(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 826 413 A2

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.08.2007 Bulletin 2007/35

(51) Int Cl.:
F04D 29/32 *(2006.01)* ***F04D 29/66*** *(2006.01)*

(21) Application number: **07103096.9**

(22) Date of filing: **27.02.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **27.02.2006 IT MI20060341**

(71) Applicant: **Nuovo Pignone S.P.A.**
50127 Florence (IT)

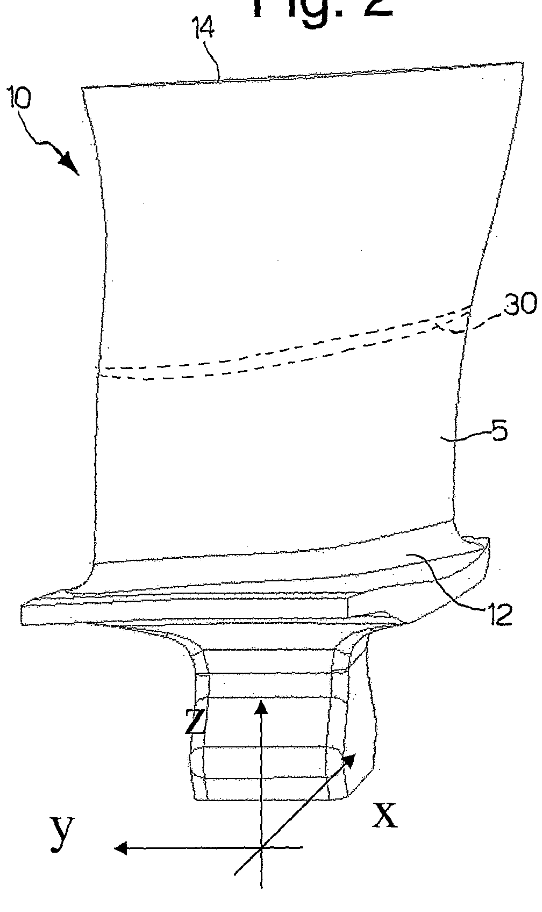
(72) Inventors:
- **NOVORI, Alessio**
  Florence (IT)
- **ARINCI, Paolo**
  50032, Firenze (IT)
- **LORUSSO, Salvatore**
  Florence (IT)

(74) Representative: **Bedford, Grant Richard**
London Patent Operation
GE International Inc
15 John Adam Street
London WC2N 6LU (GB)

(54) **Rotor blade for a ninth phase of a compressor**

(57) The invention relates to a blade (10) of a rotor of a ninth phase of a compressor, which can be defined by coordinates of a discreet combination of points, in a Cartesian reference system (X,Y,Z), wherein the axis (Z) is a radial axis intersecting the central axis of the compressor, said blade (10) having a profile which can be identified by means of a series of closed intersection curves between the profile itself and planes (X,Y) lying at distances (Z) from the central axis, said blade (10) also comprising a thickening (30), substantially parallel to a base portion (12) of the blade (10) itself, fixable to said rotor, said thickening (30) being substantially situated half-way up the blade (10) and being suitable for shifting the natural resonance frequencies of the blade (10) itself outside a functioning frequency range of said rotor.

Fig. 2



EP 1 826 413 A2

Description

[0001] The present invention relates generally to a blade of a rotor of a ninth phase of a compressor.

[0002] More specifically, the invention relates to a blade of a rotor having a high aerodynamic efficiency of a ninth phase of a compressor.

[0003] Compressors normally pressurize in their interior air removed from the outside.

[0004] The fluid penetrates the compressor through a series of inlet ducts.

[0005] In these channels, the gas has low pressure and low temperature characteristics, whereas as it passes through the compressor, the gas is compressed and its temperature increases.

[0006] In order to increase the efficiency, the compressor is normally divided into various phases, each of which has a rotor and a stator respectively equipped with a series of blades.

[0007] In recent years, technologically advanced compressors have been further improved, obtaining an increased improvement in efficiency, operating in particular on the aerodynamic conditions.

[0008] The geometric configuration of the blades in fact significantly influences the aerodynamic efficiency.

[0009] This depends on the fact that the geometric characteristics of the blade cause a distribution of the relative velocities in the fluid, consequently influencing the distribution of the limit layers along the walls and, ultimately, losses due to friction.

[0010] In particular, in the case of rotor blades of a ninth phase of a compressor an extremely high efficiency is required, at the same time maintaining an appropriate aerodynamic and mechanical load.

[0011] An objective of the present invention is to provide a blade of a rotor of a ninth phase of a compressor which avoids or in any case reduces resonance problems due to flexural vibrations which reduce the life of the component, and at the same time allow a high aerodynamic efficiency.

[0012] A further objective of the present invention is to provide a rotor of a ninth phase of a compressor which allows a high aerodynamic efficiency and at the same time allows a high reliability of the compressor to be obtained with a consequent increase in the power of the turbine itself with the same compressor dimensions.

[0013] These objectives according to the present invention are addressed by providing a rotor blade of a ninth phase of a compressor as specified in claim 1.

[0014] Further characteristics of the invention are indicated in the subsequent claims.

[0015] The characteristics and advantages of a rotor blade of a ninth phase of a compressor according to various embodiments of the present invention will appear more evident from the following illustrative and non-limiting description, referring to the enclosed schematic drawings in which:

- Figure 1 is a raised view of a rotor blade of a compressor produced with an aerodynamic profile according to an embodiment of the present invention;
- Figure 2 is a raised view of the opposite side of the blade of figure 1; and
- Figure 3 is a diagram of the maximum thickness trend of a blade according to an embodiment of the present invention, with respect to its height.

[0016] With reference to the figures, a blade 10 is provided of a rotor of a ninth phase of a compressor.

[0017] Said blade 10 is defined by means of coordinates of a discreet combination of points, in a Cartesian reference system (X,Y,Z), wherein the axis (Z) is a radial axis intersecting the central axis of the compressor, not shown.

[0018] The profile of the blade 10 is identified by means of a series of closed intersection curves between the profile itself and planes (X,Y) lying at distances (Z) from the central axis.

[0019] The profile of said blade 10 comprises a first substantially concave surface 3, which is pressurized, and a second substantially convex surface 5 which is in depression and opposite the first.

[0020] The two surfaces 3, 5 are continuous and joined to each other, and together form the profile of said blade 10.

[0021] At a base portion 12, commonly called "foot" of the blade 10, according to the known art there is a connecting joint with the aerodynamic profile of the blade 10 itself, said base portion 12 being suitable for being fixed to said rotor of said compressor.

[0022] Said blade 10 comprises a thickening 30, i.e. a prolonged portion having a greater thickness with respect to the adjacent portions, which is substantially parallel to said base portion 12 so as to shift the resonance frequencies of said blade 10 outside a functioning frequency range of the rotor itself, thus reducing or in any case avoiding problems of instability and vibrations of the blade 10 and rotor.

[0023] This advantageously leads to an increase in both the useful life and reliability of the rotor and compressor itself.

[0024] Said thickening 30 relates to at least one section or closed curve, and is also situated half-way up the blade 10.

[0025] In other words, said thickening 30 confers a dynamic behaviour to said blade which is such as to have flexural frequencies which fall outside a functioning velocity range of the rotor of said compressor and consequently such that there is no intensification of the maximum flexural deformation of the blade during the functioning of the compressor.

[0026] This consequently leads to a higher performance of the compressor, of the rotor and a longer useful life of its components, as problems of resonance such as those described above are avoided.

[0027] The clearances and tolerances of the blade and stator can therefore be dimensioned so as to further increase the performances of the compressor itself.

[0028] This is possible as the blade 10 is prevented, upon deforming, from causing a contact and relative friction against the relative stator.

[0029] In particular, each closed curve has a maximum thickness determined by the maximum distance between said first surface 3 and said second surface 5.

[0030] Said maximum surface of each closed curve, along the height of the blade 10, moving towards a free end 14 of the blade 10, has first a decreasing and then an increasing trend, followed again by a decreasing and finally increasing trend, with two different slopes, said blade 10 comprising a further thickening substantially parallel to said base portion 12 and situated in particular close to said free end 14.

[0031] For example, the variation in the trend of the maximum thickness is shown in figure 3, in which it is compared with the maximum thickness trend of a blade according to the known art. In particular, in figure 3, the abscissa indicates the height of the blade 10, whereas the ordinate represents the maximum thickness of the blade 10, adimensionalized by putting the thickness in correspondence with the foot of the blade equal to 1. In the diagram shown in figure 3, the lower line represents the maximum thickness trend of a blade according to the known art, whereas the upper line shows the trend of the maximum thickness of the blade according to an embodiment of the present invention.

[0032] Along the height of the blade 10 in the direction of a free end 14 of the blade 10, said maximum thickness preferably has a trend which can be described by four different mathematical functions, identifying four different regions of the blade.

[0033] In the first region, that closest to the blade 10, up to a height equal to 45% of the height of the blade, the maximum thickness trend can be described by a polynomial function of the fourth degree (first decreasing and subsequently increasing) and in particular said polynomial function is:

$$Tmax = -34.522*h^4 + 36.4*h^3 - 8.4113*h^2 - 0.7259*h + 0.9961$$

wherein h represents the percentage of the height of the blade 10, and wherein Tmax is the maximum adimensionalized thickness relating to that closed curve corresponding to that percentage of the height of the blade 10.

[0034] In the subsequent region, ranging from 45% to 58% of the height of the blade 10, the thickness varies according to the linear function (decreasing):

$$Tmax = -1.3509*h + 1.4459$$

[0035] Therefore, between 58% and 86% of the height of the blade 10, the thickness trend is represented by the linear function (increasing):

$$Tmax = 0.2074*h + 0.5443$$

[0036] Finally, between 86% and the free end 14 of the blade, the maximum thickness varies according to the linear function (increasing):

$$Tmax = 0.9058*h - 0.0518$$

[0037] The profile of each blade 10 was also suitably shaped to be able to maintain the same efficiency at high levels.

[0038] The aerodynamic profile of each blade 10 is preferably defined by means of a series of closed curves whose coordinates are defined with respect to a Cartesian reference system X, Y, Z, wherein the axis Z is a radial axis intersecting the central axis of the turbine, and said closed curves lying at distances Z from the central axis are defined according to Table I, whose values, expressed in millimeters, refer to an aerodynamic profile at room temperature, in particular 25°C.

Table I

X	Y	Z
-8.852	9.902	255.999
-8.847	9.904	255.999
-8.835	9.905	255.999
-8.812	9.901	255.999
-8.771	9.880	255.999
-8.717	9.833	255.999
-8.632	9.734	255.999
-8.533	9.594	255.999
-8.410	9.400	255.999
-8.263	9.152	255.999
-8.080	8.826	255.999
-7.871	8.449	255.999
-7.643	8.050	255.999

-7.382	7.603	255.999
-7.086	7.110	255.999
-6.751	6.573	255.999
-6.390	6.019	255.999
-6.005	5.448	255.999
-5.593	4.860	255.999
-5.155	4.256	255.999
-4.688	3.638	255.999
-4.190	3.006	255.999
-3.660	2.364	255.999
-3.096	1.711	255.999
-2.520	1.069	255.999
-1.933	0,30278	255.999
-1.338	-0.189	255.999
-0.735	-0.806	255.999
-0.126	-1.417	255.999
0,33958	-2.023	255.999
1.108	-2.624	255.999
1.732	-3.219	255.999
2.362	-3.809	255.999
2.995	-4.395	255.999
3.631	-4.978	255.999
4.249	-5.538	255.999

4.849	-6.075	255.999
5.432	-6.588	255.999
5.998	-7.077	255.999
6.545	-7.543	255.999
7.075	-7.986	255.999
7.586	-8.405	255.999
8.056	-8.784	255.999
8.485	-9.124	255.999
8.871	-9.424	255.999
9.214	-9.685	255.999
9.515	-9.908	255.999
9.771	-10.093	255.999
9.992	-10.249	255.999
10.179	-10.379	255.999
10.332	-10.485	255.999
10.426	-10.600	255.999
10.461	-10.708	255.999
10.465	-10.793	255.999
10.452	-10.864	255.999
10.432	-10.917	255.999
10.411	-10.955	255.999
10.385	-10.991	255.999
10.343	-11.034	255.999
10.282	-11.077	255.999

10.199	-11.110	255.999
10.081	-11.119	255.999
9.933	-11.073	255.999
9.765	-10.976	255.999
9.561	-10.857	255.999
9.318	-10.717	255.999
9.034	-10.552	255.999
8.697	-10.359	255.999
8.308	-10.137	255.999
7.867	-9.884	255.999
7.376	-9.600	255.999
6.835	-9.282	255.999
6.245	-8.931	255.999
5.633	-8.559	255.999
4.999	-8.165	255.999
4.344	-7.748	255.999
3.670	-7.305	255.999
2.977	-6.837	255.999
2.267	-6.341	255.999
1.543	-5.816	255.999
0,57639	-5.280	255.999
0,08958	-4.730	255.999
-0.558	-4.165	255.999

-1.230	-3.583	255.999
-1.886	-2.983	255.999
-2.526	-2.366	255.999
-3.146	-1.727	255.999
-3.744	-1.064	255.999
-4.317	-0.373	255.999
-4.864	0,24028	255.999
-5.383	1.085	255.999
-5.861	1.816	255.999
-6.301	2.535	255.999
-6.704	3.242	255.999
-7.070	3.934	255.999
-7.401	4.611	255.999
-7.697	5.271	255.999
-7.962	5.912	255.999
-8.194	6.533	255.999
-8.387	7.104	255.999
-8.547	7.623	255.999
-8.675	8.088	255.999
-8.783	8.528	255.999
-8.864	8.911	255.999
-8.914	9.209	255.999
-8.940	9.449	255.999

-8.945	9.630	255.999
-8.932	9.765	255.999
-8.911	9.837	255.999
-8.887	9.878	255.999
-8.869	9.894	255.999
-8.858	9.900	255.999
-8.675	9.767	258.001
-8.669	9.769	258.001
-8.658	9.770	258.001
-8.635	9.767	258.001
-8.593	9.746	258.001
-8.538	9.700	258.001
-8.452	9.604	258.001
-8.349	9.465	258.001
-8.222	9.274	258.001
-8.069	9.031	258.001
-7.877	8.711	258.001
-7.657	8.340	258.001
-7.419	7.947	258.001
-7.147	7.508	258.001
-6.840	7.022	258.001
-6.494	6.493	258.001
-6.123	5.948	258.001

-5.726	5.385	258.001
-5.304	4.805	258.001
-4.855	4.211	258.001
-4.377	3.601	258.001
-3.871	2.978	258.001
-3.333	2.342	258.001
-2.766	1.694	258.001
-2.187	1.055	258.001
-1.600	0,29514	258.001
-1.004	-0.198	258.001
-0.402	-0.814	258.001
0,14236	-1.425	258.001
0,56736	-2.031	258.001
1.433	-2.634	258.001
2.053	-3.232	258.001
2.677	-3.827	258.001
3.304	-4.418	258.001
3.933	-5.006	258.001
4.545	-5.571	258.001
5.139	-6.113	258.001
5.715	-6.632	258.001
6.274	-7.127	258.001
6.815	-7.600	258.001

7.337	-8.049	258.001
7.841	-8.476	258.001
8.305	-8.861	258.001
8.728	-9.206	258.001
9.109	-9.512	258.001
9.448	-9.778	258.001
9.744	-10.005	258.001
9.997	-10.194	258.001
10.215	-10.354	258.001
10.399	-10.486	258.001
10.552	-10.594	258.001
10.671	-10.684	258.001
10.731	-10.780	258.001
10.749	-10.863	258.001
10.744	-10.934	258.001
10.727	-10.988	258.001
10.707	-11.026	258.001
10.680	-11.062	258.001
10.636	-11.102	258.001
10.570	-11.137	258.001
10.482	-11.152	258.001
10.366	-11.127	258.001
10.233	-11.049	258.001

10.067	-10.949	258.001
9.866	-10.828	258.001
9.626	-10.684	258.001
9.346	-10.517	258.001
9.013	-10.321	258.001
8.629	-10.094	258.001
8.194	-9.837	258.001
7.710	-9.547	258.001
7.176	-9.224	258.001
6.594	-8.867	258.001
5.990	-8.489	258.001
5.364	-8.089	258.001
4.718	-7.666	258.001
4.052	-7.219	258.001
3.368	-6.746	258.001
2.667	-6.245	258.001
1.952	-5.716	258.001
1.247	-5.175	258.001
0,38472	-4.623	258.001
-0.127	-4.057	258.001
-0.794	-3.477	258.001
-1.448	-2.882	258.001
-2.087	-2.272	258.001

-2.710	-1.644	258.001
-3.314	-0.995	258.001
-3.895	-0.323	258.001
-4.454	0,25903	258.001
-4.991	1.094	258.001
-5.485	1.807	258.001
-5.940	2.511	258.001
-6.356	3.203	258.001
-6.736	3.884	258.001
-7.080	4.549	258.001
-7.389	5.198	258.001
-7.668	5.828	258.001
-7.915	6.439	258.001
-8.123	7.002	258.001
-8.297	7.513	258.001
-8.438	7.971	258.001
-8.559	8.404	258.001
-8.653	8.782	258.001
-8.713	9.076	258.001
-8.746	9.313	258.001
-8.757	9.493	258.001
-8.749	9.627	258.001
-8.731	9.700	258.001

-8.708	9.742	258.001
-8.691	9.759	258.001
-8.680	9.765	258.001
-8.508	9.651	259.194
-8.503	9.652	259.194
-8.491	9.654	259.194
-8.468	9.651	259.194
-8.427	9.631	259.194
-8.371	9.586	259.194
-8.283	9.491	259.194
-8.177	9.355	259.194
-8.046	9.168	259.194
-7.887	8.929	259.194
-7.688	8.614	259.194
-7.459	8.249	259.194
-7.212	7.863	259.194
-6.931	7.429	259.194
-6.615	6.950	259.194
-6.261	6.428	259.194
-5.882	5.888	259.194
-5.480	5.331	259.194
-5.052	4.757	259.194
-4.598	4.166	259.194

-4.117	3.561	259.194
-3.607	2.941	259.194
-3.069	2.307	259.194
-2.502	1.660	259.194
-1.925	1.022	259.194
-1.339	0,27222	259.194
-0.745	-0.231	259.194
-0.144	-0.847	259.194
0,32083	-1.458	259.194
1.073	-2.064	259.194
1.687	-2.667	259.194
2.304	-3.266	259.194
2.925	-3.862	259.194
3.549	-4.454	259.194
4.175	-5.044	259.194
4.784	-5.611	259.194
5.374	-6.155	259.194
5.946	-6.677	259.194
6.501	-7.176	259.194
7.037	-7.652	259.194
7.555	-8.105	259.194
8.055	-8.535	259.194
8.515	-8.924	259.194

8.933	-9.273	259.194
9.311	-9.582	259.194
9.646	-9.851	259.194
9.940	-10.081	259.194
10.190	-10.273	259.194
10.406	-10.435	259.194
10.588	-10.570	259.194
10.739	-10.679	259.194
10.860	-10.766	259.194
10.943	-10.845	259.194
10.975	-10.924	259.194
10.978	-10.996	259.194
10.963	-11.052	259.194
10.943	-11.090	259.194
10.915	-11.125	259.194
10.868	-11.161	259.194
10.798	-11.187	259.194
10.709	-11.185	259.194
10.603	-11.133	259.194
10.472	-11.052	259.194
10.309	-10.951	259.194
10.110	-10.828	259.194
9.873	-10.683	259.194

9.595	-10.513	259.194
9.266	-10.314	259.194
8.886	-10.085	259.194
8.456	-9.824	259.194
7.977	-9.531	259.194
7.449	-9.204	259.194
6.873	-8.842	259.194
6.275	-8.460	259.194
5.655	-8.057	259.194
5.015	-7.630	259.194
4.355	-7.180	259.194
3.678	-6.705	259.194
2.985	-6.205	259.194
2.278	-5.676	259.194
1.581	-5.137	259.194
0,62222	-4.586	259.194
0,15417	-4.023	259.194
-0.440	-3.446	259.194
-1.088	-2.855	259.194
-1.722	-2.249	259.194
-2.340	-1.626	259.194
-2.941	-0.984	259.194
-3.522	-0.322	259.194

-4.082	0,25139	259.194
-4.622	1.069	259.194
-5.124	1.773	259.194
-5.588	2.470	259.194
-6.014	3.155	259.194
-6.405	3.828	259.194
-6.760	4.486	259.194
-7.084	5.127	259.194
-7.377	5.750	259.194
-7.640	6.353	259.194
-7.864	6.909	259.194
-8.053	7.413	259.194
-8.209	7.866	259.194
-8.345	8.294	259.194
-8.451	8.668	259.194
-8.521	8.959	259.194
-8.563	9.195	259.194
-8.580	9.374	259.194
-8.577	9.509	259.194
-8.562	9.582	259.194
-8.540	9.625	259.194
-8.524	9.642	259.194
-8.514	9.648	259.194

-8.337	9.565	260.388
-8.331	9.567	260.388
-8.320	9.569	260.388
-8.297	9.566	260.388
-8.255	9.547	260.388
-8.198	9.503	260.388
-8.109	9.409	260.388
-8.001	9.275	260.388
-7.867	9.090	260.388
-7.705	8.854	260.388
-7.499	8.543	260.388
-7.264	8.183	260.388
-7.010	7.801	260.388
-6.723	7.373	260.388
-6.401	6.899	260.388
-6.041	6.381	260.388
-5.658	5.845	260.388
-5.252	5.291	260.388
-4.820	4.720	260.388
-4.364	4.133	260.388
-3.880	3.529	260.388
-3.370	2.911	260.388
-2.831	2.278	260.388
-2.265	1.632	260.388
-1.689	0,69028	260.388
-1.105	0,25278	260.388
-0.514	-0.259	260.388
0.084	-0.876	260.388
0,47708	-1.489	260.388
1.294	-2.096	260.388
1.906	-2.701	260.388
2.520	-3.301	260.388
3.139	-3.898	260.388
3.760	-4.492	260.388
4.384	-5.083	260.388
4.990	-5.651	260.388
5.578	-6.197	260.388
6.147	-6.720	260.388
6.699	-7.221	260.388
7.232	-7.699	260.388
7.747	-8.154	260.388
8.245	-8.586	260.388
8.702	-8.977	260.388
9.118	-9.328	260.388
9.494	-9.638	260.388
9.827	-9.909	260.388

10.119	-10.141	260.388
10.367	-10.335	260.388
10.581	-10.498	260.388
10.762	-10.634	260.388
10.912	-10.745	260.388
11.032	-10.833	260.388
11.118	-10.909	260.388
11.153	-10.987	260.388
11.157	-11.059	260.388
11.142	-11.115	260.388
11.122	-11.153	260.388
11.093	-11.187	260.388
11.045	-11.222	260.388
10.975	-11.244	260.388
10.887	-11.238	260.388
10.783	-11.182	260.388
10.654	-11.099	260.388
10.493	-10.996	260.388
10.297	-10.871	260.388
10.063	-10.723	260.388
9.789	-10.550	260.388
9.465	-10.347	260.388
9.090	-10.114	260.388

8.666	-9.848	260.388
8.193	-9.549	260.388
7.672	-9.216	260.388
7.104	-8.848	260.388
6.514	-8.460	260.388
5.902	-8.050	260.388
5.270	-7.617	260.388
4.619	-7.162	260.388
3.950	-6.683	260.388
3.265	-6.178	260.388
2.564	-5.646	260.388
1.874	-5.104	260.388
1.194	-4.550	260.388
0,36458	-3.983	260.388
-0.132	-3.404	260.388
-0.777	-2.810	260.388
-1.407	-2.202	260.388
-2.024	-1.577	260.388
-2.624	-0.935	260.388
-3.206	-0.273	260.388
-3.769	0,28472	260.388
-4.313	1.114	260.388
-4.818	1.811	260.388

-5.284	2.498	260.388
-5.714	3.173	260.388
-6.111	3.836	260.388
-6.474	4.483	260.388
-6.805	5.113	260.388
-7.109	5.725	260.388
-7.383	6.318	260.388
-7.619	6.863	260.388
-7.819	7.359	260.388
-7.987	7.803	260.388
-8.133	8.224	260.388
-8.249	8.592	260.388
-8.327	8.879	260.388
-8.376	9.111	260.388
-8.398	9.288	260.388
-8.399	9.422	260.388
-8.387	9.495	260.388
-8.368	9.538	260.388
-8.352	9.556	260.388
-8.342	9.562	260.388
-8.170	9.508	261.582
-8.164	9.510	261.582
-8.153	9.512	261.582

-8.130	9.509	261.582
-8.088	9.490	261.582
-8.031	9.446	261.582
-7.941	9.354	261.582
-7.832	9.222	261.582
-7.695	9.038	261.582
-7.530	8.804	261.582
-7.321	8.496	261.582
-7.081	8.140	261.582
-6.823	7.761	261.582
-6.531	7.336	261.582
-6.205	6.866	261.582
-5.841	6.352	261.582
-5.454	5.819	261.582
-5.045	5.268	261.582
-4.611	4.700	261.582
-4.152	4.114	261.582
-3.668	3.512	261.582
-3.156	2.895	261.582
-2.618	2.263	261.582
-2.052	1.618	261.582
-1.478	0,68056	261.582
-0.896	0,24236	261.582

-0.307	-0.277	261.582
0,19931	-0.896	261.582
0,61597	-1.511	261.582
1.491	-2.122	261.582
2.099	-2.728	261.582
2.711	-3.330	261.582
3.327	-3.929	261.582
3.945	-4.525	261.582
4.566	-5.118	261.582
5.170	-5.688	261.582
5.755	-6.235	261.582
6.322	-6.760	261.582
6.871	-7.263	261.582
7.402	-7.742	261.582
7.915	-8.199	261.582
8.410	-8.633	261.582
8.865	-9.026	261.582
9.280	-9.378	261.582
9.653	-9.690	261.582
9.985	-9.963	261.582
10.275	-10.196	261.582
10.522	-10.391	261.582
10.735	-10.556	261.582

10.915	-10.693	261.582
11.064	-10.805	261.582
11.183	-10.894	261.582
11.268	-10.970	261.582
11.303	-11.048	261.582
11.306	-11.119	261.582
11.291	-11.174	261.582
11.271	-11.212	261.582
11.242	-11.246	261.582
11.193	-11.280	261.582
11.123	-11.301	261.582
11.035	-11.292	261.582
10.933	-11.234	261.582
10.806	-11.150	261.582
10.646	-11.046	261.582
10.453	-10.919	261.582
10.222	-10.768	261.582
9.951	-10.592	261.582
9.630	-10.386	261.582
9.260	-10.147	261.582
8.841	-9.876	261.582
8.375	-9.572	261.582
7.860	-9.233	261.582

7.299	-8.858	261.582
6.716	-8.463	261.582
6.112	-8.047	261.582
5.488	-7.608	261.582
4.845	-7.147	261.582
4.184	-6.661	261.582
3.507	-6.151	261.582
2.814	-5.614	261.582
2.130	-5.068	261.582
1.457	-4.510	261.582
0,55139	-3.942	261.582
0,09931	-3.360	261.582
-0.496	-2.764	261.582
-1.121	-2.154	261.582
-1.733	-1.529	261.582
-2.329	-0.888	261.582
-2.909	-0.229	261.582
-3.471	0,31181	261.582
-4.016	1.147	261.582
-4.523	1.839	261.582
-4.993	2.519	261.582
-5.429	3.188	261.582
-5.831	3.843	261.582

-6.202	4.483	261.582
-6.543	5.106	261.582
-6.855	5.710	261.582
-7.140	6.295	261.582
-7.386	6.833	261.582
-7.597	7.322	261.582
-7.773	7.762	261.582
-7.929	8.177	261.582
-8.054	8.541	261.582
-8.139	8.824	261.582
-8.194	9.055	261.582
-8.222	9.230	261.582
-8.227	9.363	261.582
-8.217	9.436	261.582
-8.200	9.480	261.582
-8.185	9.498	261.582
-8.175	9.505	261.582
-8.032	9.470	262.778
-8.027	9.472	262.778
-8.015	9.475	262.778
-7.992	9.472	262.778
-7.950	9.453	262.778
-7.893	9.409	262.778

-7.803	9.318	262.778
-7.693	9.186	262.778
-7.555	9.003	262.778
-7.389	8.771	262.778
-7.177	8.465	262.778
-6.934	8.112	262.778
-6.673	7.736	262.778
-6.379	7.313	262.778
-6.049	6.846	262.778
-5.682	6.334	262.778
-5.293	5.804	262.778
-4.882	5.255	262.778
-4.447	4.688	262.778
-3.987	4.104	262.778
-3.502	3.504	262.778
-2.991	2.888	262.778
-2.454	2.257	262.778
-1.889	1.611	262.778
-1.316	0,675	262.778
-0.737	0,23542	262.778
-0.152	-0.289	262.778
0,30486	-0.911	262.778
1.035	-1.529	262.778

1.635	-2.142	262.778
2.240	-2.750	262.778
2.849	-3.355	262.778
3.461	-3.956	262.778
4.076	-4.554	262.778
4.694	-5.149	262.778
5.295	-5.721	262.778
5.877	-6.271	262.778
6.442	-6.798	262.778
6.988	-7.302	262.778
7.517	-7.783	262.778
8.028	-8.242	262.778
8.521	-8.678	262.778
8.974	-9.072	262.778
9.386	-9.426	262.778
9.758	-9.740	262.778
10.088	-10.014	262.778
10.376	-10.249	262.778
10.622	-10.445	262.778
10.833	-10.611	262.778
11.012	-10.750	262.778
11.159	-10.863	262.778
11.278	-10.953	262.778

11.364	-11.028	262.778
11.400	-11.106	262.778
11.404	-11.179	262.778
11.389	-11.235	262.778
11.367	-11.273	262.778
11.338	-11.306	262.778
11.290	-11.339	262.778
11.219	-11.359	262.778
11.132	-11.349	262.778
11.031	-11.289	262.778
10.905	-11.204	262.778
10.747	-11.098	262.778
10.556	-10.969	262.778
10.327	-10.816	262.778
10.060	-10.637	262.778
9.743	-10.426	262.778
9.378	-10.183	262.778
8.965	-9.907	262.778
8.504	-9.596	262.778
7.996	-9.251	262.778
7.442	-8.870	262.778
6.866	-8.468	262.778
6.270	-8.045	262.778

5.653	-7.599	262.778
5.018	-7.130	262.778
4.366	-6.638	262.778
3.696	-6.121	262.778
3.012	-5.578	262.778
2.336	-5.026	262.778
1.669	-4.464	262.778
1.012	-3.892	262.778
0,25556	-3.307	262.778
-0.264	-2.708	262.778
-0.883	-2.096	262.778
-1.490	-1.471	262.778
-2.082	-0.831	262.778
-2.659	-0.174	262.778
-3.219	0,34722	262.778
-3.762	1.192	262.778
-4.271	1.877	262.778
-4.746	2.553	262.778
-5.186	3.215	262.778
-5.594	3.864	262.778
-5.971	4.497	262.778
-6.320	5.113	262.778
-6.640	5.711	262.778
-6.933	6.290	262.778

-7.188	6.822	262.778	-7.086	8.444	263.972
-7.407	7.305	262.778	-6.841	8.091	263.972
-7.593	7.739	262.778	-6.578	7.717	263.972
-7.757	8.150	262.778	-6.282	7.296	263.972
-7.890	8.509	262.778	-5.950	6.830	263.972
-7.981	8.790	262.778	-5.582	6.320	263.972
-8.042	9.018	262.778	-5.191	5.791	263.972
-8.074	9.192	262.778	-4.778	5.244	263.972
-8.084	9.324	262.778	-4.342	4.678	263.972
-8.077	9.397	262.778	-3.882	4.095	263.972
-8.061	9.442	262.778	-3.397	3.495	263.972
-8.047	9.460	262.778	-2.886	2.878	263.972
-8.037	9.467	262.778	-2.350	2.246	263.972
-7.944	9.446	263.972	-1.787	1.599	263.972
-7.938	9.448	263.972	-1.216	0,66597	263.972
-7.927	9.451	263.972	-0.640	0,225	263.972
-7.904	9.448	263.972	-0.058	-0.306	263.972
-7.862	9.428	263.972	0,36736	-0.931	263.972
-7.805	9.385	263.972	1.122	-1.551	263.972
-7.714	9.294	263.972	1.719	-2.166	263.972
-7.604	9.162	263.972	2.320	-2.778	263.972
-7.466	8.980	263.972	2.926	-3.385	263.972
-7.299	8.748	263.972	3.535	-3.989	263.972

4.147	-4.590	263.972
4.762	-5.188	263.972
5.359	-5.762	263.972
5.939	-6.314	263.972
6.501	-6.843	263.972
7.046	-7.350	263.972
7.572	-7.833	263.972
8.081	-8.294	263.972
8.571	-8.732	263.972
9.022	-9.128	263.972
9.433	-9.484	263.972
9.802	-9.800	263.972
10.130	-10.076	263.972
10.417	-10.312	263.972
10.661	-10.510	263.972
10.872	-10.678	263.972
11.049	-10.818	263.972
11.196	-10.932	263.972
11.313	-11.023	263.972
11.398	-11.099	263.972
11.432	-11.178	263.972
11.434	-11.249	263.972
11.418	-11.304	263.972

11.396	-11.341	263.972
11.367	-11.374	263.972
11.318	-11.406	263.972
11.247	-11.426	263.972
11.160	-11.415	263.972
11.060	-11.355	263.972
10.936	-11.268	263.972
10.780	-11.160	263.972
10.591	-11.029	263.972
10.365	-10.873	263.972
10.101	-10.690	263.972
9.788	-10.476	263.972
9.427	-10.228	263.972
9.019	-9.947	263.972
8.564	-9.630	263.972
8.062	-9.278	263.972
7.515	-8.890	263.972
6.947	-8.480	263.972
6.358	-8.050	263.972
5.750	-7.596	263.972
5.123	-7.120	263.972
4.478	-6.621	263.972
3.817	-6.097	263.972

3.141	-5.547	263.972
2.473	-4.988	263.972
1.814	-4.421	263.972
1.165	-3.843	263.972
0,36597	-3.254	263.972
-0.099	-2.652	263.972
-0.712	-2.038	263.972
-1.313	-1.411	263.972
-1.901	-0.771	263.972
-2.475	-0.116	263.972
-3.032	0,38542	263.972
-3.574	1.242	263.972
-4.083	1.922	263.972
-4.560	2.592	263.972
-5.005	3.250	263.972
-5.418	3.893	263.972
-5.801	4.520	263.972
-6.155	5.130	263.972
-6.483	5.722	263.972
-6.784	6.295	263.972
-7.046	6.821	263.972
-7.273	7.299	263.972
-7.465	7.729	263.972

-7.636	8.135	263.972
-7.776	8.491	263.972
-7.873	8.769	263.972
-7.939	8.995	263.972
-7.976	9.167	263.972
-7.990	9.299	263.972
-7.985	9.372	263.972
-7.971	9.417	263.972
-7.958	9.436	263.972
-7.949	9.443	263.972
-7.918	9.437	264.569
-7.912	9.439	264.569
-7.901	9.441	264.569
-7.878	9.438	264.569
-7.836	9.419	264.569
-7.779	9.376	264.569
-7.688	9.284	264.569
-7.578	9.153	264.569
-7.440	8.971	264.569
-7.272	8.739	264.569
-7.058	8.435	264.569
-6.812	8.084	264.569
-6.549	7.710	264.569

-6.252	7.290	264.569
-5.920	6.824	264.569
-5.550	6.316	264.569
-5.158	5.787	264.569
-4.745	5.240	264.569
-4.308	4.675	264.569
-3.848	4.092	264.569
-3.363	3.492	264.569
-2.852	2.876	264.569
-2.316	2.244	264.569
-1.754	1.596	264.569
-1.185	0,66319	264.569
-0.610	0,22153	264.569
-0.029	-0.312	264.569
0,38611	-0.938	264.569
1.147	-1.560	264.569
1.743	-2.177	264.569
2.343	-2.790	264.569
2.946	-3.399	264.569
3.553	-4.005	264.569
4.164	-4.607	264.569
4.777	-5.207	264.569
5.373	-5.783	264.569

5.951	-6.336	264.569
6.511	-6.867	264.569
7.054	-7.375	264.569
7.579	-7.859	264.569
8.086	-8.322	264.569
8.575	-8.761	264.569
9.025	-9.159	264.569
9.434	-9.516	264.569
9.802	-9.833	264.569
10.129	-10.110	264.569
10.415	-10.348	264.569
10.659	-10.547	264.569
10.868	-10.716	264.569
11.045	-10.856	264.569
11.191	-10.971	264.569
11.308	-11.062	264.569
11.391	-11.140	264.569
11.424	-11.218	264.569
11.425	-11.289	264.569
11.408	-11.343	264.569
11.387	-11.380	264.569
11.357	-11.412	264.569
11.308	-11.445	264.569

11.238	-11.464	264.569
11.151	-11.453	264.569
11.051	-11.392	264.569
10.927	-11.305	264.569
10.772	-11.196	264.569
10.584	-11.063	264.569
10.360	-10.906	264.569
10.097	-10.722	264.569
9.786	-10.506	264.569
9.427	-10.256	264.569
9.021	-9.972	264.569
8.569	-9.653	264.569
8.070	-9.298	264.569
7.526	-8.906	264.569
6.961	-8.493	264.569
6.376	-8.059	264.569
5.771	-7.602	264.569
5.148	-7.122	264.569
4.507	-6.619	264.569
3.850	-6.092	264.569
3.177	-5.538	264.569
2.513	-4.977	264.569
1.858	-4.406	264.569

1.212	-3.825	264.569
0,40139	-3.234	264.569
-0.045	-2.630	264.569
-0.656	-2.015	264.569
-1.254	-1.387	264.569
-1.840	-0.746	264.569
-2.412	-0.091	264.569
-2.968	0,40208	264.569
-3.509	1.265	264.569
-4.018	1.942	264.569
-4.495	2.610	264.569
-4.941	3.266	264.569
-5.356	3.906	264.569
-5.741	4.531	264.569
-6.099	5.138	264.569
-6.429	5.727	264.569
-6.733	6.298	264.569
-6.998	6.822	264.569
-7.228	7.298	264.569
-7.423	7.725	264.569
-7.597	8.130	264.569
-7.740	8.484	264.569
-7.840	8.761	264.569

-7.908	8.985	264.569
-7.946	9.157	264.569
-7.961	9.289	264.569
-7.958	9.362	264.569
-7.945	9.407	264.569
-7.932	9.426	264.569
-7.923	9.434	264.569
-7.904	9.427	265.166
-7.898	9.430	265.166
-7.887	9.432	265.166
-7.864	9.429	265.166
-7.822	9.410	265.166
-7.765	9.367	265.166
-7.674	9.276	265.166
-7.563	9.144	265.166
-7.424	8.963	265.166
-7.256	8.732	265.166
-7.041	8.429	265.166
-6.795	8.078	265.166
-6.530	7.705	265.166
-6.232	7.285	265.166
-5.899	6.821	265.166
-5.528	6.313	265.166

-5.136	5.786	265.166
-4.721	5.240	265.166
-4.284	4.675	265.166
-3.823	4.093	265.166
-3.337	3.493	265.166
-2.827	2.877	265.166
-2.291	2.245	265.166
-1.730	1.597	265.166
-1.162	0,66319	265.166
-0.588	0,22083	265.166
-0.009	-0.315	265.166
0,39931	-0.942	265.166
1.164	-1.565	265.166
1.758	-2.183	265.166
2.356	-2.798	265.166
2.957	-3.410	265.166
3.561	-4.017	265.166
4.169	-4.622	265.166
4.780	-5.223	265.166
5.374	-5.801	265.166
5.950	-6.357	265.166
6.509	-6.889	265.166
7.050	-7.399	265.166

7.573	-7.886	265.166
8.078	-8.350	265.166
8.565	-8.791	265.166
9.013	-9.191	265.166
9.420	-9.550	265.166
9.787	-9.868	265.166
10.113	-10.147	265.166
10.397	-10.386	265.166
10.640	-10.586	265.166
10.848	-10.756	265.166
11.024	-10.897	265.166
11.170	-11.013	265.166
11.286	-11.105	265.166
11.369	-11.182	265.166
11.401	-11.261	265.166
11.402	-11.332	265.166
11.385	-11.386	265.166
11.363	-11.423	265.166
11.333	-11.455	265.166
11.284	-11.487	265.166
11.214	-11.506	265.166
11.127	-11.495	265.166
11.028	-11.434	265.166

10.905	-11.346	265.166
10.750	-11.236	265.166
10.563	-11.102	265.166
10.340	-10.944	265.166
10.078	-10.759	265.166
9.769	-10.540	265.166
9.412	-10.288	265.166
9.008	-10.002	265.166
8.558	-9.681	265.166
8.062	-9.323	265.166
7.521	-8.928	265.166
6.959	-8.512	265.166
6.377	-8.075	265.166
5.775	-7.615	265.166
5.155	-7.132	265.166
4.517	-6.626	265.166
3.863	-6.095	265.166
3.194	-5.538	265.166
2.534	-4.973	265.166
1.882	-4.400	265.166
1.240	-3.816	265.166
0,42222	-3.222	265.166
-0.011	-2.617	265.166

-0.620	-2.000	265.166
-1.216	-1.371	265.166
-1.800	-0.729	265.166
-2.369	-0.074	265.166
-2.924	0,41389	265.166
-3.464	1.281	265.166
-3.972	1.957	265.166
-4.450	2.622	265.166
-4.897	3.276	265.166
-5.313	3.915	265.166
-5.700	4.537	265.166
-6.060	5.143	265.166
-6.392	5.730	265.166
-6.699	6.298	265.166
-6.966	6.820	265.166
-7.199	7.294	265.166
-7.396	7.720	265.166
-7.572	8.123	265.166
-7.717	8.475	265.166
-7.819	8.750	265.166
-7.889	8.975	265.166
-7.929	9.147	265.166
-7.946	9.278	265.166
-7.943	9.352	265.166
-7.931	9.397	265.166
-7.918	9.417	265.166
-7.909	9.424	265.166
-7.900	9.417	265.763
-7.895	9.420	265.763
-7.884	9.422	265.763
-7.861	9.419	265.763
-7.819	9.400	265.763
-7.761	9.357	265.763
-7.669	9.267	265.763
-7.558	9.136	265.763
-7.419	8.956	265.763
-7.250	8.725	265.763
-7.034	8.423	265.763
-6.786	8.073	265.763
-6.521	7.701	265.763
-6.221	7.283	265.763
-5.887	6.820	265.763
-5.515	6.313	265.763
-5.121	5.787	265.763
-4.705	5.242	265.763
-4.267	4.678	265.763

-3.805	4.097	265.763
-3.319	3.498	265.763
-2.809	2.882	265.763
-2.274	2.250	265.763
-1.713	1.602	265.763
-1.146	0,66597	265.763
-0.574	0,22292	265.763
0.003	-0.312	265.763
0,40625	-0.941	265.763
1.172	-1.565	265.763
1.764	-2.186	265.763
2.359	-2.802	265.763
2.958	-3.416	265.763
3.560	-4.026	265.763
4.165	-4.633	265.763
4.773	-5.237	265.763
5.364	-5.817	265.763
5.938	-6.375	265.763
6.494	-6.909	265.763
7.032	-7.421	265.763
7.553	-7.910	265.763
8.055	-8.377	265.763
8.540	-8.820	265.763

8.985	-9.222	265.763
9.391	-9.583	265.763
9.756	-9.903	265.763
10.080	-10.184	265.763
10.363	-10.424	265.763
10.604	-10.626	265.763
10.812	-10.796	265.763
10.987	-10.939	265.763
11.132	-11.055	265.763
11.248	-11.148	265.763
11.332	-11.225	265.763
11.366	-11.305	265.763
11.367	-11.377	265.763
11.350	-11.433	265.763
11.328	-11.470	265.763
11.298	-11.503	265.763
11.249	-11.534	265.763
11.178	-11.553	265.763
11.091	-11.541	265.763
10.993	-11.480	265.763
10.870	-11.391	265.763
10.716	-11.281	265.763
10.530	-11.146	265.763

10.307	-10.986	265.763
10.047	-10.800	265.763
9.739	-10.580	265.763
9.383	-10.327	265.763
8.981	-10.038	265.763
8.533	-9.714	265.763
8.039	-9.354	265.763
7.500	-8.957	265.763
6.940	-8.538	265.763
6.361	-8.098	265.763
5.762	-7.635	265.763
5.144	-7.149	265.763
4.509	-6.640	265.763
3.858	-6.106	265.763
3.192	-5.547	265.763
2.535	-4.979	265.763
1.886	-4.402	265.763
1.247	-3.816	265.763
0,42986	-3.220	265.763
0.001	-2.612	265.763
-0.605	-1.994	265.763
-1.199	-1.364	265.763
-1.780	-0.721	265.763

-2.348	-0.065	265.763
-2.901	0,42014	265.763
-3.440	1.290	265.763
-3.947	1.965	265.763
-4.424	2.629	265.763
-4.872	3.281	265.763
-5.290	3.918	265.763
-5.678	4.539	265.763
-6.039	5.143	265.763
-6.374	5.729	265.763
-6.682	6.295	265.763
-6.951	6.816	265.763
-7.185	7.289	265.763
-7.385	7.714	265.763
-7.563	8.115	265.763
-7.709	8.467	265.763
-7.812	8.741	265.763
-7.883	8.965	265.763
-7.924	9.137	265.763
-7.941	9.268	265.763
-7.939	9.342	265.763
-7.927	9.387	265.763
-7.914	9.407	265.763

-7.905	9.414	265.763
-7.906	9.405	266.360
-7.901	9.408	266.360
-7.889	9.410	266.360
-7.866	9.408	266.360
-7.824	9.389	266.360
-7.766	9.347	266.360
-7.674	9.257	266.360
-7.562	9.127	266.360
-7.421	8.947	266.360
-7.251	8.718	266.360
-7.034	8.417	266.360
-6.785	8.068	266.360
-6.518	7.697	266.360
-6.217	7.280	266.360
-5.880	6.818	266.360
-5.507	6.313	266.360
-5.111	5.788	266.360
-4.694	5.244	266.360
-4.255	4.681	266.360
-3.792	4.101	266.360
-3.306	3.502	266.360
-2.795	2.887	266.360

-2.260	2.255	266.360
-1.699	1.606	266.360
-1.134	0,66806	266.360
-0.563	0,22431	266.360
0.012	-0.312	266.360
0,41181	-0.942	266.360
1.178	-1.568	266.360
1.768	-2.190	266.360
2.361	-2.809	266.360
2.956	-3.425	266.360
3.555	-4.038	266.360
4.158	-4.648	266.360
4.763	-5.254	266.360
5.351	-5.838	266.360
5.922	-6.398	266.360
6.475	-6.936	266.360
7.011	-7.450	266.360
7.529	-7.942	266.360
8.029	-8.411	266.360
8.511	-8.858	266.360
8.954	-9.262	266.360
9.357	-9.625	266.360
9.721	-9.948	266.360

10.043	-10.230	266.360
10.324	-10.473	266.360
10.564	-10.675	266.360
10.771	-10.847	266.360
10.945	-10.991	266.360
11.089	-11.108	266.360
11.205	-11.201	266.360
11.288	-11.279	266.360
11.321	-11.359	266.360
11.322	-11.431	266.360
11.305	-11.486	266.360
11.283	-11.524	266.360
11.252	-11.556	266.360
11.203	-11.588	266.360
11.133	-11.606	266.360
11.046	-11.594	266.360
10.947	-11.532	266.360
10.825	-11.443	266.360
10.672	-11.331	266.360
10.486	-11.196	266.360
10.265	-11.035	266.360
10.005	-10.848	266.360
9.698	-10.627	266.360

9.344	-10.371	266.360
8.943	-10.081	266.360
8.496	-9.755	266.360
8.004	-9.393	266.360
7.467	-8.993	266.360
6.909	-8.573	266.360
6.332	-8.130	266.360
5.735	-7.665	266.360
5.119	-7.176	266.360
4.487	-6.664	266.360
3.838	-6.128	266.360
3.175	-5.565	266.360
2.520	-4.995	266.360
1.874	-4.415	266.360
1.237	-3.827	266.360
0,42431	-3.228	266.360
-0.004	-2.618	266.360
-0.607	-1.998	266.360
-1.199	-1.366	266.360
-1.779	-0.722	266.360
-2.344	-0.065	266.360
-2.896	0,42083	266.360
-3.434	1.290	266.360

-3.940	1.964	266.360
-4.417	2.628	266.360
-4.864	3.279	266.360
-5.282	3.915	266.360
-5.672	4.535	266.360
-6.034	5.138	266.360
-6.370	5.723	266.360
-6.679	6.288	266.360
-6.950	6.808	266.360
-7.186	7.280	266.360
-7.386	7.704	266.360
-7.565	8.105	266.360
-7.712	8.456	266.360
-7.816	8.730	266.360
-7.888	8.954	266.360
-7.929	9.125	266.360
-7.947	9.256	266.360
-7.945	9.330	266.360
-7.933	9.375	266.360
-7.920	9.395	266.360
-7.911	9.402	266.360
-7.918	9.391	266.957
-7.913	9.393	266.957

-7.902	9.396	266.957
-7.878	9.394	266.957
-7.836	9.376	266.957
-7.778	9.334	266.957
-7.684	9.245	266.957
-7.571	9.116	266.957
-7.430	8.937	266.957
-7.258	8.709	266.957
-7.039	8.409	266.957
-6.788	8.062	266.957
-6.520	7.692	266.957
-6.217	7.276	266.957
-5.879	6.816	266.957
-5.503	6.312	266.957
-5.106	5.788	266.957
-4.688	5.245	266.957
-4.247	4.683	266.957
-3.783	4.104	266.957
-3.295	3.506	266.957
-2.784	2.891	266.957
-2.249	2.259	266.957
-1.689	1.610	266.957
-1.125	0,67014	266.957

-0.555	0,22569	266.957
0.019	-0.312	266.957
0,41528	-0.944	266.957
1.181	-1.572	266.957
1.768	-2.196	266.957
2.359	-2.818	266.957
2.951	-3.436	266.957
3.547	-4.052	266.957
4.147	-4.665	266.957
4.749	-5.275	266.957
5.334	-5.862	266.957
5.901	-6.425	266.957
6.451	-6.966	266.957
6.984	-7.484	266.957
7.499	-7.979	266.957
7.996	-8.451	266.957
8.475	-8.900	266.957
8.916	-9.308	266.957
9.317	-9.674	266.957
9.678	-9.999	266.957
9.998	-10.283	266.957
10.278	-10.527	266.957
10.517	-10.731	266.957

10.722	-10.905	266.957
10.896	-11.049	266.957
11.039	-11.167	266.957
11.154	-11.261	266.957
11.237	-11.339	266.957
11.270	-11.419	266.957
11.270	-11.492	266.957
11.253	-11.547	266.957
11.230	-11.585	266.957
11.200	-11.617	266.957
11.150	-11.648	266.957
11.080	-11.666	266.957
10.993	-11.654	266.957
10.895	-11.591	266.957
10.773	-11.501	266.957
10.620	-11.389	266.957
10.435	-11.253	266.957
10.214	-11.092	266.957
9.955	-10.903	266.957
9.649	-10.681	266.957
9.296	-10.424	266.957
8.896	-10.132	266.957
8.450	-9.805	266.957

7.959	-9.441	266.957
7.423	-9.039	266.957
6.867	-8.616	266.957
6.291	-8.172	266.957
5.696	-7.704	266.957
5.082	-7.213	266.957
4.451	-6.699	266.957
3.804	-6.160	266.957
3.143	-5.595	266.957
2.490	-5.021	266.957
1.846	-4.439	266.957
1.212	-3.848	266.957
0,40903	-3.247	266.957
-0.024	-2.636	266.957
-0.626	-2.013	266.957
-1.215	-1.380	266.957
-1.793	-0.734	266.957
-2.357	-0.076	266.957
-2.907	0,41389	266.957
-3.443	1.281	266.957
-3.948	1.955	266.957
-4.424	2.618	266.957
-4.871	3.268	266.957

-5.290	3.905	266.957
-5.680	4.524	266.957
-6.042	5.127	266.957
-6.379	5.711	266.957
-6.689	6.276	266.957
-6.961	6.795	266.957
-7.196	7.267	266.957
-7.397	7.690	266.957
-7.577	8.091	266.957
-7.725	8.442	266.957
-7.828	8.716	266.957
-7.900	8.939	266.957
-7.942	9.111	266.957
-7.960	9.242	266.957
-7.958	9.315	266.957
-7.945	9.361	266.957
-7.932	9.380	266.957
-7.923	9.388	266.957
-8.048	9.150	271.165
-8.043	9.153	271.165
-8.032	9.156	271.165
-8.008	9.157	271.165
-7.964	9.144	271.165

-7.902	9.108	271.165
-7.802	9.026	271.165
-7.682	8.903	271.165
-7.531	8.731	271.165
-7.350	8.510	271.165
-7.121	8.216	271.165
-6.859	7.876	271.165
-6.580	7.513	271.165
-6.267	7.103	271.165
-5.920	6.648	271.165
-5.535	6.150	271.165
-5.131	5.630	271.165
-4.706	5.090	271.165
-4.261	4.530	271.165
-3.794	3.950	271.165
-3.306	3.351	271.165
-2.796	2.733	271.165
-2.264	2.095	271.165
-1.710	1.439	271.165
-1.152	0,54583	271.165
-0.592	0,09375	271.165
-0.030	-0.515	271.165
0,37083	-1.162	271.165

1.101	-1.807	271.165
1.670	-2.450	271.165
2.240	-3.093	271.165
2.812	-3.733	271.165
3.385	-4.373	271.165
3.961	-5.010	271.165
4.539	-5.645	271.165
5.100	-6.257	271.165
5.644	-6.845	271.165
6.172	-7.410	271.165
6.683	-7.951	271.165
7.177	-8.469	271.165
7.654	-8.963	271.165
8.115	-9.433	271.165
8.539	-9.860	271.165
8.925	-10.243	271.165
9.274	-10.583	271.165
9.583	-10.880	271.165
9.854	-11.136	271.165
10.085	-11.349	271.165
10.284	-11.530	271.165
10.453	-11.681	271.165
10.592	-11.805	271.165

10.704	-11.903	271.165
10.784	-11.984	271.165
10.815	-12.066	271.165
10.813	-12.138	271.165
10.794	-12.193	271.165
10.770	-12.230	271.165
10.739	-12.261	271.165
10.689	-12.292	271.165
10.617	-12.308	271.165
10.531	-12.293	271.165
10.434	-12.227	271.165
10.314	-12.134	271.165
10.165	-12.018	271.165
9.982	-11.876	271.165
9.765	-11.709	271.165
9.510	-11.513	271.165
9.208	-11.283	271.165
8.860	-11.018	271.165
8.465	-10.717	271.165
8.025	-10.380	271.165
7.540	-10.004	271.165
7.012	-9.590	271.165
6.463	-9.155	271.165

5.894	-8.698	271.165
5.307	-8.217	271.165
4.702	-7.713	271.165
4.080	-7.184	271.165
3.443	-6.630	271.165
2.793	-6.049	271.165
2.151	-5.461	271.165
1.518	-4.864	271.165
0,62153	-4.258	271.165
0,19583	-3.642	271.165
-0.319	-3.016	271.165
-0.909	-2.380	271.165
-1.488	-1.733	271.165
-2.055	-1.076	271.165
-2.609	-0.406	271.165
-3.149	0,19236	271.165
-3.676	0,67431	271.165
-4.173	1.654	271.165
-4.640	2.325	271.165
-5.079	2.982	271.165
-5.491	3.625	271.165
-5.875	4.250	271.165
-6.232	4.858	271.165

-6.563	5.446	271.165
-6.868	6.015	271.165
-7.136	6.538	271.165
-7.367	7.013	271.165
-7.564	7.440	271.165
-7.739	7.844	271.165
-7.883	8.197	271.165
-7.983	8.473	271.165
-8.050	8.698	271.165
-8.088	8.871	271.165
-8.100	9.003	271.165
-8.093	9.077	271.165
-8.077	9.121	271.165
-8.062	9.140	271.165
-8.053	9.147	271.165
-8.158	8.724	275.374
-8.153	8.727	275.374
-8.141	8.729	275.374
-8.118	8.727	275.374
-8.075	8.708	275.374
-8.017	8.665	275.374
-7.923	8.575	275.374
-7.809	8.444	275.374

-7.666	8.263	275.374
-7.493	8.033	275.374
-7.272	7.729	275.374
-7.020	7.378	275.374
-6.749	7.003	275.374
-6.446	6.582	275.374
-6.108	6.114	275.374
-5.734	5.600	275.374
-5.340	5.066	275.374
-4.927	4.510	275.374
-4.493	3.933	275.374
-4.038	3.337	275.374
-3.562	2.720	275.374
-3.064	2.084	275.374
-2.544	1.428	275.374
-2.001	0,52292	275.374
-1.456	0.081	275.374
-0.907	-0.589	275.374
-0.355	-1.256	275.374
0,13889	-1.921	275.374
0,52639	-2.583	275.374
1.319	-3.243	275.374
1.882	-3.900	275.374

2.448	-4.555	275.374
3.018	-5.207	275.374
3.590	-5.857	275.374
4.166	-6.503	275.374
4.727	-7.125	275.374
5.272	-7.721	275.374
5.800	-8.294	275.374
6.313	-8.842	275.374
6.809	-9.366	275.374
7.288	-9.866	275.374
7.750	-10.343	275.374
8.175	-10.775	275.374
8.562	-11.163	275.374
8.911	-11.509	275.374
9.220	-11.812	275.374
9.490	-12.072	275.374
9.721	-12.291	275.374
9.919	-12.476	275.374
10.086	-12.631	275.374
10.224	-12.758	275.374
10.335	-12.859	275.374
10.414	-12.942	275.374
10.444	-13.025	275.374

10.442	-13.098	275.374
10.422	-13.153	275.374
10.397	-13.190	275.374
10.365	-13.220	275.374
10.313	-13.249	275.374
10.241	-13.263	275.374
10.155	-13.244	275.374
10.061	-13.175	275.374
9.943	-13.078	275.374
9.797	-12.956	275.374
9.619	-12.808	275.374
9.407	-12.632	275.374
9.158	-12.427	275.374
8.864	-12.185	275.374
8.525	-11.906	275.374
8.140	-11.589	275.374
7.712	-11.234	275.374
7.241	-10.838	275.374
6.727	-10.402	275.374
6.194	-9.944	275.374
5.643	-9.462	275.374
5.075	-8.956	275.374
4.490	-8.426	275.374

3.890	-7.870	275.374
3.276	-7.289	275.374
2.648	-6.680	275.374
2.028	-6.064	275.374
1.417	-5.440	275.374
0,56528	-4.808	275.374
0,15417	-4.168	275.374
-0.362	-3.518	275.374
-0.935	-2.860	275.374
-1.499	-2.194	275.374
-2.054	-1.518	275.374
-2.597	-0.833	275.374
-3.129	-0.138	275.374
-3.651	0,39444	275.374
-4.144	1.259	275.374
-4.610	1.936	275.374
-5.050	2.597	275.374
-5.462	3.240	275.374
-5.849	3.864	275.374
-6.211	4.470	275.374
-6.548	5.056	275.374
-6.862	5.621	275.374
-7.139	6.140	275.374

-7.380	6.610	275.374
-7.588	7.032	275.374
-7.776	7.431	275.374
-7.932	7.780	275.374
-8.044	8.052	275.374
-8.122	8.273	275.374
-8.170	8.443	275.374
-8.192	8.574	275.374
-8.194	8.647	275.374
-8.184	8.693	275.374
-8.172	8.713	275.374
-8.163	8.721	275.374
-8.263	8.345	279.583
-8.257	8.348	279.583
-8.245	8.350	279.583
-8.222	8.348	279.583
-8.178	8.329	279.583
-8.117	8.286	279.583
-8.021	8.194	279.583
-7.904	8.061	279.583
-7.757	7.876	279.583
-7.579	7.639	279.583
-7.353	7.328	279.583

-7.095	6.968	279.583
-6.819	6.583	279.583
-6.510	6.150	279.583
-6.166	5.668	279.583
-5.787	5.139	279.583
-5.390	4.587	279.583
-4.973	4.013	279.583
-4.537	3.416	279.583
-4.080	2.797	279.583
-3.603	2.157	279.583
-3.104	1.497	279.583
-2.583	0,56597	279.583
-2.041	0,07847	279.583
-1.496	-0.587	279.583
-0.948	-1.285	279.583
-0.399	-1.982	279.583
0,10625	-2.677	279.583
0,49236	-3.369	279.583
1.266	-4.059	279.583
1.826	-4.747	279.583
2.389	-5.433	279.583
2.954	-6.117	279.583
3.524	-6.797	279.583

4.097	-7.474	279.583
4.655	-8.125	279.583
5.198	-8.751	279.583
5.724	-9.351	279.583
6.235	-9.926	279.583
6.729	-10.476	279.583
7.207	-11.001	279.583
7.668	-11.501	279.583
8.092	-11.955	279.583
8.478	-12.363	279.583
8.826	-12.727	279.583
9.134	-13.045	279.583
9.404	-13.319	279.583
9.634	-13.549	279.583
9.832	-13.744	279.583
10.000	-13.907	279.583
10.138	-14.041	279.583
10.249	-14.147	279.583
10.330	-14.233	279.583
10.360	-14.317	279.583
10.358	-14.392	279.583
10.336	-14.448	279.583
10.310	-14.486	279.583

10.277	-14.516	279.583
10.223	-14.544	279.583
10.149	-14.555	279.583
10.061	-14.531	279.583
9.967	-14.457	279.583
9.850	-14.354	279.583
9.703	-14.226	279.583
9.524	-14.071	279.583
9.311	-13.886	279.583
9.061	-13.671	279.583
8.765	-13.417	279.583
8.424	-13.123	279.583
8.038	-12.790	279.583
7.608	-12.417	279.583
7.135	-12.001	279.583
6.618	-11.544	279.583
6.083	-11.063	279.583
5.529	-10.558	279.583
4.959	-10.028	279.583
4.372	-9.473	279.583
3.771	-8.891	279.583
3.155	-8.282	279.583
2.526	-7.644	279.583

1.906	-6.998	279.583
1.295	-6.344	279.583
0,48125	-5.682	279.583
0,07014	-5.011	279.583
-0.481	-4.331	279.583
-1.053	-3.642	279.583
-1.615	-2.944	279.583
-2.168	-2.238	279.583
-2.709	-1.521	279.583
-3.241	-0.796	279.583
-3.761	-0.060	279.583
-4.254	0,45694	279.583
-4.718	1.360	279.583
-5.155	2.043	279.583
-5.565	2.708	279.583
-5.950	3.353	279.583
-6.311	3.978	279.583
-6.648	4.581	279.583
-6.962	5.163	279.583
-7.240	5.696	279.583
-7.483	6.179	279.583
-7.691	6.612	279.583
-7.880	7.021	279.583

-8.038	7.379	279.583
-8.151	7.657	279.583
-8.231	7.884	279.583
-8.278	8.058	279.583
-8.300	8.192	279.583
-8.300	8.267	279.583
-8.289	8.313	279.583
-8.277	8.334	279.583
-8.268	8.342	279.583
-8.384	8.472	283.792
-8.378	8.475	283.792
-8.366	8.477	283.792
-8.341	8.475	283.792
-8.296	8.454	283.792
-8.235	8.408	283.792
-8.138	8.310	283.792
-8.020	8.170	283.792
-7.872	7.976	283.792
-7.692	7.728	283.792
-7.465	7.402	283.792
-7.205	7.025	283.792
-6.929	6.622	283.792
-6.619	6.167	283.792

-6.276	5.661	283.792
-5.898	5.105	283.792
-5.502	4.525	283.792
-5.087	3.920	283.792
-4.653	3.292	283.792
-4.198	2.640	283.792
-3.722	1.966	283.792
-3.225	1.269	283.792
-2.707	0,38194	283.792
-2.167	-0.191	283.792
-1.625	-0.929	283.792
-1.079	-1.666	283.792
-0.530	-2.400	283.792
0.022	-3.132	283.792
0,40069	-3.862	283.792
1.136	-4.588	283.792
1.697	-5.313	283.792
2.261	-6.036	283.792
2.829	-6.756	283.792
3.399	-7.473	283.792
3.974	-8.188	283.792
4.532	-8.876	283.792
5.075	-9.537	283.792

5.602	-10.172	283.792
6.113	-10.781	283.792
6.607	-11.363	283.792
7.085	-11.920	283.792
7.546	-12.450	283.792
7.970	-12.932	283.792
8.356	-13.365	283.792
8.705	-13.751	283.792
9.014	-14.089	283.792
9.285	-14.380	283.792
9.516	-14.624	283.792
9.715	-14.831	283.792
9.884	-15.004	283.792
10.023	-15.145	283.792
10.135	-15.258	283.792
10.217	-15.348	283.792
10.249	-15.434	283.792
10.245	-15.510	283.792
10.223	-15.567	283.792
10.196	-15.605	283.792
10.160	-15.635	283.792
10.104	-15.662	283.792
10.027	-15.670	283.792

9.938	-15.641	283.792
9.843	-15.561	283.792
9.724	-15.453	283.792
9.574	-15.319	283.792
9.391	-15.155	283.792
9.174	-14.961	283.792
8.919	-14.734	283.792
8.617	-14.467	283.792
8.269	-14.158	283.792
7.876	-13.807	283.792
7.438	-13.412	283.792
6.957	-12.974	283.792
6.433	-12.490	283.792
5.891	-11.981	283.792
5.331	-11.445	283.792
4.755	-10.883	283.792
4.164	-10.293	283.792
3.558	-9.675	283.792
2.940	-9.028	283.792
2.310	-8.351	283.792
1.689	-7.666	283.792
1.079	-6.972	283.792
0,33264	-6.270	283.792

-0.110	-5.558	283.792
-0.689	-4.837	283.792
-1.256	-4.108	283.792
-1.813	-3.369	283.792
-2.359	-2.621	283.792
-2.893	-1.864	283.792
-3.417	-1.098	283.792
-3.931	-0.324	283.792
-4.416	0,30139	283.792
-4.875	1.173	283.792
-5.307	1.891	283.792
-5.713	2.589	283.792
-6.093	3.265	283.792
-6.450	3.920	283.792
-6.784	4.551	283.792
-7.094	5.160	283.792
-7.370	5.716	283.792
-7.611	6.221	283.792
-7.818	6.672	283.792
-8.006	7.099	283.792
-8.163	7.471	283.792
-8.276	7.760	283.792
-8.355	7.995	283.792
-8.402	8.176	283.792
-8.423	8.314	283.792
-8.423	8.391	283.792
-8.411	8.440	283.792
-8.398	8.461	283.792
-8.389	8.469	283.792
-8.429	8.614	285.054
-8.423	8.617	285.054
-8.411	8.620	285.054
-8.386	8.617	285.054
-8.340	8.597	285.054
-8.278	8.550	285.054
-8.179	8.452	285.054
-8.061	8.309	285.054
-7.911	8.113	285.054
-7.730	7.862	285.054
-7.502	7.532	285.054
-7.241	7.148	285.054
-6.964	6.739	285.054
-6.654	6.277	285.054
-6.311	5.764	285.054
-5.932	5.199	285.054
-5.535	4.609	285.054

-5.120	3.995	285.054
-4.685	3.357	285.054
-4.230	2.695	285.054
-3.755	2.009	285.054
-3.259	1.300	285.054
-2.741	0,39514	285.054
-2.202	-0.185	285.054
-1.660	-0.937	285.054
-1.113	-1.686	285.054
-0.565	-2.433	285.054
-0.013	-3.177	285.054
0,37639	-3.920	285.054
1.100	-4.660	285.054
1.661	-5.398	285.054
2.224	-6.135	285.054
2.789	-6.869	285.054
3.358	-7.601	285.054
3.931	-8.330	285.054
4.487	-9.032	285.054
5.028	-9.707	285.054
5.553	-10.356	285.054
6.062	-10.977	285.054
6.555	-11.572	285.054

7.031	-12.141	285.054
7.490	-12.683	285.054
7.914	-13.175	285.054
8.299	-13.617	285.054
8.647	-14.011	285.054
8.956	-14.356	285.054
9.227	-14.653	285.054
9.458	-14.902	285.054
9.658	-15.113	285.054
9.827	-15.289	285.054
9.966	-15.434	285.054
10.079	-15.549	285.054
10.162	-15.639	285.054
10.196	-15.727	285.054
10.192	-15.805	285.054
10.170	-15.863	285.054
10.142	-15.901	285.054
10.106	-15.932	285.054
10.048	-15.959	285.054
9.970	-15.966	285.054
9.881	-15.935	285.054
9.786	-15.853	285.054
9.664	-15.743	285.054

9.513	-15.607	285.054
9.328	-15.441	285.054
9.109	-15.243	285.054
8.851	-15.013	285.054
8.546	-14.742	285.054
8.194	-14.429	285.054
7.796	-14.072	285.054
7.353	-13.672	285.054
6.866	-13.227	285.054
6.336	-12.736	285.054
5.788	-12.219	285.054
5.222	-11.675	285.054
4.640	-11.104	285.054
4.043	-10.504	285.054
3.433	-9.876	285.054
2.811	-9.217	285.054
2.177	-8.528	285.054
1.554	-7.831	285.054
0,65417	-7.124	285.054
0,23681	-6.409	285.054
-0.249	-5.684	285.054
-0.826	-4.950	285.054
-1.392	-4.208	285.054

-1.948	-3.456	285.054
-2.491	-2.695	285.054
-3.023	-1.924	285.054
-3.543	-1.144	285.054
-4.051	-0.355	285.054
-4.532	0,28889	285.054
-4.986	1.170	285.054
-5.413	1.903	285.054
-5.815	2.616	285.054
-6.191	3.306	285.054
-6.544	3.974	285.054
-6.873	4.618	285.054
-7.179	5.239	285.054
-7.450	5.807	285.054
-7.686	6.321	285.054
-7.890	6.782	285.054
-8.073	7.216	285.054
-8.226	7.596	285.054
-8.335	7.891	285.054
-8.411	8.131	285.054
-8.455	8.314	285.054
-8.473	8.455	285.054
-8.470	8.533	285.054

-8.457	8.582	285.054
-8.443	8.603	285.054
-8.434	8.611	285.054
-8.544	9.086	288.000
-8.538	9.088	288.000
-8.525	9.091	288.000
-8.500	9.088	288.000
-8.454	9.066	288.000
-8.391	9.018	288.000
-8.291	8.915	288.000
-8.172	8.768	288.000
-8.021	8.564	288.000
-7.840	8.305	288.000
-7.612	7.962	288.000
-7.354	7.564	288.000
-7.079	7.138	288.000
-6.772	6.659	288.000
-6.432	6.125	288.000
-6.057	5.538	288.000
-5.664	4.925	288.000
-5.253	4.286	288.000
-4.824	3.622	288.000
-4.374	2.933	288.000

-3.905	2.219	288.000
-3.415	1.480	288.000
-2.905	0,49792	288.000
-2.373	-0.069	288.000
-1.838	-0.853	288.000
-1.300	-1.635	288.000
-0.758	-2.415	288.000
-0.214	-3.194	288.000
0,23125	-3.970	288.000
0,61319	-4.743	288.000
1.435	-5.516	288.000
1.990	-6.286	288.000
2.547	-7.055	288.000
3.107	-7.822	288.000
3.671	-8.585	288.000
4.220	-9.321	288.000
4.754	-10.028	288.000
5.273	-10.707	288.000
5.776	-11.358	288.000
6.263	-11.982	288.000
6.735	-12.577	288.000
7.190	-13.145	288.000
7.611	-13.660	288.000

7.994	-14.123	288.000
8.341	-14.535	288.000
8.649	-14.896	288.000
8.919	-15.206	288.000
9.151	-15.466	288.000
9.351	-15.686	288.000
9.521	-15.869	288.000
9.662	-16.020	288.000
9.775	-16.139	288.000
9.860	-16.232	288.000
9.896	-16.321	288.000
9.893	-16.401	288.000
9.869	-16.461	288.000
9.840	-16.500	288.000
9.803	-16.531	288.000
9.744	-16.558	288.000
9.663	-16.563	288.000
9.573	-16.528	288.000
9.477	-16.442	288.000
9.354	-16.328	288.000
9.199	-16.186	288.000
9.011	-16.014	288.000
8.788	-15.810	288.000

8.525	-15.571	288.000
8.215	-15.289	288.000
7.857	-14.963	288.000
7.453	-14.593	288.000
7.003	-14.177	288.000
6.510	-13.713	288.000
5.973	-13.202	288.000
5.417	-12.662	288.000
4.845	-12.094	288.000
4.258	-11.498	288.000
3.657	-10.872	288.000
3.043	-10.215	288.000
2.418	-9.527	288.000
1.784	-8.807	288.000
1.161	-8.078	288.000
0,38194	-7.339	288.000
-0.048	-6.591	288.000
-0.632	-5.833	288.000
-1.203	-5.065	288.000
-1.762	-4.287	288.000
-2.309	-3.501	288.000
-2.843	-2.705	288.000
-3.364	-1.899	288.000

-3.873	-1.084	288.000
-4.370	-0.260	288.000
-4.838	0,37847	288.000
-5.280	1.331	288.000
-5.695	2.096	288.000
-6.084	2.840	288.000
-6.448	3.560	288.000
-6.788	4.257	288.000
-7.103	4.929	288.000
-7.396	5.576	288.000
-7.654	6.168	288.000
-7.877	6.705	288.000
-8.068	7.184	288.000
-8.240	7.637	288.000
-8.380	8.033	288.000
-8.480	8.340	288.000
-8.547	8.589	288.000
-8.585	8.779	288.000
-8.597	8.924	288.000
-8.591	9.004	288.000
-8.575	9.053	288.000
-8.559	9.074	288.000
-8.549	9.082	288.000

[0039] At the same time, each blade 10 therefore has an aerodynamic profile which allows a high conversion efficiency and a high useful life to be maintained.

[0040] Furthermore, the aerodynamic profile of the blade 10 according to an embodiment of the invention is obtained with the values of Table I by piling up the series of closed curves and grouping them so as to obtain a continuous aerodynamic profile.

[0041] In order to take into account the dimensional variability of each blade 10, the profile of each blade 10 can have a tolerance of +/- 2 mm in a normal direction with respect to the profile of the blade 10 itself.

[0042] The profile of each blade 10 can also comprise a coating, applied subsequently and which varies the profile itself.

[0043] Said antiwear coating preferably has a thickness defined in a normal direction at each surface of the blade 10 and ranging from 0 to 0.5 mm.

[0044] It is evident, moreover, that the values of the coordinates of Table I can be multiplied or divided by a corrective constant to obtain a profile in a greater or smaller scale, maintaining the same form.

[0045] According to another aspect of the present invention, a rotor of a ninth phase of a compressor is provided, which comprises a series of blades 10 of the type described above, each of which having a shaped aerodynamic profile, which are fixed to an outer surface of said rotor so as to be uniformly distanced thereon, and also oriented so as to confer a high efficiency to the compressor in which said rotor is preferably inserted.

[0046] According to another aspect of the present invention, a compressor is provided, comprising a rotor of the type described above.

[0047] It can thus be seen that a blade of a rotor of a ninth phase of a compressor according to various embodiments of the present invention achieves the objectives specified above.

[0048] The rotor blade of a ninth phase of a compressor of various embodiments of the present invention thus conceived, can undergo numerous modifications and variants, all included in the same inventive concept.

[0049] Furthermore, in practice, the materials used, as also the dimensions and components, can vary according to technical requirements.

Claims

1. A blade (10) of a rotor of a ninth phase of a compressor, which can be defined by coordinates of a discreet combination of points, in a Cartesian reference system (X, Y, Z), wherein the axis (Z) is a radial axis intersecting the central axis of the compressor, said blade (10) having a profile which can be identified by means of a series of closed intersection curves between the profile itself and planes (X, Y) lying at distances (Z) from the central axis, said blade (10) being **characterized in that** it comprises a thickening (30), substantially parallel to a base portion (12) of the blade (10) itself, fixable to said rotor, said thickening (30) being substantially situated halfway up the blade (10) and being suitable for shifting the natural resonance frequencies of the blade (10) itself outside a functioning frequency range of said rotor.

2. The blade (10) according to claim 1, **characterized in that** it comprises a further thickening, substantially parallel to said base portion (12) and situated in particular close to a free end (14).

3. The blade (10) according to claim 1 or 2, **characterized in that** it comprises a profile which is identified by a first substantially concave surface (3), which is pressurized, and a second substantially convex surface (5) which is in depression and which is opposite to the first, said two surfaces (3, 5) being continuous and joined to each other to form the profile of said blade 10.

4. The blade (10) according to claim 3, **characterized in that** each closed curve has a maximum thickness determined by the maximum distance between said first surface (3) and said second surface (5), said maximum thickness of each closed curve, along the height of the blade 10 in the direction of a free end (14) of the blade (10), first having a decreasing and then an increasing trend, followed again by a decreasing and finally increasing trend, with a discontinuity point of the slope.

5. The blade (10) according to claim 4, **characterized in that** along the height of the blade (10) in the direction of its free end (14), said maximum thickness has a trend according to the following equations, wherein h represents the height of the blade (10), expressed as a percentage of the total height of the blade (10), and wherein Tmax is the maximum adimensionalized thickness relating to the closed curve corresponding to the height:

$$Tmax = -34.522*h^4 + 36.4*h^3 - 8.4113*h^2 - 0.7259*h + 0.9961$$

for height values ranging from 0 to 45%;

$$Tmax = -1.3509*h + 1.4459$$

for a height ranging from 45% to 58%;

$$Tmax = 0.2074*h + 0.5443$$

for a height ranging from 58% to 86%;

$$Tmax = 0.9058*h - 0.0518$$

for a height ranging from 86% to 100%.

6. The blade (10) according to any of the previous claims, **characterized in that** said closed curves are defined according to Table I, whose values, expressed in millimeters, refer to a profile at room temperature.

7. The blade (10) according to any of the previous claims, **characterized in that** the profile of each blade (10) has a tolerance of +/- 2 mm in a normal direction with respect to the profile of the blade 10 itself.

8. The blade (10) according to any of the previous claims, **characterized in that** the profile of each blade (10) comprises an antiwear coating.

9. The blade (10) according to claim 8, **characterized in that** said coating has a thickness ranging from 0 to 0.5 mm.

10. A rotor of a ninth phase of a compressor, **characterized in that** it comprises a series of blades (10) according to any of the claims 1-9.

11. The rotor according to claim 10, **characterized in that** said series of blades (10) is constrained to an outer surface of said rotor and said series of blades (10) is also uniformly distributed thereon in order to maximize the efficiency of the rotor itself.

12. A compressor **characterized in that** it comprises a rotor according to claim 10 or 11.

Fig. 2

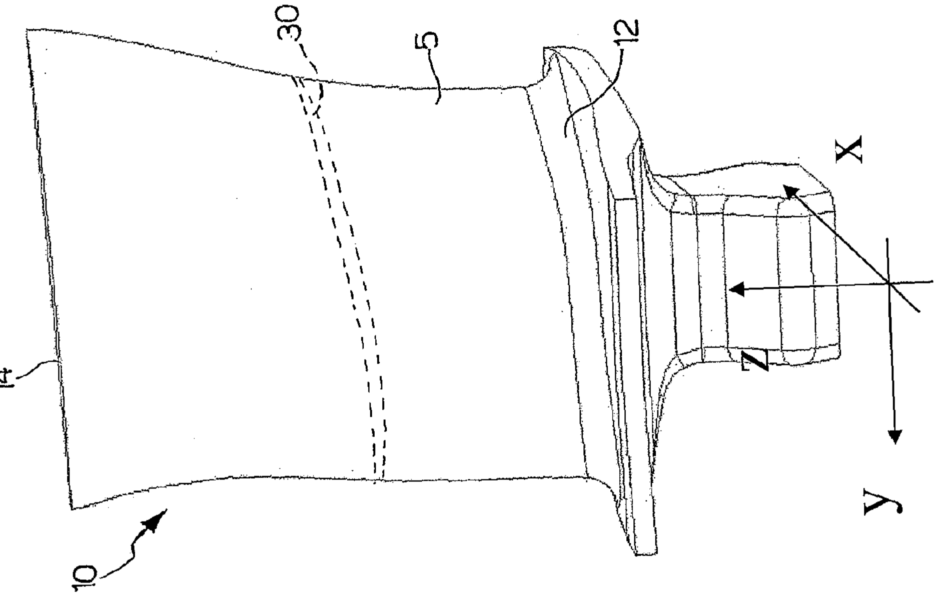


Fig.1

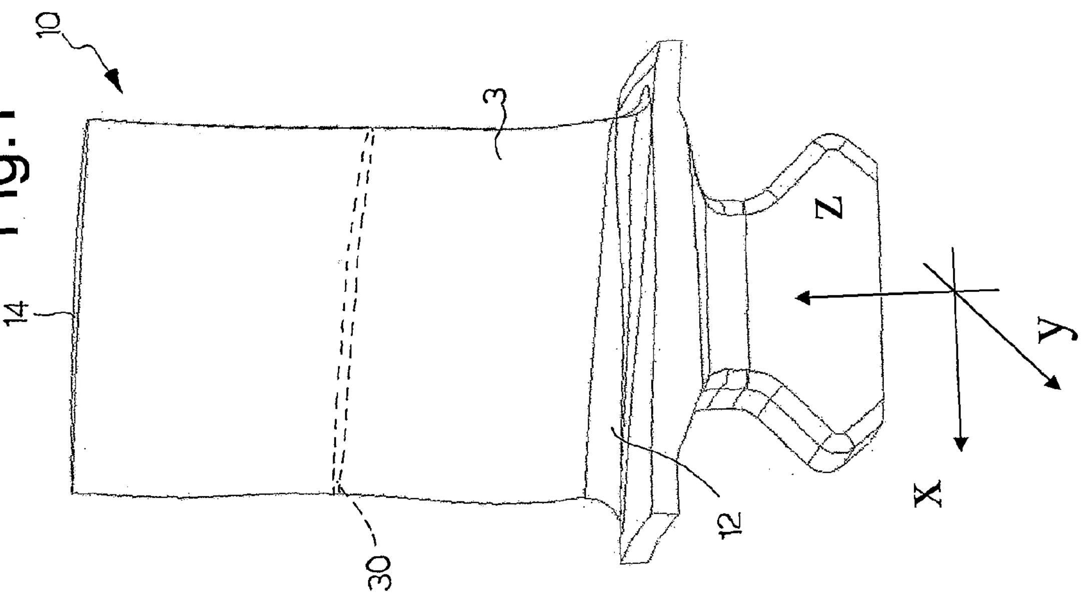


Fig. 3