

# Fortran Compiler benchmarks for

**gfortran**

**Intel ifort**

**Intel ifx**

**NAG**

**and**

**Nvidia**

## Version 1

These tables were produced using the Polyhedron Fortran Benchmarks. Their web site is [www.fortran.uk](http://www.fortran.uk)

Thanks to Polyhedron Software & Services Ltd for permission to use the benchmark suite. The tests were ran in August and September 2022.

Our web site is

<https://www.fortranplus.co.uk/>

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# 1 Fortran compiler benchmarks

## 1.1 Background

The following is an extract from the Polyhedron site regarding their benchmarks.

- Here we only compare the run-times of computing intensive Fortran programs created by various Fortran compiler systems – the so-called runtime benchmarks. As stated in our webpage “Fortran Compiler Advice”, it should be emphasized that run-time performance is not the only criterion for choosing a Fortran compiler. What is the use of the best performance when the compiler is difficult to use – the computational results may not be accurate or accurate enough; the compilation and link times are frustratingly long; the error diagnostics are weak and so on?
- The compiler comparisons by Dr. Appleyard are much more detailed than the ones presented here. In particular, the diagnostic capabilities and the respective Fortran language scope (Fortran 95, 2003, 2008, etc.) should be noted. Regarding the latter, the tables of Ian Chivers & Jane Sleightholme are also informative. Desirable (and actually necessary) would be the review of the computational results and the numerical accuracy of the Fortran compiler systems. In particular, the messages of some compilers due to numerical problems – see, for example, the results of `capacita` and `channel2` – raise doubts about the correctness of the test programs. Maybe one day we will find the time for more thorough analysis in addition to our regular daily business. We ask for your patience and understanding..

We present the results of running these benchmarks using the following compilers<sup>1</sup>

- gfortran
- Intel ifort
- Intel ifx
- NAG
- Nvidia

on the following operating systems

- Windows 10
- Linux
  - openSuSe Leap 15.3
  - openSuSe Tumbleweed
  - Redhat 9
  - Ubuntu 20.04.4

using the following hardware

1 Please see the individual tables for which compiler versions were used.

- Dell Precision 5820 workstation, Intel I9 10980 XE processor, 32 GB RAM, 18 cores, 36 with hyper threading.
- Dell Vostro 5515 laptop, AMD Ryzen 7 5500U processor, 32 GB RAM. 8 cores, 16 with hyper threading.

More detailed information is available in the tables that follow.

Not all combinations of compiler, operating system and PC are possible.

## 1.2 Benchmark results

Here are the results for the following machines and operating systems.

- Dell 5515, Windows 10, native
- Dell 5280, Windows 10, native
- Dell 5515, openSuSe Leap 15.3, hyper-v
- Dell 5280, openSuSe Leap 15.3, hyper-v
- Dell 5515, openSuSe Tumbleweed, WSL
- Dell 5280, openSuSe Tumbleweed, WSL
- Dell 5280, Redhat 9, hyper-v
- Dell 5280, Ubuntu 20.04.4, Native

The versions of gfortran vary with the above from 7.5 to 12.x.

### 1.2.1 Dell Vostro 5515, native Windows

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	12.1.0	2021.6.0	2021.6.0	2021.6.0	7.1		
ac	5.90	4.91	5.00	5.75	6.29		
aermod	10.49	7.93	14.77	5.75	9.28		
air	1.64	2.76	1.29	1.57	2.09		
capacita	18.78	17.66	19.98	20.89	19.71		
channel2	58.36	60.96	55.89	74.80	70.01		
doduc	9.92	11.78	10.93	7.01	9.63		
fatigue2	56.91	48.84	48.48	42.28	87.91		
gas_dyn2	67.10	79.51	78.64	77.10	66.27		
induct2	22.26	47.09	52.38	46.68	53.28		
linpk	5.08	6.37	6.35	5.66	5.72		
mdbx	5.28	8.63	9.26	5.38	5.19		
mp_prop_design	73.13	69.83	13.23	95.00	82.54		
nf	6.23	6.38	6.57	5.69	6.39		
protein	11.98	13.42	13.76	13.02	11.61		
rnflow	16.34	11.53	14.73	11.58	18.33		
test_fpu2	34.51	58.55	53.08	54.26	45.49		
tfft2	58.75	57.82	36.89	47.60	46.03		
Geometric mean	16.41	18.41	16.44	16.60	18.51		
	08/08/2022	07/08/2022	31/07/2022	01/08/2022	30/07/2022		
						NA	NA

#### 1.2.1.1 Notes

gfortran The equation.com implementation.

NA Not available for the Windows platform

### 1.2.2 Dell Precision 5820, native Windows

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	12.1.0	2021.6.0	2021.6.0	2021.6.0	7.1		
ac	5.97	3.45	3.45	3.57	5.24		
aermod	13.74	5.85	13.79	5.95	9.83		
air	0.27	1.80	1.11	1.83	2.05		
capacita	15.04	10.13	23.25	10.53	12.66		
channel2	0.27	65.51	32.44	66.38	80.22		
doduc	14.36	6.37	6.48	6.55	9.87		
fatigue2	57.48	39.33	39.86	40.25	83.51		
gas_dyn2	0.24	28.84	18.02	28.71	57.74		
induct2	21.75	23.77	165.89	24.49	54.56		
linpk	0.24	2.77	2.72	2.70	3.80		
mdbx	3.72	3.47	8.33	3.56	5.00		
mp_prop_design	81.70	39.66	6.60	40.74	86.32		
nf	6.15	4.45	4.66	4.48	6.87		
protein	13.34	13.76	13.91	14.20	12.84		
rnflow	0.23	7.74	5.30	7.93	16.41		
test_fpu2	0.25	18.63	20.79	19.05	48.27		
tfft2	0.23	45.97	38.33	47.21	41.75		
Geometric mean	4.62	11.16	11.61	11.30	17.48		
	14/09/2022	07/08/2022	01/08/2022	03/08/2022	08/08/2022		
	Fails					NA	NA

#### 1.2.2.1 Notes

gfortran The equation.com implementation.

NA Not available for the Windows platform

Fails air, linpk, channel2, gas\_dyn2, linpk, rnflow, test\_fpu2, tfft2

**1.2.3 Dell Vostro 5515, Linux, openSuSe 15.3, hyper-v**

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
		2021.5.0	2021.5.0	2021.5.0	7.1	22.3	22.3
ac		5.06	5.24	5.88	13.93	6.11	6.12
aermod		7.96	11.47	5.39	7.64	7.23	8.14
air		2.98	1.27	2.38	1.94	1.39	2.77
capacita		17.47	18.63	0.02	11.86	8.58	12.98
channel2		56.74	52.38	81.60	81.91	53.86	57.95
doduc		11.65	11.93	6.22	11.33	7.52	69.76
fatigue2		53.76	54.50	41.59	89.02	43.38	83.96
gas_dyn2		118.35	118.18	59.39	56.47	49.74	62.23
induct2		45.28	36.20	17.81	67.13	15.89	16.60
linpk		5.92	5.91	4.50	2.79	4.26	8.71
mdbx		9.00	9.08	4.54	5.51	3.95	5.93
mp_prop_design		69.56	-1.00	129.63	151.18	40.71	41.19
nf		0.06	0.08	0.05	6.56	0.05	0.06
protein		13.05	12.61	12.53	14.10	12.44	12.52
rnflow		11.12	12.56	8.39	17.11	13.58	14.59
test_fpu2		34.50	25.95	12.29	48.56	10.53	21.60
tfft2		51.35	54.50	44.40	43.25	49.15	48.99
Geometric mean		13.83	15.59	7.09	19.09	9.17	13.48
		08/08/2022	08/08/2022	09/08/2022	08/08/2022	14/09/2022	14/09/2022
Notes	NR		12	Fails			

**1.2.3.1 Notes**

12 Problem with the mp\_prop\_design test. Internal compiler error.

NR gfortran is not in the openSuSe repository

Fails capacita

**1.2.4 Dell Precision 5820, Linux, openSuSe 15.3, hyper-v**

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	7.5.0	2021.6.0	2021.6.0	2022.1.0	7.1	22.5	22.5
ac	4.87	3.49	3.51	3.68	14.04	6.04	6.05
aermod	5.38	5.87	8.90	5.06	7.59	6.73	7.80
air	1.96	1.68	0.97	1.86	1.94	1.56	3.25
capacita	11.68	9.94	15.16	0.02	11.83	10.10	17.49
channel2	69.10	65.93	31.66	83.50	81.28	67.10	33.53
doduc	7.91	7.26	7.15	5.67	11.41	7.05	67.72
fatigue2	41.13	44.51	44.26	32.89	90.50	41.07	65.43
gas_dyn2	52.64	31.88	18.55	56.54	56.27	42.45	33.36
induct2	16.77	24.12	50.75	19.18	67.84	21.23	21.45
linpk	2.89	2.30	2.33	2.42	2.76	2.44	8.19
mdbx	4.42	3.85	3.84	4.15	5.57	4.27	5.98
mp_prop_design	57.05	45.27	5.50	107.80	153.37	30.15	30.80
nf	5.63	0.05	0.07	0.05	6.39	0.06	0.06
protein	13.51	13.39	13.65	13.03	14.25	13.32	13.65
rnflow	13.88	7.75	5.25	8.17	17.31	13.40	12.53
test_fpu2	33.00	11.59	12.57	13.05	48.89	12.89	25.28
tfft2	31.68	47.06	44.72	45.96	41.69	48.12	47.45
Geometric mean	13.08	8.50	7.39	6.24	19.09	9.17	12.61
	03/08/2022	06/08/2022	06/08/2022	07/08/2022	08/08/2022	01/08/2022	01/08/2022



### 1.2.5 Dell Vostro 5515, Linux, openSuSe Tumbleweed, WSL

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	12.1.0	2021.6.0	2021.6.0	2022.1.0			
ac	5.89	5.18	5.17	5.95		8.65	6.05
aermod	5.68	7.73	15.52	5.21		10.37	7.80
air	1.59	2.84	1.47	1.88		1.82	3.25
capacita	18.20	16.47	19.33	0.09		11.93	17.49
channel2	55.78	61.66	57.19	71.87		60.81	33.53
doduc	6.48	11.94	11.81	6.12		11.05	67.72
fatigue2	35.44	51.69	53.06	43.60		52.42	65.43
gas_dyn2	56.41	99.24	101.25	60.00		59.45	33.36
induct2	21.56	43.95	52.14	16.30		21.70	21.45
linpk	4.99	6.23	6.36	4.64		4.78	8.19
mdbx	5.25	8.73	9.35	4.91		5.59	5.98
mp_prop_design	53.55	67.73	-1.00	131.86		60.63	30.80
nf	6.01	0.16	0.24	0.14		0.23	0.06
protein	13.76	13.90	14.35	13.27		17.16	13.65
rnflow	15.70	17.26	15.81	9.17		16.92	12.53
test_fpu2	33.70	34.45	25.77	11.99		11.61	25.28
tfft2	55.15	51.24	38.48	26.23		26.44	47.45
Geometric mean	14.43	14.80	17.52	7.81		12.18	12.61
		10/08/2022	10/08/2022	10/08/2022		14/09/2022	1/8/2022
			12		NI		

#### 1.2.5.1 Notes

12 Problem with mp\_prop\_design. Internal compiler error.

NI Not installed

### 1.2.6 Dell Precision 5820, Linux, openSuSe Tumbleweed, WSL

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	12.1.0	2021.6.0	2021.6.0	2022.1.0		22.5	22.5
ac	4.65	5.86	5.87	6.00		6.05	6.07
aermod	5.56	5.83	11.97	5.88		6.75	8.79
air	1.93	1.67	1.09	1.69		1.62	4.03
capacita	10.80	10.48	14.41	10.54		11.25	20.01
channel2	66.47	63.07	32.69	63.09		66.51	33.82
doduc	7.79	8.63	8.58	8.60		7.05	107.51
fatigue2	34.77	44.30	44.34	44.06		40.98	87.54
gas_dyn2	50.03	35.81	35.60	35.74		41.85	36.83
induct2	16.87	30.22	30.11	30.04		21.33	21.34
linpk	3.11	3.00	2.91	2.97		2.63	11.31
mdbx	5.07	4.51	5.07	4.47		4.31	5.82
mp_prop_design	56.09	47.53	7.20	47.20		30.07	30.59
nf	6.39	0.20	0.21	0.20		0.13	0.15
protein	16.44	16.37	16.43	16.27		16.50	16.63
rnflow	13.15	8.79	6.21	8.72		13.38	12.63
test_fpu2	31.62	16.07	14.85	16.04		13.19	30.59
tfft2	30.07	46.28	42.58	44.22		35.65	38.21
Geometric mean	13.07	10.45	9.14	10.44		9.71	14.83
	09/08/2022	04/08/2022	04/08/2022	04/08/2022		13/09/2022	13/09/2022
Notes					NI		

#### 1.2.6.1 Notes

NI Not installed

**1.2.7 Dell Precision 5820, Linux, Redhat 9, hyper-v**

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	11.2.1	2021.6.0	2021.6.0	2022.1.0		22.7	22.7
ac	4.90	3.72	3.79	3.72		6.34	6.35
aermod	5.65	5.96	9.85	5.18		6.88	7.76
air	1.92	1.71	1.47	1.85		1.59	3.29
capacita	9.95	9.52	15.15	0.02		10.21	17.14
channel2	68.24	65.07	32.78	82.17		68.56	34.36
doduc	7.97	7.27	7.25	5.62		7.14	60.63
fatigue2	40.69	44.60	45.22	33.45		41.57	65.80
gas_dyn2	50.81	26.10	14.13	49.62		42.38	30.86
induct2	16.61	24.24	51.90	18.94		21.47	21.68
linpk	2.83	2.36	2.36	2.36		2.52	7.76
mdbx	5.02	3.84	3.92	4.08		4.34	6.15
mp_prop_design	57.19	44.06	5.51	104.79		30.49	31.20
nf	5.44	0.06	0.06	0.05		0.10	0.10
protein	13.03	13.71	13.63	12.94		13.49	13.80
rnflow	13.33	7.77	5.32	8.01		13.55	12.58
test_fpu2	31.43	12.24	12.44	12.88		13.09	23.04
tfft2	32.28	47.27	44.59	44.92		47.44	35.25
Geometric mean	12.91	8.53	7.53	6.15		9.58	12.65
	19/08/2022	18/08/2022	18/08/2022	19/08/2022		14/09/2022	14/09/2022
Notes					NI		

**1.2.7.1 Notes**

NI Not installed

**1.2.8 Dell Precision 5820, Linux, Ubuntu 20.04.4, native**

Here are the results.

	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia
			parallel				parallel
	9.1.0	2021.6.0	2021.6.0	2022.1.0	NI	22.5	22.5
ac	5.04	3.79	3.75	4.03		6.13	5.99
aermod	5.90	6.15	10.38	5.47		6.81	12.25
air	2.84	2.08	0.87	2.19		1.76	4.19
capacita	10.56	9.93	17.24	0.05		10.51	19.40
channel2	67.39	65.54	32.19	82.42		66.65	33.70
doduc	7.43	7.36	7.33	6.00		7.03	86.81
fatigue2	40.05	43.91	44.41	33.57		40.73	81.71
gas_dyn2	51.62	26.69	12.76	50.82		41.04	35.31
induct2	16.67	24.45	110.57	19.57		21.26	21.69
linpk	3.20	2.60	2.59	2.68		2.62	8.78
mdbx	4.65	4.01	6.93	4.31		4.38	6.12
mp_prop_design	53.97	46.27	6.27	105.18		29.77	31.02
nf	5.85	0.11	0.12	0.11		0.29	0.28
protein	13.55	13.62	13.49	13.02		13.24	13,41
rnflow	13.19	8.14	5.42	8.40		13.44	12.35
test_fpu2	31.00	12.55	12.86	13.17		13.31	27.28
tfft2	27.60	33.94	26.76	33.20		31.60	25.68
Geometric mean	13.19	9.02	8.11	7.05		9.97	14.55
		10/08/2022	10/08/2022	10/08/2022		15/09/2022	15/09/2022
					NI		

**1.2.8.1 Notes**

NI Not installed

### 1.3 Compiler switches

Here are the compiler switches used.

gfortran Windows

- "-O3 -ffast-math -funroll-loops -fmax-stack-var-size=64000000"

gfortran Linux

- "-O3 -ffast-math -funroll-loops"

ifort Windows

- "-O3 -ipo -xHost -prec-div -fp-model fast:2" "/link /stack:64000000"

ifort parallel Windows

- "-O3 -ipo -xHost -prec-div -fp-model fast:2" "/Qparallel"

ifx Windows

- "-O3 -ipo -xHost -prec-div -fp-model fast:2"

ifort Linux

- "-O3 -ipo -xHost -prec-div -fp-model=fast=2"

ifort parallel Linux

- "-O3 -ipo -xHost -prec-div -fp-model=fast=2" "-parallel"

ifx Linux

- "-O3 -ipo -xHost -prec-div -fp-model=fast=2"

nag Windows

- "-abi=64 -O4 -s -v -V"

nag Linux

- "-O4 -s -v -V"

nvidia Linux

- "-V -fastsse -Munroll=n:4 -Mipa=fast,inline"

nvidia parallel Linux

- "-V -fastsse -Munroll=n:4 -Mipa=fast,inline -Mconcur=innermost,allcores"

### 1.4 Fails

Some of the program tests fail, i.e. don't run to successful completion to generate meaningful timing figures. Please check the individual tables for more information.

mp\_prop\_design generates an internal compiler error (ice) using Intel in one table.

## 1.5 Summary

Here is a summary table.

Notes	gfortran	ifort	ifort	ifx	nag	nvidia	nvidia	OS Type
			parallel				parallel	
Dell 5515								
1	16.41	18.41	16.44	16.60	18.51	NA	NA	Native
2	NR	13.83	15.59	7.09	19.09	9.17	13.48	hyper-v
3	14.43	14.80	17.52	7.81	NI	12.18	12.61	WSL
Dell 5820								
4	4.62	11.16	11.61	11.30	17.48	NA	NA	Native
5	13.19	9.02	8.11	7.05	NI	9.97	14.55	Native
6	13.08	8.50	7.39	6.24	19.09	9.17	12.61	hyper-v
7	13.07	10.45	9.14	10.44	NI	9.71	14.83	WSL
8	12.91	8.53	7.53	6.15	NI	9.58	12.65	hyper-v

### Notes

- 1 AMD, Windows 10, native, gfortran 12.1.0
- 2 AMD, hyper-v, openSuSe 15.3, gfortran 7.5.0
- 3 AMD, WSL, openSuSe Tumbleweed, gfortran 12.1.0
- 4 Intel, Windows 10, native, gfortran 12.1.0 (equation.com) . Large number of fails for the gfortran entry. See the full table for more information.
- 5 Intel, Ubuntu 20.04.4, native, gfortran 9.1.0
- 6 Intel, hyper-v, openSuSe 15.3, gfortran 7.5.0
- 7 Intel, WSL, openSuSe Tumbleweed, gfortran 12.1.0
- 8 Intel, hyper-v, Redhat 9, gfortran 11.2.1
- Native Native Windows (Windows 10) or linux (Ubuntu 20.04.4) operating system
- NA No Nvidia HPC Toolkit for Windows
- NI Not installed
- NR gfortran is not in the openSuSe repository

## 1.6 Acknowledgements

These tables were produced using the Polyhedron Fortran Benchmarks. Their web site is [www.fortran.uk](http://www.fortran.uk)

Thanks to Polyhedron Software & Services Ltd for permission to use the benchmark suite.