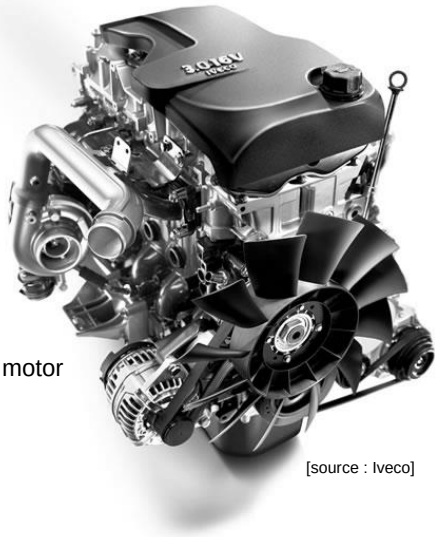
Test engine specifications

IVECO F1C Euro 4 / 105 kW @ 3500 rpm
Diesel / 4 cylinders / 16 valves

Displacement:	2998 cm^3
Bore:	95.8 mm
Stroke:	104 mm
Compression ratio:	18:1
Injection system:	Bosch common rail, 1600bar
Turbo charger:	MHI waste gate
EGR:	cooled (engine can also be used w/o EGR)
Engine brake:	K&S, dynamic test bench with ABB 3-phase asynchronous motor
Intake air flow:	~ 600kg/h @ ~3500 rpm FL (with limited engine map: ~400kg/h @ ~2200rpm FL)



[source : Iveco]

Bern University of Applied Sciences — Laboratory for IC-Engines and Exhaust Gas Control

measured and calculated values

engine:	**IVECO F1C E(4)**	equipment	**Reference (w/o Exhaust Gas Aftertreatment System) / EGR valve closed**		
date:	**05.11.2009**	fuel	**ULSD**	$CO_{2\ room}$ [%]:	-
measurement :	**VSET / RO-36**		**0-100min**		**SP3**

R_{room} [%]:	32
P_{atm} [mbar]:	950
t_{room} [°C]:	21

pt.	time	n	M	Gair	V_{fuel}	SZ	CO	$HC3_{FID}$	$HC6_{IR}$	$NO_{(hot)}$	$NO_{x\ (hot)}$	$NO_{2\ (hot)}$	NO_2/NO_x	N_2O	NH_3	O_2	$CO_{2\ high}$	$CO_{2\ low}$	Urea[1)]
		[rpm]	[Nm]	[kg/h]	[l/h]	[-]	[ppm]	[ppm]	[ppm]	[ppm]	[ppm]	[ppm]	[%]	[ppm]	[ppm]	[%]	[%]	[%]	[l/h]
1	10:02	2200	356	391	21.6	-	65	11	6	683	698	*15*	*2*	1.4	1	7.2	9.9	-	-
2	10:17	2200	244	322	14.8	-	34	16	7	552	575	*23*	*4*	1.3	1	9.7	8.2	-	-
3	10:32	2200	162	275	10.3	-	59	19	7	382	408	*26*	*6*	1.2	0	11.9	6.7	-	-
4	10:42	2200	32	213	3.4	-	294	36	8	110	145	*35*	*24*	1.0	0	17.2	2.9	-	-
5	10:52	1600	351	234	15.8	-	312	12	8	772	792	*20*	*3*	1.5	1	4.4	11.6	-	-
6	11:02	1600	247	196	10.8	-	237	18	9	822	857	*35*	*4*	1.7	0	7.5	9.6	-	-
7	11:12	1600	165	172	7.2	-	115	23	9	837	885	*48*	*5*	1.9	0	10.8	7.4	-	-
8	11:26	800	idle	72	0.5	-	89	23	7	131	162	*31*	*19*	0.5	0	19.2	1.3	-	-

pt.	t_0	t_1	t_2	t_3	t_{4a}	t_5	t_6	t_9[1)]	t_9	t_{H2O}	t_{oil}	t_{fuel}	Δp_2	Δp_3	Δp_4	Δp_5	Δp_7	Δp_8	Δp_9
	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[°C]	[mbar]	[mbar]	[mbar]	[mbar]	[mbar]	[mbar]	[mbar]
1	21	21	29	136	45	634	520	-	429	82	95	25	-	1056	1050	1052	96	-	-
2	21	21	26	100	35	518	432	-	352	81	92	25	-	681	674	728	61	-	-
3	20	20	25	75	30	427	361	-	291	79	88	25	-	437	430	532	40	-	-
4	20	20	23	40	19	198	173	-	143	78	83	24	-	114	107	268	21	-	-
5	20	20	26	103	32	651	562	-	416	81	93	24	-	667	663	550	46	-	-
6	20	20	26	73	24	520	456	-	336	80	90	24	-	385	380	371	28	-	-
7	20	20	25	53	19	400	349	-	259	79	87	24	-	216	211	265	19	-	-
8	20	20	22	28	13	95	88	-	75	77	74	22	-	12	10	65	2	-	-

pt.	P_e	p_{me}	G_{fuel}	G_{exh}	b_e	λ	CO	HC	$NO_{x\ (hot)}$	PM	CO	HC	NO_x	PM_{engine}	N_2O	NH_3	$NO_{x\ (in)}$[1)]	$NO_{x\ (out)}$[1)]	K_{NOx}[1)]
	[kW]	[bar]	[kg/h]	[kg/h]	[g/kWh]	[-]	[g/kWh]	[g/kWh]	[g/kWh]	[g/kWh]	[g/h]	[g/h]	[g/h]	[g/h]	[g/h]	[g/h]	[ppm]	[ppm]	[%]
1	*82.0*	*14.91*	*17.9*	*409*	*219*	*1.50*	*0.29*	*0.08*	*4.75*	-	*23.5*	*6.2*	*426*	-	*1.10*	*0.31*	-	-	-
2	*56.2*	*10.22*	*12.3*	*335*	*219*	*1.80*	*0.18*	*0.13*	*4.76*	-	*10.2*	*7.6*	*288*	-	*0.86*	*0.25*	-	-	-
3	*37.3*	*6.79*	*8.6*	*284*	*230*	*2.21*	*0.41*	*0.21*	*4.39*	-	*15.3*	*7.9*	*174*	-	*0.68*	*0.00*	-	-	-
4	*7.4*	*1.34*	*2.8*	*216*	*383*	*5.20*	*8.12*	*1.50*	*6.27*	-	*59.9*	*11.1*	*47*	-	*0.42*	*0.00*	-	-	-
5	*58.8*	*14.69*	*13.1*	*248*	*224*	*1.23*	*1.14*	*0.07*	*4.46*	-	*66.8*	*4.2*	*292*	-	*0.72*	*0.19*	-	-	-
6	*41.4*	*10.35*	*9.0*	*205*	*217*	*1.51*	*1.04*	*0.12*	*5.81*	-	*43.0*	*5.2*	*263*	-	*0.67*	*0.00*	-	-	-
7	*27.6*	*6.91*	*6.0*	*178*	*217*	*1.98*	*0.67*	*0.21*	*8.01*	-	*18.5*	*5.8*	*237*	-	*0.67*	*0.00*	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Values are averages of 60 seconds stationnary operating points

– : not measured — Δp: rel.pressure
1) datalogger values — PM: -

L_{min}= 14.52 kg_{air}/kg_{Fuel} ρ_{fuel} = 0.832 kg/dm^3 H_u = 42.700 MJ/kg

[AFHB, 8PTS-RO36, 05.11.2009]

Measured values

n	1/min	engine speed
M	Nm	torque
GAir	kg/h	air mass flow
VFuel	l/h	fuel flow
tH2O	°C	cooling water
tOil	°C	oil temperature
tFuel	°C	fuel temperature
t0	°C	test room temperature
t1	°C	temperature at air filter
t2	°C	temperature before compressor
t3	°C	temperature after compressor
t4	°C	temperature before intercooler
t4a	°C	temperature after intercooler
t5	°C	temperature before turbine
t6	°C	temperature after turbine
t7	°C	temperature before particle trap
t8	°C	temperature before DeNOx
t9	°C	temperature at tailpipe
p0	mbar	atmospheric pressure in the testing room
Δp1	mbar	rel. pressure at air filter
Δp2	mbar	rel. pressure before compressor
Δp3	mbar	rel. pressure after compressor
Δp4	mbar	rel. pressure before intercooler
Δp4a	mbar	rel. pressure after intercooler
Δp5	mbar	rel. pressure before turbine
Δp6	mbar	rel. pressure after turbine
Δp7	mbar	rel. pressure before particle trap
Δp8	mbar	rel. pressure before DeNOx
Δp9	mbar	rel. pressure at tailpipe
RRaum	%	rel. humidity in the testing room
CO, HC3FID, HC6IR, NO, NO2, NOX, N2O, NH3	ppm	volumetric concentration of the emissions
CO2, O2	%	volumetric concentration of the emissions

Emissions measured with different systems

Ecophysics 1CLD:	NO, NO2, NOx	ppm	volumetric concentration of the emissions
Ecophysics 2CLD:	NO, NO2, NOx, NH3	ppm	volumetric concentration of the emissions
Siemens:	NH3 LDS, N2O IR	ppm	volumetric concentration of the emissions
SESAM FTIR:	NO, NO2, NOx, NH3, N2O, …	ppm	volumetric concentration of the emissions

Calculated values

Pe	kW	power
pme	bar	mean effective pressure
GFuel	kg/h	fuel mass flow
be	g/kWh	specific fuel consumption
ηe	-	effective efficiency
β	mm3/Hub	injection quantity
λ	-	global equivalence ratio
GExh	kg/h	exhaust gas mass flow
CO	g/kWh	specific emissions
HC	g/kWh	specific emissions
NOX	g/kWh	specific emissions
NH3	g/kWh	specific emissions
N2O	g/kWh	specific emissions

Test bench schema