	2/min
8) Temp in No. 5 tank - stbd. only.	-65 +160°	2%	2/min
9) Pressure in No. 5 tank stbd. only.	0-30 psia	2%	10/min
10) Fuel temp. entering heat exchanger stbd. only.	-65 +200°F	1%	2/min

+ Fuel contents gauges in all tanks (instrumentation already fitted).

UTILITY HYDRAULICS

LOW PRESSURE PNEUMATICS

	<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
1) Temp. at port engine bleed.	+100 +1000°F	1%	10/min
2) Static pressure at port engine bleed.	0-360 psia	2%	10/min
3) Static pressure after reducing valve on port engine line.	0-100 psia	1%	10/min
4) Temp of fuel pressurization air.	-20 +400°F	1%	5/min
5) Static pressure of fuel pressurization air.	0-100 psia	1%	5/min
6) Total head of fuel pressurization air (Differential pressure).	0-10 psia	2%	5/min
7) Temp. at turbine inlet.	-20 +250°F	2%	5/min
8) Total head turbine inlet.	0-100 psia	1%	5/min
9) Temp. at turbine outlet.	-130 +100°F	2%	5/min
10) Static pressure at turbine outlet.	0-20 psia	1%	5/min
11) Turbine bearing temperature.			2/min
12) Turbine R.P.M.			2/min
13) Inlet temp to fan.	0 +500°F	2%	5/min
14) Temp of air to cabin.	-20 +130°F	3%	5 /min
15) Static pressure air to cabin.	0-20 psia	1%	5/min
16) Total head air to cabin (Differential press)	0-10 psia	2%	5/min
17) Cabin pressure.	0-20 psia	0.5%	2/min
18) Integrating total head rake in port cooling air exit.	0-30 psia	1%	5/min
19) Integrating total head rake in stb'd cooling air exit.	0-30 psia	1%	5/min
20) Static pressure in port cooling air exit.	0-20 psia	1%	5/min
21) Static pressure in stbd. cooling air exit.	0-20 psia	1%	5/min
+ 6 temperature indicators in the cabin.			

ELECTRICS

	<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
1) Temp of aft bearing - port alternator.	-70 +450°F	2%	2/min
2) Voltage A ø port alternator.	0-130VAC	0.5%	1/min
3) Voltage B ø port alternator.	0-130VAC	0.5%	1/min
4) Voltage C ø port alternator.	0-130VAC	0.5%	1/min
5) Voltage A ø stbd alternator.	0-130VAC	0.5%	1/min
6) Voltage B ø stbd alternator.	0-130VAC	0.5%	1/min
7) Voltage C ø stbd alternator.	0-130VAC	0.5%	1/min
8) Current A ø port alternator.	0-80A	0.5%	1/min
9) Current B ø port alternator.	0-80A	0.5%	1/min
10) Current C ø port alternator.	0-80A	0.5%	1/min
11) Current A ø stbd alternator.	0-80A	0.5%	1/min
12) Current B ø stbd alternator.	0-80A	0.5%	1/min
13) Current c ø stbd alternator.	0-80A	0.5%	1/min
14) D.C. voltage of trans rect vint. port.	0-32VDC	0.5%	1/min
15) D.C. voltage of trans rect vint. stbd.	0-32VDC	0.5%	1/min
16) D.C. current of trans rect vint. port.	0-135A	0.5%	1/min
17) D.C. current of trans rect vint. stbd.	0-135A	0.5%	1/min
18) Exhaust temp of T.R.U.S.	0-300°F	2%	1/min
19) Temp of N.W. well.	0-200°F	2%	1/min
20) Temp of electrical bay.	-70 +275°F	2%	1/min

UNDERCARRIAGE

	<u>Range</u>	<u>Accuracy</u>	<u>Frequency Sampling</u>
1) Temp of brake plates.	0-2000°F	2%	1/sec)
1			) 4 off
4) Temp of brake plates.	0-2000°F	2%	1/sec)
5) U/C leg acceleration fore and aft - port.	-75 +75g	4%	50/sec
6) U/C leg acceleration fore and aft - stbd.	-75 +75g	4%	50/sec

STRUCTURAL INTEGRITY

Provision to be made for 50 strain gauges, positions to be decided by F. Mitchell, Stress Department. The frequency of sampling will be provisionally 5/sec.