

ANEXOS

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ANEXO 1 – HOJA TÉCNICA DEL MEDIDOR TIPO CORIOLIS

Date:	01-sep-14	Micro Motion Configuration Data Sheet			Sheet		of	
Company:	Pontificia Universidad Católica del Perú				Spec No.		Rev.	
Service:	Flujo	Contract		P.O.				
Manufacturer:	Micro Motion, Inc.	Req.		By				
		Chk'd		Appr.				
Service	1 Sensor Tag(s):							
	2 Transmitter Tag(s):							
	3 Fluid State Fluid Name	Liquid	Diesel					
	4 Flow Min Operating Max Design	0.100	3.000	5.000	USGPH			
	5 Pressure Min Operating Max Design		60.000		psig			
	6 Temperature Min Operating Max Design		25.0		C			
	7 Specific Gravity or Density (operating)	0.8500		g/cm3				
	8 Viscosity (operating)	15.000000		cP				
	9 Product No. Proposal Line No. Quantity	CMF010M313NQBNSZZZ			1			
10 Description	Micro Motion Coriolis ELITE sensor; 1/10-inch; 316L stainless steel							
11 ETO#: ETO Description								
12 ETO#: ETO Description								
13 Process Connections	1/2-inch CL150 ASME B16.5 F316/F316L Weld neck flange Raised face							
14 Approval	Micro Motion Standard / PED compliant							
15 Wetted Parts	316L stainless steel							
16 Mass Flow Accuracy @ Op Flow (% of rate)	0.10 %							
17 Density Accuracy @ All Rates	0.0005 g/cm3							
18 Pressure Drop @ Op Flow	4.860 psi							
19 Calibration Type Rate Units	Standard			lb/min				
20 Custom Calibration Points								
21 Density for Volume to Mass Conversion								
22 Special Units Text Totalizer Text								
23 Base Units: Flow Time Conversion								
24 Warning								
25 Sensor Notes								
26 Product No. Proposal Line No. Quantity	270R11ABMSZZZ			1				
27 Description	Micro Motion Coriolis MVD multivariable flow and density transmitter							
28 ETO#: Description								
29 ETO#: Description								
30 Input Power	18 to 100 VDC and 85 to 265 VAC; self switching							
31 Approval	Micro Motion Standard (no approval)							
32 Digital Communications								
33 Transmitter Flow Units: Mass Volume								
34 Transmitter Units: Density Temperature								
35 Special Mass Units Text Totalizer Text								
36 Base Mass Units: Flow Time Conversion								
37 Special Volume Units Text Totalizer Text								
38 Base Volume Units: Flow Time Conversion								
39 Channel A Type Variable								
40 Channel A Scaling LRV URV Units								
41 Channel B Type Variable								
42 Channel B Setting Rate Units								
43 Fault Action Channel A Channel B								
44 Slug High Limit Slug Low Limit								
45 Flow Direction								
46 Flow Damping Units			sec					
47 Transmitter Notes								
48 Warning								
49 Product No. Proposal Line No. Quantity								
50 Description								
51 ETO#: Description								
52 ETO#: Description								
53 Power								
54 Peripheral Tag(s)								
55 Peripheral Notes								
Notes	56							
Instrument Toolkit(TM)		Toolkit Project ID: 001-20140826-000191						
Version: 3.0 (Build 187D)		Application: Diesel 2						

Micro Motion Calculation Summary					
Date:	09/01/14				
Company:	Pontificia Universidad Católica del Perú				
Project Name:	VA-804-07-14 REV-01				
Service:	Flujo				
Sensor Model #:	CMF010M313NQBNSZZ				
Sensor Tag(s):					
Transmitter Model #:	2700R11ABMSZZ				
Transmitter Tag(s):					
Wetted Material:	316L stainless steel				
Fluid:	Diesel				
Fluid State:	Liquid				
Mass Flow Accuracy at Operating Flow (+/- % of Rate):	0.10000				
Density Accuracy at all Rates (+/-):	0.00950 g/cm3				
Pressure Drop at Operating Flow:	4.86005 psi				
Sensor Minimum Pressure at operating conditions:	psi				
Velocity at Operating Flow:	1.57183 ft/sec				
	Min	Operating*	Max	Design	Units
Flow Rate:	0.100	3.000	5.000		USGPH
Pressure:		60.000			psig
Process Fluid Temperature:		25.000			C
Ambient Temperature:		18.000			C
Density:		0.850			g/cm3
Viscosity:		15.000			cP
Gas only	Base Reference Temperature:	F		Density:	
	Base Reference Pressure:	psia			
	Base Reference Density:	lb/ft3			
Process Connection:	1/2-inch CL150 ASME B16.5 F316/F316L Weld neck flange Raised face				
Process Connection Pressure Rating:	275.000 psig				
@ Temperature:	25.000 C				
Flow Rate	USGPH	Mass Flow Accuracy +/- % of Rate	Pressure Drop*	Velocity*	Re
5.000		0.100	8.464 psi	2.619 ft/sec	131.003
4.510		0.100	7.539	2.363	118.164
4.020		0.100	6.643	2.106	105.326
3.530		0.100	5.774	1.849	92.488
3.000		0.100	4.860	1.572	78.602
2.550		0.100	4.099	1.336	66.811
2.060		0.100	3.275	1.079	53.973
1.570		0.100	2.444	0.822	41.135
1.080		0.100	1.606	0.566	28.297
0.590		0.108	0.790	0.309	15.458
0.100		0.634	0.103	0.052	2.620
*All pressure drop and velocity results are based on the process conditions (except flow rate) that are entered in the Operating column.					
Notes:					
Prepared by:	Instrument Toolkit		Version: 3.0 (Build 187D)	Project ID:	001-20140826-000191
				Application:	Diesel 2

ANEXO 2 – PLANILLA DE DATOS DEL MOTOR CUMMINS

PLANILLA DE DATOS MOTOR CUMMINS																									
RPM	Torque	Consumo Gravimétrico						Coriolis				Contenedor de aire				Emisiones					Temperatura ambiente		Humedad relativa		
		Media	uΔp	uΔT	Incer.	Valor max	Valor min	Media	Incer.	Valor max	Valor min	Dif de presión	Dif de presión	Media	Incer.	Valor max	Valor min	Tf	Ta	O2	CO2	CO	NO	°C	%
rpm	Nm	kg/h	%	%	±%	kg/h	kg/h	kg/h	±%	kg/h	kg/h	P ₁	P ₂	Pa	±%	Pa	Pa	°C	°C	%	%	ppm	ppm	°C	%
2000	200	14.40	0.86%	0.70%	1.11%	14.55	14.24	14.23	0.10%	14.24	14.21	1570	1570	1570.00	0.02%	1570.35	1569.65	387.00	28.20	14.78	4.64	296.67	135.00	24.00	72.67
2000	180	13.44	1.78%	1.34%	2.22%	13.74	13.14	13.39	0.10%	13.40	13.38	1525	1517	1521.00	0.02%	1521.35	1520.65	383.00	26.90	13.48	5.60	428.50	159.00	24.00	71.00
2000	160	12.55	2.02%	1.42%	2.47%	12.86	12.24	12.49	0.10%	12.51	12.48	1456	1459	1457.50	0.02%	1457.85	1457.15			13.90	5.23	367.00	143.00	24.50	70.00
2000	140	11.49	3.07%	1.97%	3.65%	11.90	11.07	11.37	0.10%	11.38	11.36	1383	1381	1382.10	0.03%	1382.46	1381.75	357.20	27.50	14.21	5.01	364.00	140.00	24.25	71.50
2000	120	10.66	3.09%	1.84%	3.60%	11.05	10.28	10.59	0.10%	10.60	10.58	1320	1321	1320.32	0.03%	1320.67	1319.96	342.20	27.80	14.67	4.67	351.50	132.00	24.50	70.00
2000	100	9.73	4.26%	2.32%	4.85%	10.21	9.26	9.61	0.10%	9.62	9.60	1242	1232	1236.82	0.03%	1237.17	1236.47			15.21	4.27	316.00	120.00	24.50	75.00
2000	80	8.74	3.59%	1.75%	3.99%	9.09	8.39	8.75	0.10%	8.76	8.74	1177	1175	1175.80	0.03%	1176.16	1175.45			15.74	3.88	304.00	113.00	24.00	73.00
2000	60	8.05	3.93%	1.76%	4.31%	8.40	7.71	7.93	0.10%	7.94	7.92	1125	1124	1124.66	0.03%	1125.01	1124.31	278.00	26.80	16.21	3.51	284.50	102.50	24.00	72.50
2000	40	7.15	4.25%	1.69%	4.57%	7.48	6.82	7.02	0.10%	7.02	7.01	1064	1059	1061.37	0.03%	1061.73	1061.02			16.53	3.28	285.00	95.00	24.00	73.00
2000	20	6.06	5.40%	1.83%	5.70%	6.40	5.71	6.09	0.10%	6.10	6.08	1023	1023	1022.60	0.03%	1022.95	1022.25	232.50	27.10	17.06	2.90	266.00	89.00	24.00	71.50
1800	200	10.68	2.60%	1.49%	2.99%	11.00	10.36	10.63	0.10%	10.64	10.62	1119	1022	1070.25	0.03%	1070.60	1069.90	355.00	26.00	13.51	5.55	313.00	179.00	23.50	69.00
1800	180	10.74	2.43%	1.45%	2.83%	11.05	10.44	10.84	0.10%	10.85	10.83	1075	998	1036.33	0.03%	1036.69	1035.98	351.00	26.70	13.88	5.26	302.00	174.00	24.00	70.00
1800	160	10.20	3.51%	1.99%	4.04%	10.61	9.79	10.20	0.10%	10.21	10.19	1050	964	1006.75	0.04%	1007.10	1006.40	344.55	26.40	14.30	4.70	312.50	163.50	23.50	69.50
1800	140	9.63	3.49%	1.87%	3.96%	10.01	9.24	9.50	0.10%	9.51	9.49	923	922	922.25	0.04%	922.60	921.90	330.00	26.15	14.74	4.62	303.50	150.00	24.25	70.75
1800	120	8.75	4.21%	2.05%	4.68%	9.16	8.34	8.66	0.10%	8.67	8.65	878	881	879.25	0.04%	879.60	878.90	309.63	26.97	15.24	4.25	290.33	136.33	24.33	68.67
1800	100	7.99	4.28%	1.91%	4.69%	8.37	7.62	7.91	0.10%	7.91	7.90	847	844	845.67	0.04%	846.02	845.31	292.43	26.83	15.65	3.71	282.00	129.00	24.00	69.00
1800	80	7.27	5.05%	2.03%	5.44%	7.67	6.87	7.31	0.10%	7.32	7.30	813	807	809.83	0.04%	810.19	809.48	271.93	26.67	16.13	3.59	277.00	113.33	24.00	69.00
1800	60	6.56	5.36%	1.96%	5.70%	6.94	6.19	6.52	0.10%	6.53	6.52	784	787	785.67	0.05%	786.02	785.31	255.70	26.77	16.48	3.32	273.67	103.00	24.00	69.00
1800	40	5.53	6.55%	1.99%	6.84%	5.91	5.15	5.77	0.10%	5.78	5.77	762	760	760.92	0.05%	761.27	760.56	234.17	26.67	16.94	2.82	260.00	90.33	24.17	69.67
1800	20	5.23	6.31%	1.85%	6.57%	5.58	4.89	4.97	0.10%	4.98	4.97	739	736	737.33	0.05%	737.69	736.98	206.47	26.87	17.44	2.59	231.33	84.67	24.33	70.33
1600	200	8.96	3.21%	1.60%	3.58%	9.28	8.64	9.05	0.10%	9.06	9.04	737	738	737.65	0.05%	738.00	737.29	336.70	26.55	13.54	5.54	309.50	184.50	24.50	73.00
1600	180	9.40	2.60%	1.36%	2.93%	9.67	9.12	9.20	0.10%	9.21	9.19	718	716	716.64	0.05%	717.00	716.29	335.97	26.55	13.70	5.26	292.33	177.33	24.27	70.33
1600	160	8.65	4.44%	2.14%	4.93%	9.08	8.23	8.67	0.10%	8.67	8.66	697	699	697.75	0.05%	698.10	697.40	327.27	26.93	14.28	4.95	308.00	170.00	24.20	70.00
1600	140	7.92	4.54%	2.00%	4.96%	8.31	7.52	7.89	0.10%	7.90	7.88	667	670	668.67	0.05%	669.02	668.31	308.63	27.07	14.50	4.52	291.67	158.00	24.13	69.67
1600	120	7.10	4.62%	1.82%	4.97%	7.45	6.75	7.19	0.10%	7.20	7.18	644	644	643.75	0.05%	644.10	643.40	289.83	27.07	15.41	4.12	282.33	146.67	24.07	69.33
1600	100	6.70	4.98%	1.88%	5.32%	7.06	6.35	6.52	0.10%	6.53	6.52	624	626	624.58	0.06%	624.94	624.23	270.27	27.13	15.85	3.79	267.00	133.00	24.00	69.00
1600	80	5.82	6.00%	1.92%	6.30%	6.19	5.46	5.92	0.10%	5.92	5.91	606	606	605.75	0.06%	606.10	605.40	251.43	26.83	16.28	3.47	262.00	121.67	24.00	69.00
1600	60	5.43	7.46%	2.25%	7.80%	5.85	5.00	5.34	0.10%	5.35	5.33	591	589	589.58	0.06%	589.94	589.23	234.53	26.53	16.69	3.17	251.67	109.00	24.00	69.00
1600	40	4.49	8.93%	2.22%	9.20%	4.90	4.08	4.61	0.10%	4.62	4.61	570	570	569.83	0.06%	570.19	569.48	207.60	26.43	17.19	2.64	231.67	99.67	24.00	69.00
1600	20	3.98	8.93%	1.98%	9.15%	4.35	3.62	4.25	0.10%	4.25	4.24	556	556	555.83	0.06%	556.19	555.48	517.90	26.76	17.74	2.37	208.00	93.00	24.00	69.00
1400	200	7.57	2.51%	1.05%	2.72%	7.78	7.37	7.63	0.10%	7.64	7.62	509	510	509.42	0.07%	509.77	509.06	309.50	26.65	13.75	5.37	284.50	206.00	24.00	68.00
1400	180	7.42	5.33%	2.19%	5.76%	7.84	6.99	7.46	0.10%	7.47	7.45	494	497	495.42	0.07%	495.77	495.06	307.30	26.90	14.13	5.07	291.50	206.00	24.00	68.00
1400	160	7.10	5.46%	2.15%	5.87%	7.51	6.68	6.94	0.10%	6.95	6.94	484	484	483.75	0.07%	484.10	483.40	270.00	26.80	14.64	4.70	293.50	192.00	24.00	68.50
1400	140	6.37	5.33%	1.89%	5.66%	6.73	6.01	6.46	0.10%	6.46	6.45	473	475	474.00	0.07%	474.35	473.65	278.80	26.45	15.09	4.36	279.00	182.50	24.00	68.50
1400	120	5.66	6.43%	2.02%	6.74%	6.04	5.28	5.89	0.10%	5.90	5.88	462	464	462.75	0.08%	463.10	462.40	261.80	26.63	15.63	3.96	262.67	165.67	23.67	69.67
1400	100	5.28	5.89%	1.74%	6.14%	5.60	4.96	5.32	0.10%	5.33	5.32	452	452	452.33	0.08%	452.69	451.98	242.80	26.83	16.05	3.61	252.00	146.33	23.67	69.67
1400	80	4.76	7.25%	1.91%	7.50%	5.11	4.40	4.82	0.10%	4.82	4.81	439	439	439.00	0.08%	439.35	438.65	225.30	24.46	16.51	3.31	245.33	134.00	23.67	70.00
1400	60	4.40	8.93%	2.18%	9.19%	4.80	4.00	4.31	0.10%	4.31	4.30	429	431	430.00	0.08%	430.35	429.65	206.30	26.37	16.96	2.96	231.67	121.67	23.67	70.00
1400	40	3.95	8.13%	1.80%	8.33%	4.28	3.62	3.74	0.10%	3.75	3.74	423	424	423.50	0.08%	423.85	423.15	185.13	26.53	17.46	2.60	210.67	112.00	23.67	70.67
1400	20	3.40	10.21%	1.94%	10.40%	3.76	3.05	3.25	0.10%	3.25	3.25	416	418	417.00	0.08%	417.35	416.65	166.00	26.30	15.33	2.19	193.00	95.67	23.67	70.67

PLANILLA DE DATOS MOTOR CUMMINS

RPM	Torque	P _{sat}	Humedad absoluta	Rair	P _{air}	Velocidad del aire	Flujo volumétrico	Flujo másico	A	B	G	E	C	F	Relación A/C	Consumo combustible	Incer.	Valor max	Valor min	Consumo obtenido del Insite						
																				rpm	Nm	kPa	kg/kg	kJ/kgK	kg/m3	m/s
2000	200	2.954	0.00134	0.287	3.354	18.36	0.0768	927.76	0.0160	0.3044	0.0009	4.0695	21.4613	80.690	66.99	13.85	1.050%	13.995	13.704	6.96	7.48	6.75	5%	22.39	23.56	21.23
2000	180	2.954	0.00131	0.287	3.354	18.07	0.0756	913.17	0.0193	0.3675	0.0011	4.9141	21.5482	81.017	55.70	16.39	1.067%	16.570	16.220	6.90	7.37	6.75	4%	22.21	23.21	21.21
2000	160	3.044	0.00133	0.287	3.348	17.70	0.0741	893.15	0.0181	0.3430	0.0011	4.5866	21.4318	80.579	59.35	15.05	1.020%	15.201	14.894	6.58	7.06	6.24	6%	21.18	22.49	19.87
2000	140	2.999	0.00134	0.287	3.351	17.23	0.0721	870.11	0.0173	0.3287	0.0010	4.3947	21.4263	80.558	61.93	14.05	1.054%	14.198	13.902	6.33	6.90	5.99	7%	20.39	21.85	18.92
2000	120	3.044	0.00133	0.287	3.348	16.85	0.0705	850.08	0.0161	0.3065	0.0009	4.0975	21.3928	80.432	66.32	12.82	1.046%	12.952	12.684	6.10	6.50	5.74	6%	19.64	20.85	18.42
2000	100	3.044	0.00143	0.287	3.348	16.31	0.0683	822.76	0.0147	0.2802	0.0009	3.7461	21.3610	80.313	72.43	11.36	1.001%	11.473	11.245	5.83	6.24	5.50	6%	18.77	19.96	17.58
2000	80	2.954	0.00135	0.287	3.354	15.89	0.0665	802.88	0.0134	0.2547	0.0008	3.4054	21.3309	80.200	79.57	10.09	0.995%	10.191	9.990	5.56	6.02	5.29	7%	17.89	19.05	16.72
2000	60	2.954	0.00134	0.287	3.354	15.54	0.0650	785.23	0.0121	0.2301	0.0007	3.0771	21.2565	79.920	87.75	8.95	1.021%	9.040	8.857	5.32	5.80	4.92	8%	17.11	18.52	15.71
2000	40	2.954	0.00135	0.287	3.354	15.09	0.0632	762.81	0.0113	0.2155	0.0007	2.8812	21.2589	79.929	93.72	8.14	0.986%	8.219	8.059	4.96	5.58	4.60	10%	15.96	17.53	14.38
2000	20	2.954	0.00132	0.287	3.354	14.82	0.0620	748.75	0.0100	0.1906	0.0006	2.5487	21.2376	79.849	105.85	7.07	1.007%	7.145	7.003	4.54	4.85	4.13	8%	14.60	15.75	13.45
1800	200	2.866	0.00124	0.287	3.360	15.14	0.0634	766.64	0.0191	0.3635	0.0011	4.8605	21.4969	80.824	56.18	13.65	1.066%	13.792	13.501	6.44	6.60	5.91	5%	20.73	21.84	19.62
1800	180	2.954	0.00129	0.287	3.354	14.92	0.0624	753.76	0.0181	0.3446	0.0011	4.6070	21.4502	80.649	59.14	12.74	1.059%	12.880	12.610	6.22	6.42	5.59	7%	20.02	21.36	18.69
1800	160	2.866	0.00124	0.287	3.360	14.69	0.0615	743.55	0.0162	0.3078	0.0009	4.1159	21.0615	79.187	65.00	11.44	1.049%	11.559	11.319	6.00	6.15	5.38	6%	19.30	20.54	18.06
1800	140	2.999	0.00133	0.287	3.351	14.08	0.0589	710.77	0.0159	0.3029	0.0009	4.0498	21.3876	80.413	67.08	10.60	1.045%	10.706	10.485	5.76	6.08	5.29	7%	18.53	19.79	17.27
1800	120	3.014	0.00129	0.287	3.350	13.75	0.0575	693.90	0.0147	0.2789	0.0009	3.7294	21.3622	80.317	72.76	9.54	1.036%	9.636	9.438	5.47	5.71	4.98	7%	17.60	18.78	16.41
1800	100	2.954	0.00127	0.287	3.354	13.47	0.0564	680.90	0.0128	0.2435	0.0007	3.2555	20.9962	78.941	81.92	8.31	1.026%	8.397	8.226	5.26	5.47	4.58	8%	16.93	18.36	15.50
1800	80	2.954	0.00127	0.287	3.354	13.19	0.0552	666.32	0.0124	0.2354	0.0007	3.1476	21.2950	80.065	85.94	7.75	1.022%	7.833	7.674	5.01	5.44	4.36	11%	16.12	17.86	14.37
1800	60	2.954	0.00127	0.287	3.354	12.99	0.0544	656.30	0.0115	0.2180	0.0007	2.9151	21.2689	79.967	92.68	7.08	1.016%	7.153	7.010	4.80	5.19	3.94	13%	15.46	17.47	13.45
1800	40	2.984	0.00130	0.287	3.352	12.78	0.0535	645.70	0.0098	0.1854	0.0006	2.4785	21.0076	78.984	107.67	6.00	1.007%	6.058	5.937	4.50	4.87	3.91	11%	14.48	16.03	12.93
1800	20	3.014	0.00132	0.287	3.350	12.59	0.0527	635.44	0.0089	0.1700	0.0005	2.2728	21.1704	79.596	118.32	5.37	1.002%	5.424	5.317	4.12	4.31	3.21	13%	13.26	15.03	11.49
1600	200	3.044	0.00139	0.287	3.348	12.59	0.0527	635.40	0.0191	0.3628	0.0011	4.8515	21.5075	80.864	56.31	11.28	1.064%	11.404	11.164	5.31	5.77	5.02	7%	17.09	18.30	15.89
1600	180	3.002	0.00132	0.287	3.351	12.41	0.0519	626.53	0.0181	0.3443	0.0011	4.6033	21.2647	79.951	58.68	10.68	1.059%	10.790	10.564	5.24	5.71	4.80	9%	16.88	18.34	15.41
1600	160	2.990	0.00131	0.287	3.352	12.24	0.0512	618.29	0.0171	0.3246	0.0010	4.3405	21.4147	80.515	62.67	9.87	1.051%	9.969	9.762	4.97	5.34	4.63	7%	16.00	17.14	14.86
1600	140	2.978	0.00130	0.287	3.352	11.98	0.0502	605.33	0.0156	0.2965	0.0009	3.9646	21.0168	79.019	67.34	8.99	1.043%	9.083	8.896	4.73	5.05	4.43	7%	15.21	16.21	14.21
1600	120	2.966	0.00128	0.287	3.353	11.76	0.0492	594.01	0.0142	0.2704	0.0008	3.6154	21.3458	80.256	75.00	7.92	1.032%	8.002	7.839	4.68	4.93	4.42	6%	15.06	15.89	14.23
1600	100	2.954	0.00127	0.287	3.354	11.58	0.0485	585.17	0.0131	0.2488	0.0008	3.3267	21.3144	80.138	81.38	7.19	1.025%	7.264	7.116	4.53	4.90	4.18	8%	14.57	15.74	13.41
1600	80	2.954	0.00127	0.287	3.354	11.40	0.0477	576.28	0.0120	0.2277	0.0007	3.0447	21.2803	80.009	88.78	6.49	1.018%	6.557	6.425	4.43	4.70	4.19	6%	14.27	15.09	13.45
1600	60	2.954	0.00127	0.287	3.354	11.25	0.0471	568.54	0.0110	0.2081	0.0006	2.7825	21.2590	79.929	97.05	5.86	1.012%	5.918	5.799	4.22	4.48	4.01	6%	13.59	14.34	12.84
1600	40	2.954	0.00127	0.287	3.354	11.06	0.0463	558.93	0.0091	0.1735	0.0005	2.3193	20.9976	78.947	115.00	4.86	1.003%	4.909	4.811	3.79	4.21	3.29	12%	12.21	13.69	10.73
1600	20	2.954	0.00127	0.287	3.354	10.92	0.0457	552.02	0.0082	0.1555	0.0005	2.0792	21.1536	79.533	129.24	4.27	1.030%	4.315	4.227	3.40	3.95	2.66	19%	10.95	13.03	8.87
1400	200	2.954	0.00125	0.287	3.354	10.46	0.0438	528.47	0.0185	0.3513	0.0011	4.6970	21.4706	80.725	58.06	9.10	1.059%	9.198	9.005	4.73	5.22	4.06	12%	15.21	17.08	13.34
1400	180	2.954	0.00125	0.287	3.354	10.31	0.0432	521.16	0.0175	0.3321	0.0010	4.4407	21.4287	80.568	61.30	8.50	1.052%	8.592	8.413	4.54	4.95	4.09	9%	14.61	16.00	13.23
1400	160	2.954	0.00126	0.287	3.354	10.19	0.0427	514.99	0.0162	0.3080	0.0009	4.1186	21.4033	80.472	66.01	7.80	1.041%	7.883	7.720	4.49	4.93	4.06	10%	14.45	15.86	13.04
1400	140	2.954	0.00126	0.287	3.354	10.09	0.0422	509.77	0.0150	0.2855	0.0009	3.8169	21.3624	80.318	71.09	7.17	1.036%	7.245	7.096	4.45	5.11	3.95	13%	14.31	16.18	12.44
1400	120	2.895	0.00126	0.287	3.358	9.96	0.0417	503.97	0.0137	0.2596	0.0008	3.4715	21.3310	80.200	78.05	6.46	1.028%	6.523	6.390	4.28	5.23	3.54	20%	13.79	16.51	11.07
1400	100	2.895	0.00126	0.287	3.358	9.85	0.0412	498.26	0.0124	0.2365	0.0007	3.1629	21.2496	79.894	85.34	5.84	1.020%	5.898	5.779	4.14	5.01	3.50	18%	13.32	15.75	10.89
1400	80	2.895	0.00127	0.287	3.358	9.70	0.0406	490.86	0.0114	0.2170	0.0007	2.9010	21.2721	79.979	93.14	5.27	1.014%	5.323	5.217	4.04	4.80	3.44	17%	13.00	15.20	10.81
1400	60	2.895	0.00127	0.287	3.358	9.60	0.0402	485.81	0.0102	0.1943	0.0006	2.5979	21.2270	79.809	103.79	4.68	1.007%	4.728	4.634	3.83	4.36	3.45	12%	12.34	13.80	10.88
1400	40	2.895	0.00128	0.287	3.358	9.53	0.0399	482.12	0.0090	0.1707	0.0005	2.2826	21.2090	79.741	118.03	4.08	1.001%	4.126	4.044	3.35	3.92	3.15	11%	10.79	12.03	9.56
1400	20	2.895	0.00128	0.287	3.358	9.46	0.0396	478.41	0.0076	0.1437	0.0004	1.9211	18.4879	69.510	122.24	3.91	0.997%	3.953	3.875	3.20	3.80	2.70	17%	10.29	12.06	8.52

ANEXO 3 – INCERTIDUMBRES EN EL ANÁLISIS DEL BALANCE DE CARBONO EN EL MOTOR CUMMINS

Temperatura ambiente	Psat	$\frac{\delta P_{sat}}{\delta T_{amb}}$	μ Psat	Humedad absoluta	Humedad relativa	$\frac{\delta w}{\delta \phi}$	$\frac{\delta w}{\delta P_{sat}}$	μ w	Rair	$\frac{\delta R_{air}}{\delta w}$	μ Rair	ρ_{air}	Temperatura ambiente
°C	kPa		%	kg/kg	%			%	kJ/kgK		%	kg/m3	°C
24.00	2.954048	0.177620881	3.006%	0.00134129	72.67	0.0000185	0.00045503	3.091%	0.287234	0.174053	0.0025%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00131046	71.00	0.0000185	0.00044455	3.094%	0.287228	0.174063	0.0025%	3.353985	24.00
24.50	3.044033	0.182334123	2.995%	0.00133314	70.00	0.0000191	0.00043832	3.086%	0.287233	0.174056	0.0025%	3.348356	24.50
24.25	2.998746	0.179964515	3.001%	0.00133972	71.50	0.0000188	0.00044772	3.088%	0.287233	0.174053	0.0025%	3.351168	24.25
24.50	3.044033	0.182334123	2.995%	0.00133314	70.00	0.0000191	0.00043832	3.086%	0.287232	0.174056	0.0025%	3.348356	24.50
24.50	3.044033	0.182334123	2.995%	0.00142672	75.00	0.0000191	0.00046977	3.075%	0.287249	0.174023	0.0027%	3.348356	24.50
24.00	2.954048	0.177620881	3.006%	0.00134745	73.00	0.0000185	0.00045713	3.090%	0.287235	0.174051	0.0025%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00133821	72.50	0.0000185	0.00045398	3.091%	0.287233	0.174054	0.0025%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00134745	73.00	0.0000185	0.00045713	3.090%	0.287235	0.174051	0.0025%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00131971	71.50	0.0000185	0.00044769	3.093%	0.28723	0.17406	0.0025%	3.353985	24.00
23.50	2.866394	0.173010642	3.018%	0.00123561	69.00	0.0000179	0.00043192	3.110%	0.287215	0.17409	0.0023%	3.359633	23.50
24.00	2.954048	0.177620881	3.006%	0.00129196	70.00	0.0000185	0.00043826	3.097%	0.287225	0.17407	0.0024%	3.353985	24.00
23.50	2.866394	0.173010642	3.018%	0.00124458	69.50	0.0000179	0.00043507	3.109%	0.287217	0.174086	0.0023%	3.359633	23.50
24.25	2.998746	0.179964515	3.001%	0.00132564	70.75	0.0000188	0.00044301	3.089%	0.287231	0.174058	0.0025%	3.351168	24.25
24.33	3.013776	0.180751487	2.999%	0.00129298	68.67	0.0000189	0.00042992	3.092%	0.287225	0.17407	0.0024%	3.35023	24.33
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.17	2.983781	0.179180429	3.003%	0.00129877	69.67	0.0000187	0.00043619	3.094%	0.287226	0.174068	0.0024%	3.352107	24.17
24.33	3.013776	0.180751487	2.999%	0.00132443	70.33	0.0000189	0.00044404	3.088%	0.287231	0.174059	0.0025%	3.35023	24.33
24.50	3.044033	0.182334123	2.995%	0.00138859	73.00	0.0000191	0.00045719	3.079%	0.287242	0.174036	0.0026%	3.348356	24.50
24.27	3.001746	0.180121678	3.000%	0.00131913	70.33	0.0000188	0.00044039	3.090%	0.28723	0.17406	0.0025%	3.350981	24.27
24.20	2.989759	0.179493717	3.002%	0.00130762	70.00	0.0000187	0.00043828	3.092%	0.287228	0.174064	0.0025%	3.351731	24.20
24.13	2.977814	0.17886676	3.003%	0.00129617	69.67	0.0000186	0.00043618	3.094%	0.287226	0.174068	0.0024%	3.352482	24.13
24.07	2.96591	0.178243323	3.005%	0.00128478	69.33	0.0000186	0.00043408	3.097%	0.287224	0.174072	0.0024%	3.353233	24.07
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00127347	69.00	0.0000185	0.00043198	3.099%	0.287222	0.174076	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00125498	68.00	0.0000185	0.00042569	3.101%	0.287219	0.174083	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00125498	68.00	0.0000185	0.00042569	3.101%	0.287219	0.174083	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00126422	68.50	0.0000185	0.00042883	3.100%	0.28722	0.17408	0.0024%	3.353985	24.00
24.00	2.954048	0.177620881	3.006%	0.00126422	68.50	0.0000185	0.00042883	3.100%	0.28722	0.17408	0.0024%	3.353985	24.00
23.67	2.895357	0.174536054	3.014%	0.0012602	69.67	0.0000181	0.00043613	3.105%	0.28722	0.174081	0.0024%	3.357748	23.67
23.67	2.895357	0.174536054	3.014%	0.0012602	69.67	0.0000181	0.00043613	3.105%	0.28722	0.174081	0.0024%	3.357748	23.67
23.67	2.895357	0.174536054	3.014%	0.00126624	70.00	0.0000181	0.00043823	3.104%	0.287221	0.174079	0.0024%	3.357748	23.67
23.67	2.895357	0.174536054	3.014%	0.00126624	70.00	0.0000181	0.00043823	3.104%	0.287221	0.174079	0.0024%	3.357748	23.67
23.67	2.895357	0.174536054	3.014%	0.00127833	70.67	0.0000181	0.00044242	3.102%	0.287223	0.174075	0.0024%	3.357748	23.67
23.67	2.895357	0.174536054	3.014%	0.00127833	70.67	0.0000181	0.00044242	3.102%	0.287223	0.174075	0.0024%	3.357748	23.67

$\frac{\delta \rho_{air}}{\delta R_{air}}$	$\frac{\delta \rho_{air}}{\delta T_{amb}}$	μ_{Air}	ΔP	VelAir	$\frac{\delta VelAir}{\delta \Delta P}$	$\frac{\delta VelAir}{\delta \rho}$	μ_{VelAir}	FlujoVol	$\frac{\delta FlujoVol}{\delta VelAir}$	$\mu_{FlujoVol}$	FlujoMas	$\frac{\delta FlujoMas}{\delta \rho_{air}}$	$\frac{\delta FlujoMas}{\delta FlujoVol}$
		%	Pa	m/s			%	m3/s		%	kg/hr		
-0.011276278	-0.011276278	0.1681%	1570.00	18.3584293	0.005846634	-2.736808551	0.0855%	0.076837128	0.004185387	0.0855%	417.828937	276.6136601	5437.852102
-0.011276278	-0.011276278	0.1681%	1521.00	18.0696732	0.005940064	-2.693761783	0.0856%	0.075628572	0.004185387	0.0856%	413.762986	272.2628587	5470.987696
-0.011238462	-0.011238462	0.1678%	1457.50	17.7033192	0.00607318	-2.643583555	0.0856%	0.074095239	0.004185387	0.0856%	973.176454	266.7428588	13134.12944
-0.011257346	-0.011257346	0.1680%	1382.10	17.2321015	0.006234018	-2.571058858	0.0859%	0.072123011	0.004185387	0.0859%	410.72693	259.6428379	5694.811231
-0.011238462	-0.011238462	0.1678%	1320.32	16.8495966	0.006380891	-2.516099729	0.0860%	0.07052208	0.004185387	0.0860%	411.395157	253.8794863	5833.565309
-0.011238461	-0.011238461	0.1678%	1236.82	16.3081211	0.006592755	-2.435242949	0.0863%	0.068255795	0.004185387	0.0863%	896.480392	245.720862	13134.12865
-0.011276278	-0.011276278	0.1681%	1175.80	15.8874175	0.006755976	-2.368439018	0.0867%	0.066494988	0.004185387	0.0867%	873.353767	239.3819557	13134.12931
-0.011276278	-0.011276278	0.1681%	1124.66	15.5380379	0.006907887	-2.316354757	0.0869%	0.065032699	0.004185387	0.0869%	423.540196	234.1177166	6512.726714
-0.011276278	-0.011276278	0.1681%	1061.37	15.0945395	0.00711085	-2.250239621	0.0873%	0.063176487	0.004185387	0.0873%	829.768144	227.4353517	13134.12931
-0.011276278	-0.011276278	0.1681%	1022.60	14.816255	0.007244409	-2.208753936	0.0875%	0.062011758	0.004185387	0.0875%	440.186125	223.2423302	7098.429977
-0.011314287	-0.011314287	0.1684%	1070.25	15.1447798	0.007075347	-2.253933805	0.0874%	0.063386761	0.004185387	0.0874%	362.239336	228.1923413	5714.747491
-0.011276279	-0.011276279	0.1681%	1036.33	14.9154178	0.007196245	-2.223536725	0.0874%	0.062426793	0.004185387	0.0874%	359.038631	224.7364542	5751.354748
-0.011314287	-0.011314287	0.1684%	1006.75	14.6886257	0.007295071	-2.186046328	0.0878%	0.06147758	0.004185387	0.0878%	357.269724	221.319289	5811.382342
-0.011257346	-0.011257346	0.1680%	922.25	14.076428	0.007631568	-2.100226981	0.0882%	0.058915296	0.004185387	0.0882%	350.634709	212.095066	5951.505501
-0.011251047	-0.011251047	0.1679%	879.25	13.7462771	0.007817047	-2.051542007	0.0886%	0.057533487	0.004185387	0.0886%	354.371286	207.1205529	6159.391769
-0.011276279	-0.011276279	0.1681%	845.67	13.473651	0.007966289	-2.008603302	0.0891%	0.056392441	0.004185387	0.0891%	357.900857	203.0127876	6346.610486
-0.011276279	-0.011276279	0.1681%	809.83	13.1851025	0.008140627	-1.96558754	0.0895%	0.055184754	0.004185387	0.0895%	363.401208	198.6651149	6585.173998
-0.011276279	-0.011276279	0.1681%	785.67	12.9868807	0.00826488	-1.936037344	0.0899%	0.054355119	0.004185387	0.0899%	368.919049	195.6784287	6787.199711
-0.011263652	-0.011263652	0.1680%	760.92	12.7842684	0.008400571	-1.906900586	0.0902%	0.053507108	0.004185387	0.0902%	378.569376	192.6255904	7075.123042
-0.011251046	-0.011251046	0.1679%	737.33	12.5881191	0.008536247	-1.878694532	0.0905%	0.052686148	0.004185387	0.0905%	394.276697	189.6701319	7483.498298
-0.011238461	-0.011238461	0.1678%	737.65	12.5943098	0.008536827	-1.88067057	0.0905%	0.052712058	0.004185387	0.0905%	310.271139	189.7634091	5886.151103
-0.011256086	-0.011256086	0.1680%	716.64	12.408854	0.008657628	-1.85152576	0.0909%	0.051935854	0.004185387	0.0909%	306.070161	186.9690745	5893.234389
-0.011261129	-0.011261129	0.1680%	697.75	12.2428231	0.008773073	-1.826343196	0.0913%	0.051240951	0.004185387	0.0913%	306.348439	184.467422	5978.586176
-0.011266176	-0.011266176	0.1680%	668.67	11.9836149	0.008960829	-1.787274959	0.0920%	0.050156064	0.004185387	0.0920%	309.461592	180.5618301	6169.973628
-0.011271226	-0.011271226	0.1681%	643.75	11.756904	0.009131576	-1.753069715	0.0926%	0.049207191	0.004185387	0.0926%	313.740414	177.1458882	6375.905777
-0.011276279	-0.011276279	0.1681%	624.58	11.579262	0.009269589	-1.726194632	0.0931%	0.048463691	0.004185387	0.0931%	320.120131	174.4692861	6605.360151
-0.011276279	-0.011276279	0.1681%	605.75	11.4033485	0.009412586	-1.699970079	0.0936%	0.047727424	0.004185387	0.0936%	326.56883	171.8187281	6842.372779
-0.011276279	-0.011276279	0.1681%	589.58	11.2501493	0.009540763	-1.67713169	0.0941%	0.047086226	0.004185387	0.0941%	332.900379	169.5104152	7070.016092
-0.011276279	-0.011276279	0.1681%	569.83	11.0601142	0.009704692	-1.648801946	0.0948%	0.046290856	0.004185387	0.0948%	345.601383	166.647082	7465.867164
-0.011276279	-0.011276279	0.1681%	555.83	10.9234036	0.00982615	-1.628421621	0.0953%	0.045718669	0.004185387	0.0953%	207.487018	164.5872096	4538.343326
-0.011276279	-0.011276279	0.1681%	509.42	10.4573648	0.010264058	-1.558946222	0.0973%	0.043768117	0.004185387	0.0973%	269.646642	157.5652203	6160.800657
-0.011276279	-0.011276279	0.1681%	495.42	10.3126669	0.010408074	-1.537375181	0.0980%	0.0431625	0.004185387	0.0980%	266.922923	155.3850002	6184.139546
-0.011276279	-0.011276279	0.1681%	483.75	10.190516	0.010532833	-1.519165369	0.0987%	0.042651251	0.004185387	0.0987%	281.86512	153.5445042	6608.601446
-0.011276279	-0.011276279	0.1681%	474.00	10.0872981	0.01064061	-1.503778023	0.0992%	0.042219244	0.004185387	0.0992%	274.564083	151.9892802	6503.292186
-0.011301596	-0.011301596	0.1683%	462.75	9.96128597	0.01076314	-1.483328375	0.1000%	0.041691835	0.004185387	0.1000%	279.745845	150.0906058	6709.847275
-0.011301596	-0.011301596	0.1683%	452.33	9.84853178	0.010886365	-1.466538225	0.1007%	0.041219915	0.004185387	0.1007%	286.758778	148.3916942	6956.801763
-0.011301596	-0.011301596	0.1683%	439.00	9.70229455	0.011050449	-1.444762143	0.1016%	0.040607856	0.004185387	0.1016%	292.413364	146.1882804	7200.906311
-0.011301596	-0.011301596	0.1683%	430.00	9.60232548	0.011165495	-1.429875817	0.1023%	0.040189446	0.004185387	0.1023%	300.862147	144.6820072	7486.098316
-0.011301596	-0.011301596	0.1683%	423.50	9.52947344	0.011250854	-1.419027478	0.1028%	0.039884532	0.004185387	0.1028%	312.361342	143.5843169	7831.641068
-0.011301596	-0.011301596	0.1683%	417.00	9.45606011	0.011338202	-1.408095548	0.1033%	0.039577269	0.004185387	0.1033%	323.450574	142.4781694	8172.634938

μ FlujoMas	D	H	I	J	A	B	C	$\frac{\delta B}{\delta D}$	$\frac{\delta B}{\delta I}$	$\frac{\delta A}{\delta D}$	$\frac{\delta A}{\delta I}$	$\frac{\delta C}{\delta D}$	$\frac{\delta C}{\delta H}$
%	%-CO2	%-O2	%-CO	%-NO	(D+I)/291.7	(D+I)/15.4	(D+H+I/2+J/2+(D+I)/2.31						
0.305%	4.64	14.78	0.02967	0.0135	0.01601877	0.3043566	21.46127107	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.304%	5.60	13.48	0.04285	0.0159	0.01934336	0.3675238	21.54823547	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.086%	5.23	13.90	0.0367	0.0143	0.01805394	0.3430248	21.43178706	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.296%	5.01	14.21	0.0364	0.014	0.01729876	0.3286765	21.42627259	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.291%	4.67	14.67	0.03515	0.0132	0.01612898	0.3064506	21.39275809	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.086%	4.27	15.21	0.0316	0.012	0.01474563	0.280167	21.3609673	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.087%	3.88	15.74	0.0304	0.0113	0.01340462	0.2546878	21.33093922	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.267%	3.51	16.21	0.02845	0.01025	0.01211246	0.2301367	21.25652005	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.087%	3.28	16.53	0.0285	0.0095	0.01134134	0.2154855	21.25894584	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.246%	2.90	17.06	0.0266	0.0089	0.01003221	0.190612	21.23763726	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.296%	5.55	13.51	0.0313	0.0179	0.01913237	0.363515	21.49685833	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.294%	5.26	13.88	0.0302	0.0174	0.01813449	0.3445554	21.45024385	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.292%	4.70	14.30	0.03125	0.01635	0.01620131	0.3078248	21.06150259	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.287%	4.62	14.74	0.03035	0.015	0.01594113	0.3028814	21.38757333	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.280%	4.25	15.24	0.02903	0.01363	0.0146797	0.2789143	21.36218792	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.273%	3.71	15.65	0.0282	0.0129	0.01281433	0.2434723	20.99621375	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.265%	3.59	16.13	0.0277	0.01133	0.01238984	0.2354069	21.29499253	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.258%	3.32	16.48	0.02737	0.0103	0.01147458	0.2180169	21.26891082	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.248%	2.82	16.94	0.026	0.00903	0.00975592	0.1853625	21.00756831	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.233%	2.59	17.44	0.02313	0.00847	0.00894624	0.1699786	21.1704318	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.290%	5.54	13.54	0.03095	0.01845	0.01909689	0.3628409	21.50748503	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.290%	5.26	13.70	0.02923	0.01773	0.01811975	0.3442753	21.26473537	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.287%	4.95	14.28	0.0308	0.017	0.01708532	0.324621	21.41472738	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.281%	4.52	14.50	0.02917	0.0158	0.0156057	0.2965083	21.0167572	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.273%	4.12	15.41	0.02823	0.01467	0.01423133	0.2703952	21.34577234	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.265%	3.79	15.85	0.0267	0.0133	0.01309485	0.2488021	21.31436575	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.257%	3.47	16.28	0.0262	0.01217	0.01198477	0.2277106	21.2802538	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.249%	3.17	16.69	0.02517	0.0109	0.01095284	0.208104	21.25899609	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.236%	2.64	17.19	0.02317	0.00997	0.00912918	0.1734544	20.99759707	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.341%	2.37	17.74	0.0208	0.0093	0.0081841	0.1554978	21.15358852	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.283%	5.37	13.75	0.02845	0.0206	0.01848843	0.3512801	21.47059387	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.282%	5.07	14.13	0.02915	0.0206	0.01747959	0.3321121	21.42874633	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.267%	4.70	14.64	0.02935	0.0192	0.01621193	0.3080267	21.40331742	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.271%	4.36	15.09	0.0279	0.01825	0.01502432	0.2854621	21.36238046	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.264%	3.96	15.63	0.02627	0.01657	0.01366469	0.2596291	21.33096241	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.256%	3.61	16.05	0.0252	0.01463	0.01244982	0.2365467	21.24962276	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.248%	3.31	16.51	0.02453	0.0134	0.01141916	0.216964	21.27205686	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.238%	2.96	16.96	0.02317	0.01217	0.01022612	0.1942963	21.22700224	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.227%	2.60	17.46	0.02107	0.0112	0.00898486	0.1707124	21.20896796	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.215%	2.19	15.33	0.0193	0.00957	0.00756192	0.1436766	18.48786022	0.06513	0.06513	0.00343	0.00343	1.4322	1

$\frac{\delta C}{\delta I}$	$\frac{\delta C}{\delta J}$	μA	μB	μC	$\frac{air}{comb} = \frac{C}{A+B}$	$\frac{\delta C}{\delta A+B}$	$\frac{\delta C}{\delta A}$	$\frac{\delta C}{\delta B}$	$\frac{\delta C}{\delta C}$	$\mu air/comb$	Consumo	$\frac{\delta consumo}{\delta flujoMas}$	$\frac{\delta consumo}{\delta air/comb}$	$\mu consumo$
		%	%	%	kg/kg					%	kg/hr			%
0.9322	0.5	0.9942%	0.9942%	0.3392%	66.98789254	-209.0918907	-209.0918907	3.121338541	1.0047%	6.2373799	0.014928071	-0.093112049	1.0501%	
0.9322	0.5	0.9931%	0.9931%	0.3928%	55.69931609	-143.9753068	-143.9753068	2.58486669	1.0232%	7.4285111	0.017953542	-0.133368084	1.0674%	
0.9322	0.5	0.9936%	0.9936%	0.3729%	59.35488399	-164.3821042	-164.3821042	2.769478991	1.0162%	16.395895	0.016847813	-0.276234979	1.0198%	
0.9322	0.5	0.9934%	0.9934%	0.3603%	61.93007558	-179.0014686	-179.0014686	2.890380271	1.0114%	6.6321077	0.016147243	-0.107090257	1.0538%	
0.9322	0.5	0.9932%	0.9932%	0.3415%	66.31777741	-205.5858147	-205.5858147	3.100010627	1.0047%	6.2033918	0.015078913	-0.093540406	1.0460%	
0.9322	0.5	0.9933%	0.9933%	0.3198%	72.4315114	-245.6032899	-245.6032899	3.390834806	0.9976%	12.376939	0.013806146	-0.170877822	1.0014%	
0.9322	0.5	0.9930%	0.9930%	0.2995%	79.56561975	-296.7842991	-296.7842991	3.730057027	0.9910%	10.976522	0.012568242	-0.137955588	0.9948%	
0.9322	0.5	0.9928%	0.9928%	0.2812%	87.74651412	-362.2159564	-362.2159564	4.127981152	0.9854%	4.8268607	0.011396464	-0.055009144	1.0208%	
0.9322	0.5	0.9923%	0.9923%	0.2703%	93.72322891	-413.1928133	-413.1928133	4.408648935	0.9819%	8.8533884	0.010669713	-0.094463117	0.9858%	
0.9322	0.5	0.9920%	0.9920%	0.2531%	105.8472274	-527.5368161	-527.5368161	4.983945534	0.9770%	4.158693	0.009447579	-0.0839289579	1.0075%	
0.9322	0.5	0.9948%	0.9948%	0.3906%	56.17929481	-146.8174147	-146.8174147	2.613372333	1.0238%	6.4479153	0.017800152	-0.114773874	1.0656%	
0.9322	0.5	0.9947%	0.9947%	0.3744%	59.14210776	-163.0652283	-163.0652283	2.757176477	1.0176%	6.0707784	0.016908427	-0.102647313	1.0593%	
0.9322	0.5	0.9939%	0.9939%	0.3470%	64.99939543	-200.5992397	-200.5992397	3.086170854	1.0072%	5.4965084	0.015384758	-0.084562455	1.0488%	
0.9322	0.5	0.9940%	0.9940%	0.3387%	67.08300781	-210.4086269	-210.4086269	3.136541336	1.0045%	5.2268782	0.014906905	-0.077916574	1.0447%	
0.9322	0.5	0.9938%	0.9938%	0.3189%	72.76097953	-247.828554	-247.828554	3.406064014	0.9978%	4.8703479	0.01374363	-0.066936261	1.0363%	
0.9322	0.5	0.9932%	0.9932%	0.2938%	81.92474687	-319.6606887	-319.6606887	3.901881922	0.9894%	4.3686538	0.012206324	-0.053325204	1.0265%	
0.9322	0.5	0.9931%	0.9931%	0.2849%	85.93734647	-346.805828	-346.805828	4.035565936	0.9868%	4.2286762	0.011636384	-0.049206501	1.0217%	
0.9322	0.5	0.9927%	0.9927%	0.2721%	92.67841952	-403.8424684	-403.8424684	4.357459595	0.9828%	3.980636	0.010789998	-0.042951056	1.0160%	
0.9322	0.5	0.9919%	0.9919%	0.2510%	107.6657437	-551.7969613	-551.7969613	5.125093113	0.9764%	3.5161544	0.009288005	-0.032658061	1.0074%	
0.9322	0.5	0.9921%	0.9921%	0.2404%	118.3202681	-661.2848517	-661.2848517	5.588939765	0.9740%	3.3322837	0.008451637	-0.028163253	1.0015%	
0.9322	0.5	0.9948%	0.9948%	0.3899%	56.31149071	-147.4362987	-147.4362987	2.618227591	1.0236%	5.5099081	0.017758365	-0.097846959	1.0639%	
0.9322	0.5	0.9949%	0.9949%	0.3768%	58.67832329	-161.9181036	-161.9181036	2.759419399	1.0187%	5.2160686	0.017042068	-0.088892598	1.0592%	
0.9322	0.5	0.9943%	0.9943%	0.3572%	62.66997968	-183.4030518	-183.4030518	2.926489727	1.0111%	4.8882805	0.015956603	-0.078000352	1.0511%	
0.9322	0.5	0.9941%	0.9941%	0.3378%	67.33678984	-215.7441904	-215.7441904	3.203957166	1.0042%	4.5957283	0.014850723	-0.068249887	1.0427%	
0.9322	0.5	0.9938%	0.9938%	0.3121%	74.99572585	-263.4881889	-263.4881889	3.513376075	0.9956%	4.1834439	0.013334093	-0.055782431	1.0325%	
0.9322	0.5	0.9936%	0.9936%	0.2952%	81.38454078	-310.7502027	-310.7502027	3.818295216	0.9903%	3.9334268	0.012287346	-0.048331375	1.0252%	
0.9322	0.5	0.9932%	0.9932%	0.2793%	88.78041906	-370.3885716	-370.3885716	4.171962416	0.9853%	3.678388	0.011263745	-0.041432425	1.0183%	
0.9322	0.5	0.9929%	0.9929%	0.2651%	97.04784387	-443.0258118	-443.0258118	4.565024777	0.9811%	3.4302707	0.010304196	-0.035346182	1.0123%	
0.9322	0.5	0.9923%	0.9923%	0.2434%	115.0026657	-629.8631729	-629.8631729	5.476944114	0.9748%	3.0051598	0.008695451	-0.026131218	1.0029%	
0.9322	0.5	0.9922%	0.9922%	0.2320%	129.2359654	-789.5556221	-789.5556221	6.109410952	0.9720%	1.6054898	0.007737784	-0.012422933	1.0301%	
0.9322	0.5	0.9951%	0.9951%	0.3802%	58.06494995	-157.030515	-157.030515	2.704394219	1.0201%	4.6438797	0.017222094	-0.079977331	1.0586%	
0.9322	0.5	0.9947%	0.9947%	0.3637%	61.29649363	-175.3373749	-175.3373749	2.860479688	1.0137%	4.3546198	0.016314147	-0.071041907	1.0523%	
0.9322	0.5	0.9943%	0.9943%	0.3430%	66.01099705	-203.5876797	-203.5876797	3.084147927	1.0061%	4.2699722	0.015148991	-0.06468577	1.0410%	
0.9322	0.5	0.9941%	0.9941%	0.3244%	71.09265596	-236.5918789	-236.5918789	3.327936982	0.9998%	3.8620597	0.014066151	-0.054324313	1.0360%	
0.9322	0.5	0.9940%	0.9940%	0.3036%	78.05141093	-285.5953065	-285.5953065	3.659066545	0.9931%	3.5841228	0.012812068	-0.045920026	1.0277%	
0.9322	0.5	0.9937%	0.9937%	0.2863%	85.34105043	-342.7399616	-342.7399616	4.016120728	0.9877%	3.3601506	0.01171769	-0.039373204	1.0203%	
0.9322	0.5	0.9933%	0.9933%	0.2714%	93.14197299	-407.8320771	-407.8320771	4.378606808	0.9832%	3.1394371	0.010736298	-0.033705933	1.0139%	
0.9322	0.5	0.9930%	0.9930%	0.2558%	103.7881579	-507.4659908	-507.4659908	4.889440192	0.9787%	2.89881	0.009635011	-0.027930065	1.0072%	
0.9322	0.5	0.9928%	0.9928%	0.2407%	118.0261184	-656.8053975	-656.8053975	5.564915683	0.9746%	2.6465442	0.008472701	-0.022423378	1.0006%	
0.9322	0.5	0.9922%	0.9922%	0.2371%	122.2431012	-808.2804399	-808.2804399	6.612074072	0.9732%	2.6459618	0.008180421	-0.021645081	0.9968%	

ANEXO 4 – PLANILLA DE DATOS DEL MOTOR CATERPILLAR

PLANILLA DE DATOS MOTOR CATERPILLAR																									
RPM	Torque	Consumo Gravimétrico						Coriolis				Contenedor de aire						Emisiones						Temperatura ambiente	Humedad relativa
		Media	uΔP	uΔT	Incer.	Valor max	Valor min	Media	Incer.	Valor max	Valor min	Dif de presion	Dif de presion	Media	Incer.	Valor max	Valor min	Tf	Ta	O ₂	CO ₂	CO	NO		
rpm	Nm	kg/h	%	%	±%	kg/h	kg/h	kg/h	±%	kg/h	kg/h	P ₁	P ₂	Pa	±%	Pa	Pa	°C	°C	%	%	ppm	ppm		
2200	200	15.51	1.44%	1.24%	1.90%	15.81	15.22	14.88	0.10%	14.89	14.86	1344	1344	1344.00	0.03%	1344.35	1343.65	378.4	27.2	13.32	5.68	81	131	37.00	35.00
2200	180	14.31	1.24%	0.99%	1.58%	14.54	14.09	14.14	0.10%	14.15	14.12	1277	1264	1270.50	0.03%	1270.85	1270.15	381.2	37.5	12.27	6.46	329	163	39.00	34.00
2200	160	13.09	1.08%	0.78%	1.33%	13.26	12.92	13.02	0.10%	13.03	13.01	1162	1161	1161.25	0.03%	1161.60	1160.90	368.7	37.6	12.59	6.22	416	173	40.00	33.00
2200	140	12.26	1.54%	1.05%	1.86%	12.49	12.04	12.12	0.10%	12.13	12.11	1048	1052	1050.00	0.03%	1050.35	1049.65	340	34.15	13.105	5.84	353	172	36.50	38.50
2200	120	11.16	1.48%	0.92%	1.75%	11.36	10.97	11.36	0.10%	11.37	11.35	989	975	981.75	0.04%	982.10	981.40	320.6	34.65	13.555	5.495	298.5	178	36.00	38.50
2200	100	10.15	1.97%	1.10%	2.26%	10.38	9.92	10.30	0.10%	10.31	10.29	920	916	917.50	0.04%	917.85	917.15	301.45	34.05	14.035	5.145	261	180	36.00	37.50
2200	80	9.16	1.76%	0.90%	1.98%	9.34	8.98	9.21	0.10%	9.22	9.20	874	869	871.25	0.04%	871.60	870.90	284.1	34.9	14.5	4.795	243	172.5	37.00	36.00
2200	60	8.11	2.00%	0.90%	2.20%	8.29	7.93	8.05	0.10%	8.06	8.04	837	828	832.25	0.04%	832.60	831.90	267.4	36.45	14.905	4.495	237	161	38.00	34.50
2200	40	7.42	2.10%	0.86%	2.27%	7.59	7.25	7.12	0.10%	7.12	7.11	818	810	813.75	0.04%	814.10	813.40	247.05	36.55	15.445	4.09	233	147.5	39.00	34.50
2200	20	6.78	2.22%	0.83%	2.37%	6.94	6.61	6.31	0.10%	6.32	6.31	793	791	791.75	0.04%	792.10	791.40	225.2	35.5	16.04	3.65	231.5	133.5	38.50	34.50
1200	240	7.26	2.37%	0.96%	2.55%	7.45	7.08	7.29	0.10%	7.29	7.28	227	229	228.00	0.16%	228.35	227.65	324.9	35.8	10.815	7.545	216	381	37.50	36.50
1200	220	6.43	2.68%	0.96%	2.84%	6.61	6.25	6.58	0.10%	6.59	6.57	226	225	225.25	0.16%	225.60	224.90	323.3	36.2	11.385	7.12	225.5	391	37.50	36.00
1200	200	6.16	2.78%	0.95%	2.94%	6.34	5.98	6.16	0.10%	6.16	6.15	217	212	214.00	0.17%	214.35	213.65	311.65	35.75	11.945	6.3	226	385.5	38.00	35.00
1200	180	5.66	3.21%	1.01%	3.37%	5.85	5.47	5.80	0.10%	5.80	5.79	210	211	210.25	0.17%	210.60	209.90	296.55	35.2	12.505	6.285	237	381.5	36.50	33.00
1200	160	5.14	3.54%	1.01%	3.68%	5.33	4.95	5.31	0.10%	5.32	5.30	204	204	204.00	0.17%	204.35	203.65	266.85	34	13.205	5.765	240	360.5	34.00	45.00
1200	140	5.23	3.54%	1.03%	3.69%	5.43	5.04	5.03	0.10%	5.03	5.02	203	203	202.75	0.17%	203.10	202.40	254.15	31.5	13.765	5.315	240	343	33.00	46.50
1200	120	4.54	3.30%	0.82%	3.40%	4.69	4.38	4.48	0.10%	4.48	4.47	205	202	203.50	0.17%	203.85	203.15	236.75	31.05	14.445	4.835	233.5	315	31.00	48.00
1200	100	3.91	4.12%	0.89%	4.22%	4.07	3.74	3.92	0.10%	3.92	3.91	200	200	199.75	0.18%	200.10	199.40	220.4	29.55	15.05	4.39	234	292.5	30.00	52.50
1200	80	3.53	4.42%	0.87%	4.50%	3.69	3.38	3.47	0.10%	3.47	3.46	199	201	200.00	0.18%	200.35	199.65	199.6	29.3	15.72	3.885	221.5	275	29.00	54.00
1200	60	3.04	4.91%	0.83%	4.98%	3.19	2.89	3.02	0.10%	3.02	3.01	198	200	199.00	0.18%	199.35	198.65	182.65	29.5	16.285	3.47	214	276	29.00	56.50
1200	40	2.45	8.25%	1.01%	8.31%	2.63	2.26	2.46	0.10%	2.46	2.46	200	200	199.75	0.18%	200.10	199.40	163.55	29.6	16.955	2.965	210	272	29.50	56.50

PLANILLA DE DATOS MOTOR CATERPILLAR

RPM	Torque	P _{sat}	Humedad absoluta	Rair	ρ _{air}	Velocidad del aire	Flujo volumétrico	Flujo másico	A	B	G	E	C	F	Relación A/C	Consumo combustible	Incer.	Valor max	Valor min	Consumo obtenido del Electronic Technician						
																				rpm	Nm	kPa	kg/kg	kJ/kgK	kg/m ³	m/s
2200	200	6.220	0.00136	0.287	3.214	17.35	0.0726	840.22	0.0195	0.3699	0.0011	4.9465	21.4549	80.666	55.10	15.25	1.074%	15.414	15.087	49.53	50.88	48.69	2%	17.062	17.44	16.69
2200	180	6.931	0.00147	0.287	3.193	16.93	0.0708	814.31	0.0221	0.4207	0.0013	5.6258	21.5220	80.919	48.59	16.76	1.089%	16.940	16.575	45.09	46.25	44.19	2%	15.533	15.89	15.18
2200	160	7.313	0.00151	0.287	3.183	16.21	0.0678	777.27	0.0213	0.4051	0.0012	5.4168	21.4983	80.829	50.41	15.42	1.081%	15.584	15.251	41.14	41.94	40.19	2%	14.174	14.48	13.87
2200	140	6.052	0.00146	0.287	3.219	15.33	0.0641	743.26	0.0200	0.3804	0.0012	5.0858	21.4691	80.719	53.62	13.86	1.070%	14.010	13.713	36.84	37.81	36.13	2%	12.692	12.98	12.40
2200	120	5.889	0.00142	0.287	3.224	14.81	0.0620	719.28	0.0188	0.3579	0.0011	4.7854	21.4250	80.554	56.87	12.65	1.061%	12.782	12.513	33.55	34.06	33.06	1%	11.557	11.73	11.38
2200	100	5.889	0.00138	0.287	3.224	14.31	0.0599	695.34	0.0176	0.3351	0.0010	4.4806	21.4037	80.474	60.68	11.46	1.053%	11.580	11.339	30.62	31.13	30.12	2%	10.549	10.72	10.38
2200	80	6.220	0.00140	0.287	3.214	13.97	0.0585	676.50	0.0164	0.3123	0.0010	4.1758	21.3674	80.337	65.00	10.41	1.044%	10.517	10.299	27.06	27.63	26.44	2%	9.321	9.53	9.12
2200	60	6.567	0.00142	0.287	3.203	13.68	0.0572	660.12	0.0154	0.2928	0.0009	3.9145	21.3428	80.244	69.26	9.53	1.037%	9.630	9.433	24.75	25.25	24.19	2%	8.527	8.71	8.34
2200	40	6.931	0.00149	0.287	3.193	13.55	0.0567	651.70	0.0140	0.2664	0.0008	3.5618	21.3027	80.094	75.97	8.58	1.027%	8.666	8.490	22.11	22.75	21.62	3%	7.617	7.81	7.42
2200	20	6.747	0.00145	0.287	3.198	13.35	0.0559	643.34	0.0125	0.2377	0.0007	3.1786	21.2675	79.962	84.99	7.57	1.018%	7.647	7.493	19.97	20.63	19.57	3%	6.880	7.06	6.70
1200	240	6.392	0.00146	0.287	3.208	7.15	0.0299	345.79	0.0259	0.4914	0.0015	6.5707	21.6210	81.291	41.80	8.27	1.119%	8.365	8.180	42.80	43.56	42.37	1%	8.042	8.15	7.93
1200	220	6.392	0.00144	0.287	3.208	7.11	0.0298	343.70	0.0244	0.4637	0.0014	6.2005	21.5823	81.145	44.21	7.77	1.107%	7.860	7.688	40.42	40.69	40.13	1%	7.595	7.65	7.54
1200	200	6.567	0.00144	0.287	3.203	6.94	0.0290	334.74	0.0216	0.4103	0.0013	5.4864	20.9679	78.835	48.55	6.90	1.090%	6.970	6.820	37.73	38.07	37.44	1%	7.090	7.15	7.03
1200	180	6.052	0.00125	0.287	3.219	6.86	0.0287	332.59	0.0215	0.4093	0.0013	5.4734	21.5064	80.860	49.91	6.66	1.084%	6.736	6.591	34.61	34.94	34.25	1%	6.504	6.57	6.44
1200	160	5.271	0.00148	0.287	3.245	6.73	0.0282	328.94	0.0198	0.3755	0.0012	5.0205	21.4617	80.692	54.30	6.06	1.069%	6.123	5.993	31.30	31.62	31.00	1%	5.881	5.94	5.82
1200	140	4.984	0.00145	0.287	3.255	6.70	0.0280	328.47	0.0182	0.3462	0.0011	4.6286	21.3772	80.374	58.67	5.60	1.058%	5.658	5.540	28.15	28.50	27.88	1%	5.289	5.35	5.23
1200	120	4.451	0.00133	0.287	3.277	6.69	0.0280	330.15	0.0166	0.3149	0.0010	4.2106	21.3697	80.346	64.47	5.12	1.047%	5.175	5.068	24.93	25.44	24.44	2%	4.685	4.78	4.59
1200	100	4.203	0.00138	0.287	3.288	6.61	0.0277	327.64	0.0150	0.2859	0.0009	3.8231	21.3374	80.224	70.89	4.62	1.037%	4.669	4.574	21.87	22.37	21.44	2%	4.110	4.20	4.02
1200	80	3.968	0.00134	0.287	3.299	6.61	0.0277	328.38	0.0133	0.2530	0.0008	3.3833	21.2841	80.024	79.91	4.11	1.026%	4.152	4.067	19.12	19.56	18.69	2%	3.592	3.67	3.51
1200	60	3.968	0.00140	0.287	3.299	6.59	0.0276	327.56	0.0119	0.2260	0.0007	3.0219	21.2548	79.914	89.34	3.67	1.018%	3.704	3.629	16.62	17.00	16.32	2%	3.123	3.19	3.06
1200	40	4.084	0.00144	0.287	3.293	6.61	0.0277	327.91	0.0102	0.1931	0.0006	2.5821	21.2015	79.713	104.30	3.14	1.008%	3.176	3.112	13.46	13.82	13.06	3%	2.529	2.60	2.46

ANEXO 5 – INCERTIDUMBRES EN EL ANÁLISIS DEL BALANCE DE CARBONO EN EL MOTOR CATERPILLAR

Temperatura ambiente	Psat	$\frac{\delta Psat}{\delta T_{amb}}$	μ Psat	Humedad absoluta	Humedad relativa	$\frac{\delta w}{\delta \phi}$	$\frac{\delta w}{\delta Psat}$	μ w	Rair	$\frac{\delta R_{air}}{\delta w}$	μ Rair	ρ air	Temperatura ambiente
°C	kPa		%	kg/kg	%			%	kJ/kgK		%	kg/m ³	°C
37.00	6.219912	0.339298799	2.728%	0.0013603	35.00	0.0000390	0.00021918	3.086%	0.287237	0.174046	0.0025%	3.213532	37.00
39.00	6.931396	0.372616662	2.688%	0.00147286	34.00	0.0000434	0.00021299	3.071%	0.287257	0.174007	0.0027%	3.192961	39.00
40.00	7.312781	0.390265507	2.668%	0.00150828	33.00	0.0000458	0.00020675	3.076%	0.287263	0.173995	0.0028%	3.182774	40.00
36.50	6.052252	0.331367733	2.738%	0.00145622	38.50	0.0000379	0.00024117	3.037%	0.287254	0.174013	0.0027%	3.218716	36.50
36.00	5.888518	0.323591292	2.748%	0.00141674	38.50	0.0000369	0.00024114	3.046%	0.287247	0.174027	0.0026%	3.223917	36.00
36.00	5.888518	0.323591292	2.748%	0.00137986	37.50	0.0000369	0.00023485	3.061%	0.28724	0.174039	0.0026%	3.223917	36.00
37.00	6.219912	0.339298799	2.728%	0.00139925	36.00	0.0000390	0.00022547	3.068%	0.287244	0.174033	0.0026%	3.213532	37.00
38.00	6.567325	0.355634234	2.708%	0.00141589	34.50	0.0000411	0.00021609	3.078%	0.287247	0.174027	0.0026%	3.203214	38.00
39.00	6.931396	0.372616662	2.688%	0.00149457	34.50	0.0000434	0.00021614	3.061%	0.28726	0.174	0.0028%	3.192961	39.00
38.50	6.747238	0.364043368	2.698%	0.00145477	34.50	0.0000423	0.00021611	3.070%	0.287254	0.174013	0.0027%	3.198079	38.50
37.50	6.391577	0.347386842	2.718%	0.00145798	36.50	0.0000400	0.00022864	3.050%	0.287254	0.174012	0.0027%	3.208364	37.50
37.50	6.391577	0.347386842	2.718%	0.00143796	36.00	0.0000400	0.0002255	3.059%	0.287251	0.174019	0.0027%	3.208364	37.50
38.00	6.567325	0.355634234	2.708%	0.00143646	35.00	0.0000411	0.00021923	3.068%	0.28725	0.17402	0.0027%	3.203213	38.00
36.50	6.052252	0.331367733	2.738%	0.00124777	33.00	0.0000379	0.00020658	3.135%	0.287217	0.174085	0.0024%	3.218716	36.50
34.00	5.271336	0.293985558	2.789%	0.00148252	45.00	0.0000330	0.00028191	3.009%	0.287258	0.174004	0.0027%	3.24489	34.00
33.00	4.984364	0.280050967	2.809%	0.00144846	46.50	0.0000312	0.00029128	3.015%	0.287252	0.174016	0.0026%	3.255479	33.00
31.00	4.450842	0.253830072	2.851%	0.0013349	48.00	0.0000279	0.00030056	3.042%	0.287233	0.174055	0.0025%	3.276866	31.00
30.00	4.203215	0.241509519	2.873%	0.00137891	52.50	0.0000263	0.00032879	3.033%	0.28724	0.17404	0.0025%	3.287665	30.00
29.00	3.967655	0.229693313	2.895%	0.00133874	54.00	0.0000248	0.00033814	3.046%	0.287233	0.174054	0.0025%	3.298536	29.00
29.00	3.967655	0.229693313	2.895%	0.00140086	56.50	0.0000248	0.00035386	3.034%	0.287244	0.174032	0.0026%	3.298536	29.00
29.50	4.083958	0.235539396	2.884%	0.00144201	56.50	0.0000256	0.00035391	3.023%	0.287251	0.174018	0.0026%	3.293091	29.50

$\frac{\delta_{\rho air}}{\delta Rair}$	$\frac{\delta_{\rho air}}{\delta Tamb}$	$\mu_{\rho air}$	ΔP	VelAir	$\frac{\delta VelAir}{\delta \Delta P}$	$\frac{\delta VelAir}{\delta \rho}$	μ_{VelAir}	FlujoVol	$\frac{\delta FlujoVol}{\delta VelAir}$	$\mu_{FlujoVol}$	FlujoMas	$\frac{\delta FlujoMas}{\delta \rho air}$	$\frac{\delta FlujoMas}{\delta FlujoVol}$
		%	Pa	m/s			%	m3/s		%	kg/hr		
-0.010351632	-0.010351632	0.1611%	1344.00	17.353	0.006455729	-2.699988662	0.0827%	0.072629017	0.004185387	0.0827%	400.156562	261.4644627	5509.596255
-0.010219527	-0.010219527	0.1600%	1270.50	16.9260949	0.006661194	-2.650532601	0.0824%	0.070842254	0.004185387	0.0824%	388.642772	255.0321153	5486.030566
-0.010154422	-0.010154422	0.1595%	1161.25	16.2078797	0.006978635	-2.546187575	0.0826%	0.067836246	0.004185387	0.0826%	379.396111	244.2104854	5592.822918
-0.010385057	-0.010385057	0.1613%	1050.00	15.3256735	0.00729794	-2.380712281	0.0841%	0.064143872	0.004185387	0.0841%	375.529418	230.9179377	5854.486303
-0.010418646	-0.010418646	0.1616%	981.75	14.8072626	0.007541259	-2.29647081	0.0847%	0.061974121	0.004185387	0.0847%	374.6758	223.1068372	6045.68151
-0.010418646	-0.010418646	0.1616%	917.50	14.3145386	0.007800838	-2.220053792	0.0853%	0.059911881	0.004185387	0.0853%	374.273628	215.682772	6247.06855
-0.010351631	-0.010351631	0.1611%	871.25	13.9716061	0.008018138	-2.173870734	0.0855%	0.058476576	0.004185387	0.0855%	376.675169	210.5156733	6441.471022
-0.010285261	-0.010285261	0.1605%	832.25	13.6772947	0.008217059	-2.134933347	0.0857%	0.057244769	0.004185387	0.0857%	380.126507	206.0811684	6640.371057
-0.010219527	-0.010219527	0.1600%	813.75	13.5461206	0.008323269	-2.121247406	0.0857%	0.056695755	0.004185387	0.0857%	391.200479	204.104717	6899.995971
-0.010252315	-0.010252315	0.1603%	791.75	13.3510581	0.00843136	-2.087355853	0.0861%	0.055879343	0.004185387	0.0861%	402.46258	201.1656331	7202.349954
-0.010318366	-0.010318366	0.1608%	228.00	7.15305939	0.015686534	-1.114751727	0.1360%	0.02993832	0.004185387	0.1360%	179.696794	107.7779536	6002.233649
-0.010318366	-0.010318366	0.1608%	225.25	7.10979052	0.015781999	-1.108008578	0.1371%	0.029757223	0.004185387	0.1371%	179.088706	107.1260045	6018.327156
-0.010285261	-0.010285261	0.1605%	214.00	6.93553859	0.016204529	-1.082590753	0.1417%	0.029027912	0.004185387	0.1417%	178.178009	104.5004824	6138.161442
-0.010385059	-0.010385059	0.1613%	210.25	6.85792759	0.016308984	-1.065320266	0.1437%	0.02870308	0.004185387	0.1437%	180.851586	103.3310869	6300.772877
-0.01055464	-0.01055464	0.1626%	204.00	6.7279284	0.016490021	-1.036696001	0.1471%	0.028158983	0.004185387	0.1471%	187.176438	101.3723381	6647.13066
-0.010623639	-0.010623639	0.1632%	202.75	6.69636687	0.016513852	-1.028476476	0.1479%	0.028026886	0.004185387	0.1479%	190.782919	100.8967882	6807.139451
-0.010763683	-0.010763683	0.1642%	203.50	6.68681207	0.016429514	-1.020306015	0.1478%	0.027986895	0.004185387	0.1478%	197.008096	100.7528222	7039.298066
-0.010834745	-0.010834745	0.1648%	199.75	6.61402545	0.016555758	-1.005884939	0.1498%	0.027682255	0.004185387	0.1498%	201.3152	99.65611769	7272.355559
-0.010906513	-0.010906513	0.1653%	200.00	6.6072487	0.016518122	-1.001542711	0.1499%	0.027653892	0.004185387	0.1499%	209.95193	99.55400966	7592.12964
-0.010906512	-0.010906512	0.1653%	199.00	6.59071	0.016559573	-0.99903577	0.1504%	0.027584671	0.004185387	0.1504%	217.209502	99.30481452	7874.282928
-0.010870539	-0.010870539	0.1651%	199.75	6.60857407	0.016542113	-1.003399792	0.1499%	0.027659439	0.004185387	0.1499%	227.317849	99.5739796	8218.454862

μ FlujoMas	D	H	I	J	A	B	C	$\frac{\delta B}{\delta D}$	$\frac{\delta B}{\delta I}$	$\frac{\delta A}{\delta D}$	$\frac{\delta A}{\delta I}$	$\frac{\delta C}{\delta D}$	$\frac{\delta C}{\delta H}$
%	%-CO2	%-O2	%-CO	%-NO	(D+I)/291.7	(D+I)/15.4	(D+H+I/2+J/2+(D+I)/2.31)						
0.302%	5.68	13.32	0.0081	0.0131	0.01949847	0.370471	21.46901769	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.303%	6.46	12.27	0.0329	0.0163	0.02225728	0.4228883	21.5608552	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.299%	6.22	12.59	0.0416	0.0173	0.0214644	0.4078235	21.54573649	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.290%	5.84	13.105	0.0353	0.0172	0.02014018	0.3826635	21.51057621	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.283%	5.495	13.555	0.02985	0.0178	0.01893886	0.3598383	21.46168544	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.276%	5.145	14.035	0.0261	0.018	0.01772623	0.3367983	21.43701839	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.269%	4.795	14.5	0.0243	0.01725	0.01652028	0.3138853	21.39869414	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.262%	4.495	14.905	0.0237	0.0161	0.01548984	0.2943069	21.37289872	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.252%	4.09	15.445	0.0233	0.01475	0.01410015	0.2679029	21.33180835	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.242%	3.65	16.04	0.02315	0.01335	0.01259134	0.2392355	21.2957989	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.304%	7.545	10.815	0.0216	0.0381	0.02593786	0.4928193	21.66016228	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.304%	7.12	11.385	0.02255	0.0391	0.02448424	0.4652006	21.62286131	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.302%	6.3	11.945	0.0226	0.03855	0.0216735	0.4117965	21.00822591	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.297%	6.285	12.505	0.0237	0.03815	0.02162585	0.4108912	21.54756828	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.287%	5.765	13.205	0.024	0.03605	0.01984435	0.3770427	21.50205204	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.283%	5.315	13.765	0.024	0.0343	0.01830178	0.3477338	21.41668538	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.275%	4.835	14.445	0.02335	0.0315	0.01665414	0.3164286	21.40722169	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.269%	4.39	15.05	0.0234	0.02925	0.01512888	0.2874486	21.37381267	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.259%	3.885	15.72	0.02215	0.0275	0.01339348	0.2544761	21.31850956	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.250%	3.47	16.285	0.0214	0.0276	0.01196831	0.227398	21.28849589	0.06513	0.06513	0.00343	0.00343	1.4322	1
0.240%	2.965	16.955	0.021	0.0272	0.01023583	0.1944808	21.23466015	0.06513	0.06513	0.00343	0.00343	1.4322	1

$\frac{\delta C}{\delta I}$	$\frac{\delta C}{\delta J}$	μA	μB	μC	$\frac{air}{comb} = \frac{C}{A+B}$	$\frac{\delta C}{\delta A+B}$	$\frac{\delta C}{\delta A}$	$\frac{\delta C}{\delta B}$	$\mu air/comb$	Consumo	$\frac{\delta consumo}{\delta flujoMas}$	$\frac{\delta consumo}{\delta air/comb}$	$\mu consumo$
		%	%	%	kg/kg				%	kg/hr			%
0.9322	0.5	0.9986%	0.9986%	0.3987%	55.05307818	-141.1728036	-141.1728036	2.564303546	1.0303%	7.2685593	0.018164289	-0.132028208	1.0736%
0.9322	0.5	0.9953%	0.9953%	0.4440%	48.4355153	-108.8082602	-108.8082602	2.246456129	1.0457%	8.0239215	0.020646007	-0.165661941	1.0886%
0.9322	0.5	0.9939%	0.9939%	0.4298%	50.18947803	-116.9133256	-116.9133256	2.329438961	1.0386%	7.5592759	0.019924495	-0.150614754	1.0807%
0.9322	0.5	0.9944%	0.9944%	0.4076%	53.402139	-132.5761068	-132.5761068	2.482599186	1.0301%	7.0321044	0.018725842	-0.131682074	1.0700%
0.9322	0.5	0.9950%	0.9950%	0.3879%	56.66044611	-149.5877928	-149.5877928	2.640074391	1.0229%	6.6126518	0.017648996	-0.116706666	1.0613%
0.9322	0.5	0.9953%	0.9953%	0.3679%	60.46695515	-170.5578919	-170.5578919	2.820679353	1.0158%	6.1897218	0.016537959	-0.102365362	1.0525%
0.9322	0.5	0.9953%	0.9953%	0.3484%	64.76493966	-196.016513	-196.016513	3.026583736	1.0089%	5.8160352	0.015440453	-0.089802218	1.0441%
0.9322	0.5	0.9951%	0.9951%	0.3320%	68.99006822	-222.6946179	-222.6946179	3.227922854	1.0032%	5.5098729	0.01449484	-0.079864726	1.0367%
0.9322	0.5	0.9947%	0.9947%	0.3105%	75.64390551	-268.2379453	-268.2379453	3.546061556	0.9959%	5.171606	0.013219836	-0.068367782	1.0274%
0.9322	0.5	0.9942%	0.9942%	0.2881%	84.56524842	-335.8071361	-335.8071361	3.970982672	0.9887%	4.7591959	0.011825188	-0.056278388	1.0178%
0.9322	0.5	0.9972%	0.9972%	0.5088%	41.75395182	-80.48843174	-80.48843174	1.927684165	1.0765%	4.3037075	0.023949829	-0.103073057	1.1185%
0.9322	0.5	0.9970%	0.9970%	0.4833%	44.15669186	-90.17370124	-90.17370124	2.042129912	1.0645%	4.0557546	0.022646624	-0.09184915	1.1069%
0.9322	0.5	0.9966%	0.9966%	0.4443%	48.46523555	-111.8075875	-111.8075875	2.306964698	1.0470%	3.6764086	0.020633347	-0.075856613	1.0896%
0.9322	0.5	0.9964%	0.9964%	0.4336%	49.81900458	-115.1839124	-115.1839124	2.312047648	1.0424%	3.6301726	0.020072661	-0.072867225	1.0839%
0.9322	0.5	0.9961%	0.9961%	0.4032%	54.17675825	-136.5042336	-136.5042336	2.519608741	1.0298%	3.4549213	0.0184581	-0.063771282	1.0692%
0.9322	0.5	0.9958%	0.9958%	0.3780%	58.50985096	-159.8474553	-159.8474553	2.731975089	1.0199%	3.2606974	0.017091139	-0.055729033	1.0584%
0.9322	0.5	0.9955%	0.9955%	0.3506%	64.26997987	-192.954993	-192.954993	3.002256939	1.0098%	3.0653206	0.015559364	-0.047694439	1.0466%
0.9322	0.5	0.9951%	0.9951%	0.3262%	70.63913359	-233.457983	-233.457983	3.30493837	1.0012%	2.8499104	0.014156459	-0.04034464	1.0367%
0.9322	0.5	0.9947%	0.9947%	0.2998%	79.58540119	-297.105014	-297.105014	3.73315972	0.9927%	2.6380709	0.012565119	-0.033147673	1.0259%
0.9322	0.5	0.9943%	0.9943%	0.2792%	88.93690793	-371.5515475	-371.5515475	4.177698058	0.9863%	2.4422875	0.011243926	-0.0274609	1.0176%
0.9322	0.5	0.9936%	0.9936%	0.2560%	103.7270836	-506.6861342	-506.6861342	4.884800737	0.9793%	2.1914995	0.009640684	-0.021127553	1.0082%

ANEXO 6 – HOJA TÉCNICA DEL ANALIZADOR DE GASES TESTO



testo 350 Technical Data

	O ₂	CO	CO _{LOW}	NO	NO _{LOW}	NO ₂	SO ₂	H ₂ S	C _{Hy}
Range	0 to 25% vol.	0 to 10,000 ppm H ₂ comp.	0 to 500 ppm H ₂ comp.	0 to 3,000 ppm	0 to 300 ppm	0 to 500 ppm	0 to 5,000 ppm	0 to 300 ppm	0.01 to 4%
Accuracy	< 0.2% of m.v.	< 5 ppm 0 to 99 ppm < 5% of m.v. 100 to 2,000 ppm < 10% of m.v. 2,001 to 10,000 ppm	< 2 ppm 0 to 39.9 ppm < 5% of m.v. 40 to 500 ppm	< 5 ppm 0 to 99 ppm < 5% of m.v. 100 to 2,000 ppm < 10% of m.v. 2,001 to 3,000 ppm	< 2 ppm 0 to 39.9 ppm < 5% of m.v. 300 ppm	< 5 ppm 0 to 99 ppm < 5% of m.v. 500 ppm	< 5 ppm 0 to 99 ppm < 5% of m.v. 100 to 2,000 ppm < 10% of m.v. 2,001 to 5,000 ppm	< 2 ppm 0 to 39.9 ppm < 5% of m.v. 40 to 300 ppm	< 400 ppm 100 to 4,000 ppm < 10% of m.v. > 4,000 ppm
Resolution	0.1 vol. %	1 ppm	0.1 ppm	1 ppm	0.1 ppm	0.1 ppm	1 ppm	0.1 ppm	0.001 vol. % =10 ppm
Resp. Time	20 s (t95)	40 s (t90)	40 s (t90)	30 s (t90)	30 s (t90)	40 s (t90)	30 s (t90)	35 s (t90)	40 s (t90)
	CO ₂	CO ₂ Calculated	Differential Pressure 1	Differential Pressure 2	Efficiency	Flow Velocity	Current Voltage	RPM	Temperature
Range	0 to 50% vol.	0 - CO ₂ max vol. %	±80" H ₂ O	±16" H ₂ O	0 to 100%	0 to 7900 ft/min	0 to 20 mA 0 to 10 V	20 to 20,000 rpm	-40 to 2192°F
Accuracy	±0.3% vol. +1% of m.v. (0 to 25% vol.) ±0.5% vol. +1.5% of m.v. (> 25 to 50% vol.)	Calculated from O ₂	< 1% m.v. -20" to -80" H ₂ O < 1% m.v. +20" to +80" H ₂ O < 0.5% -19" to +19" H ₂ O	< 1% m.v. -16" to 1.2" H ₂ O < 1% m.v. +16" to +1.2" H ₂ O < 0.5% -1.2" to +1.2" H ₂ O			±0.04 mA ±0.01 V		< 33°F -40 to +212°F < 0.5% m.v. +212 to +2192°F
Resolution	0.01% vol. (0 to 25% vol.) 0.01% vol. (> 25% vol.)	0.01 vol. %	0.01" H ₂ O	0.01" H ₂ O	0.1%	10 ft/min	±0.01 mA ±0.01 V	1 ppm	

Dimensions: 16" x 11" x 4"

Weight: 9 lbs.

Storage temperature: -40 to +120 °F

Operating temperature: 23 to +113 °F

Housing material: ABS

Memory: 250,000 readings

Power supply: Via built-in power supply (90 V to 260 V, 47 to 63 Hz) or exchangeable rechargeable batteries or external 12 V cables

Electrical power consumption:
0.5 A (110 V AC), 0.3 A (230 V AC)

Dewpoint calculation: 32 to 210 °F td

Maximum positive pressure/Flue gas:
20" H₂O

Maximum negative pressure:
80" H₂O

Pump flow: 1 l/min. with flow monitoring

Max. dust load: 20 g/m³ dust in flue gas

Max. humidity load:
+158 °F Dewpoint temperature at sample gas inlet of analyzer box

Trigger input:

Voltage 5 to 12 Volt (rising or falling edge)

Pulse width: > 1 s

Load: 5 V/max. 5 mA, 12 V/max. 40 mA

Warranty: Analyzers 2 years (excluding working parts, e.g. measurement cells...);
CO/NO/NO₂/SO₂/H₂S/HC 1 year;
O₂ measurement cell 1 1/2 years;
CO₂ IR measurement module 2 years