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

(11) EP 1 119 476 B9

(12) **CORRECTED EUROPEAN PATENT SPECIFICATION**
Note: Bibliography reflects the latest situation

(15) Correction information:
Corrected version no 1 (W1 B1)
Corrections, see page(s) 3

(48) Corrigendum issued on:
31.03.2004 Bulletin 2004/14

(45) Date of publication and mention of the grant of the patent:
20.08.2003 Bulletin 2003/34

(21) Application number: **99943165.3**

(22) Date of filing: **22.09.1999**

(51) Int Cl.[7]: **B60S 1/38**

(86) International application number:
PCT/IB1999/001568

(87) International publication number:
WO 2000/021809 (20.04.2000 Gazette 2000/16)

(54) **A WINDSCREEN WIPER**

SCHEIBENWISCHER

ESSUIE-GLACE

(84) Designated Contracting States:
DE ES FR GB IT

(30) Priority: **09.10.1998 ZA 9809243**

(43) Date of publication of application:
01.08.2001 Bulletin 2001/31

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US-A- 3 192 551

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EP 1 119 476 B9

Description

[0001] This invention relates to a windscreen wiper, which is also known as a windshield wiper.

[0002] The invention relates in particular to a windscreen wiper which has a curved backbone and which may have a varying width and/or thickness. It will be appreciated by those skilled in the art that the backbone may be in the form of a beam that is curved in a plane or may have a compound curvature such as in EP-A-0 528 643 and DE-A-19 651 229. The beam will have width and thickness dimensions. The beam will also have a radius of curvature at each point along its length.

[0003] The applicant has conducted substantial analysis and experimentation and believes that he has found a relationship between the width, the beam material's Young's modulus and the total length of the beam and the thickness, the beam material's Young's modulus and the total length, which provides a windscreen wiper that operates in an improved manner.

[0004] In this specification, the term "spatially consolidated" is to be understood, unless the context clearly indicates otherwise, to mean that the actual perimeters of a cross-section coincides with the shortest possible perimeter encapsulating that cross-section.

[0005] According to a first aspect of the invention there is provided a windscreen wiper which includes

an elongate curved backbone which is of a resiliently flexible material having a Young's modulus of between 50 to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length, in which the magnitude of the width at substantially the widest point along the backbone, W_m (expressed in millimetres) is at most $(-8.889.10^{-5} * E + 0.05378) * L - 5.25$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

[0006] Further according to this aspect, there is provided a windscreen wiper which includes

an elongate curved backbone which is of a resiliently flexible material having a Young's modulus of between 50 to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length, in which the ratio of the magnitude of the width at substantially the widest point along the backbone, to the total length L of the backbone, R_w is at most $(-8.889.10^{-5} * E + 0.05378) - 5.25/L$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

[0007] According to a second aspect of the invention there is provided a windscreen wiper which includes

an elongate curved backbone which is of a resiliently flexible material having a Young's modulus of between 50 to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length, in which the magnitude of the thickness at substantially the thickest point along the backbone, T_m (expressed in millimetres) is at most $0.0007 * L - 0.0027407 * E + 1.37814$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

[0008] Further according to this aspect, there is provided a windscreen wiper which includes

an elongate curved backbone which is of a resiliently flexible material having a Young's modulus of between 50 to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length, in which the ratio of the magnitude of the thickness at substantially the thickest point along the backbone to the total length L of the backbone, R_t is at most $0.0007 - (0.0027407 * E - 1.37814)/L$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

[0009] The material of the backbone may be a composite material. in this case, the Young's modulus will be that of the composite material.

[0010] The total length of the backbone may be between about 300mm to 1200mm.

[0011] The backbone may have a varying width and or thickness, along its length. The backbone may have a free form curvature in a plane or may have a compound curvature (that is, curved in two planes).

[0012] The invention is now described, by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic perspective view from above of a windscreen wiper in accordance with the invention;

Figure 2 shows a side view of the wiper of Figure 1 in an unloaded free-form condition;

Figure 3 shows a graph indicating the variation of width of the backbone of the windscreen wiper shown in Figures 1 and 2;

Figure 4 shows a graph indicating the variation of thickness of the backbone of the windscreen wiper shown in Figures 1 and 2; and

Figure 5 shows a graph indicating the free-form coordinates of the centre line of the backbone of the windscreen wiper shown in Figures 1 and 2.

[0013] In the drawings, a windscreen wiper in accordance with the invention is generally designated by the reference numeral 10. The windscreen wiper 10 includes a backbone 12 which is in the form of a beam and a rubber wiper blade 14. The beam is made from spring steel having a Young's modulus of 200 GPa. The length of the beam is 600mm. The beam has a rectangular cross-sectional profile at all points along its length. Thus, the beam has a width dimension W and a thickness dimension T as shown in Figure 1. The beam tapers both in width and thickness from its centre toward

its free ends or tips as shown in Figure 3 and Figure 4 respectively. Figure 3 illustrates the beam width (in millimetres) at various positions along the length of the beam, which is also measured in millimetres. Figure 4 illustrates the thickness of the beam (in millimetres) at various positions along the length of the beam which is also measured in millimetres.

[0014] The beam is curved longitudinally, in a plane, with a predetermined radius of curvature R at every point along its length as shown in Figure 2. Figure 5 shows the beam centre line co-ordinates relative to the position along the length of the beam (in millimetres).

[0015] With the given formulas, it can be determined if the wiper, as described in the drawings conforms to the invention. The width of the beam 12 at its widest point along the beam 12, W_m (expressed in millimetres) is 15.4 as shown in Figure 3. According to the first aspect of the invention as defined in claims 1 and 2, the magnitude of the width at the widest point along the beam 12, W_m (expressed in millimetres), where L is 600 mm and E is 200 GPa, should be less than $(-8.889.10^{-5} * E + 0.05378) * L - 5.25 = (-8.889.10^{-5} * 200 + 0.05378) * 600 - 5.25 = 16,35$ mm. The width W_m of the wiper therefore falls within the scope of the invention.

[0016] The thickness of the beam 12 at the thickest point along the beam 12, T_m (expressed in millimetres) is 1.2 mm as shown in Figure 4. According to the second aspect of the invention as defined in claims 3 and 4, the magnitude of the thickness at the thickest point along the beam 12, T_m (expressed in millimetres), where L is 600 mm and E is 200 GPa, should be less than $0.0007 * L - 0.0027407 * E + 1.37814 = 0.0007 * 600 - 0.0027407 * 200 + 1.37814 = 1,25$ mm. The thickness T_m of the wiper therefore also falls with the scope of the invention.

Claims

1. A windscreen wiper (10) which includes
   an elongate curved backbone (12) which is of a resiliently flexible material having a Young's modulus of between 50 GPa to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length,
   characterised therein that the magnitude of the width at substantially the widest point along the backbone, W_m expressed in millimetres is at most $(-8.889*10^{-5} * E + 0.05378) * L - 5.25$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

2. A windscreen wiper (10) which includes
   an elongate curved backbone (12) which is of a resiliently flexible material having a Young's modulus of between 50 GPa to 350 GPa, the backbone having !a substantially spatially consolidated cross-sectional profile at substantially all points along its length,
   characterised therein that the ratio of the magnitude of the width at substantially the widest point along the backbone, to the total length L of the backbone, R_W is at most $(-8.889*10^{-5} * E + 0.053781 - 5.25/L$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

3. A windscreen wiper (10) which includes
   an elongate curved backbone (12)\which is of a resiliently flexible material having a Young's modulus of between 50 GPa to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length,
   characterised therein that the magnitude of the thickness at substantially the thickest point along the backbone, T_m expressed in millimetres is at most $0.0007 * L - 0.0027407 * E + 1.37814$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

4. A windscreen wiper (10) which includes
   an elongate curved backbone (12) which is of a resiliently flexible material having a Young's modulus of between 50 GPa to 350 GPa, the backbone having a substantially spatially consolidated cross-sectional profile at substantially all points along its length,
   characterised therein that the ratio of the magnitude of the thickness at substantially the thickest point along the backbone, to the total length L of the backbone, R_t is at most $0.0007 - (0.0027407 * E - 1.37814)/L$, where L is the total length of the backbone expressed in millimetres and E is the Young's modulus of the backbone material expressed in GPa.

5. The windscreen wiper as claimed in Claim 1, characterised therein that the material of the backbone is a composite material, with the Young's modulus being that of the composite material.

6. The windscreen wiper as claimed in Claim 3, characterised therein that the material of the backbone is a composite material, with the Young's modulus being that of the composite material.

7. The windscreen wiper as claimed in Claim 1, characterised therein that the backbone has a varying width and thickness along its length.

8. The windscreen wiper as claimed in Claim 1, characterised therein that the backbone has a free form curvature in a plane.

9. The windscreen wiper as claimed in Claim 1, characterised therein that the backbone has a compound curvature.

10. The windscreen wiper as claimed in Claim 3, characterised therein that the backbone has a varying width and thickness along its length.

11. The windscreen wiper as claimed in Claim 3, characterised therein that the backbone has a free form curvature in a plane.

12. The windscreen wiper as claimed in Claim 3, characterised therein that the backbone has a compound curvature.

Patentansprüche

1. Scheibenwischer (10), der ein längliches, gebogenes Rückenteil (12) aufweist, das aus einem weichelastischen Material mit einem Elastizitätsmodul von zwischen 50 GPa und 350 GPa besteht, wobei das Rückenteil an im wesentlichen allen Punkten entlang seiner Länge ein im wesentlichen räumlich zusammengefasstes Querschnittsprofil hat, **dadurch gekennzeichnet, dass** die Größenordnung der Breite am im wesentlichsten breitesten Punkt entlang des Rückenteils W_m in Millimetern ausgedrückt nicht mehr als $(- 8{,}889*10^{-5} * E + 0{,}05378) * L = 5{,}25$ beträgt, wobei L die Gesamtlänge des Rückenteils ausgedrückt in Millimetern und E der Elastizitätsmodul des Rückenteilmaterials ausgedrückt in GPa ist.

2. Scheibenwischer (10), der ein längliches, gebogenes Rückenteil (12) aufweist, das aus einem weichelastischen Material mit einem Elastizitätsmodul von zwischen 50 GPa und 350 GPa besteht, wobei das Rückenteil an im wesentlichen allen Punkten entlang seiner Länge ein im wesentlichen räumlich zusammengefasstes Querschnittsprofil hat, **dadurch gekennzeichnet, dass** das Verhältnis der Größenordnung der Breite am im wesentlichen breitesten Punkt entlang des Rückenteils zu der Gesamtlänge L des Rückenteils R_w $(- 8{,}889*10^{-5} * E + 0{,}05378) - 5{,}25/L$ nicht überschreitet, wobei L die Gesamtlänge des Rückenteils ausgedrückt in Millimetern und E der Elastizitätsmodul des Rückenteilmaterials ausgedrückt in GPa ist.

3. Scheibenwischer (10), der ein längliches, gebogenes Rückenteil (12) aufweist, das aus einem weichelastischen Material mit einem Elastizitätsmodul von zwischen 50 GPa und 350 GPa besteht, wobei das Rückenteil an im wesentlichen allen Punkten entlang seiner Länge ein im wesentlichen räumlich zusammengefasstes Querschnittsprofil hat, **dadurch gekennzeichnet, dass** die Größenordnung der Dicke am im wesentlichen dicksten Punkt entlang des Rückenteils T_m in Millimetern ausgedrückt $0{,}0007 *L - 0{,}0027407 * E + 1{,}37814$ nicht überschreitet, wobei L die Gesamtlänge des Rückenteils ausgedrückt in Millimetern und E der Elastizitätsmodul des Rückenteilmaterials ausgedrückt in GPa ist.

4. Scheibenwischer (10), der ein längliches, gebogenes Rückenteil (12) aufweist, das aus einem weichelastischen Material mit einem Elastizitätsmodul von zwischen 50 GPa und 350 GPa besteht, wobei das Rückenteil an im wesentlichen allen Punkten entlang seiner Länge ein im wesentlichen räumlich zusammengefasstes Querschnittsprofil hat, **dadurch gekennzeichnet, dass** das Verhältnis zwischen der Größenordnung der Dicke am im wesentlichen dicksten Punkt entlang des Rückenteils zu der Gesamtlänge L des Rückenteils R_t $0{,}0007 - (0{,}0027407 * E - 1{,}37814)/L$ nicht überschreitet, wobei L die Gesamtlänge des Rückenteils ausgedrückt in Millimetern und E der Elastizitätsmodul des Rückenteilmaterials ausgedrückt in GPa ist.

5. Scheibenwischer nach Anspruch 1, **dadurch gekennzeichnet, dass** das Material des Rückenteils ein Verbundwerkstoff ist, wobei der Elastizitätsmodul derjenige des Verbundwerkstoffs ist.

6. Scheibenwischer nach Anspruch 3, **dadurch gekennzeichnet, dass** das Material des Rückenteils ein Verbundwerkstoff ist, wobei der Elastizitätsmodul derjenige des Verbundwerkstoffs ist.

7. Scheibenwischer nach Anspruch 1, **dadurch gekennzeichnet, dass** die Breite und die Dicke des Rückenteils entlang seiner Länge variieren.

8. Scheibenwischer nach Anspruch 1, **dadurch gekennzeichnet, dass** das Rückenteil eine Freiform-Krümmung in einer Ebene hat.

9. Scheibenwischer nach Anspruch 1, **dadurch gekennzeichnet, dass** das Rückenteil eine zusammengesetzte Krümmung hat.

10. Scheibenwischer nach Anspruch 3, **dadurch gekennzeichnet, dass** die Breite und die Dicke des Rückenteils entlang seiner Länge variieren.

11. Scheibenwischer nach Anspruch 3, **dadurch gekennzeichnet, dass** das Rückenteil eine Freiform-Krümmung in einer Ebene hat.

12. Scheibenwischer nach Anspruch 3, **dadurch gekennzeichnet, dass** das Rückenteil eine zusammengesetzte Krümmung hat.

Revendications

1. Essuie-glace (10) composé d'une ossature de forme allongée et courbée (12) faite d'un matériau résilient flexible avec un module d'Young compris entre 50 GPa et 350 GPa, l'ossature ayant un profil de section sensiblement uniforme sur sensiblement la totalité de sa longueur, **caractérisé en ce que** la dimension en largeur au point sensiblement le plus large le long de l'ossature, W_m, exprimée en millimètres, est au maximum (-8,889*10^5*E+0,05378) *L-5,25, où L est la longueur totale de l'ossature exprimée en millimètres et E est le module d'Young du matériau composant l'ossature, exprimé en GPa.

2. Essuie-glace (10) composé d'une ossature de forme allongée et courbée (12) faite d'un matériau résilient flexible avec un module d'Young compris entre 50 GPa et 350 GPa, l'ossature ayant un profil de section sensiblement uniforme sur sensiblement la totalité de sa longueur, **caractérisé en ce que** le rapport de la dimension en largeur au point sensiblement le plus large le long de l'ossature, à la longueur totale L de l'ossature centrale, R_w est au maximum (-8,889*10^5*E+0,05378)-5,25/L, où L est la longueur totale de l'ossature exprimée en millimètres et E est le module d'Young du matériau composant l'ossature exprimé en GPa.

3. Essuie-glace (10) composé d'une ossature de forme allongée et courbée (12) faite d'un matériau résilient flexible avec un module d'Young compris entre 50 GPa et 350 GPa, l'ossature ayant un profil de section sensiblement uniforme sur sensiblement la totalité de sa longueur, **caractérisé en ce que** la dimension en épaisseur au point sensiblement le plus épais le long de l'ossature, T_m, exprimé en millimètres, est au maximum 0,0007*L-0,0027407*E) 1,37814, où L est la longueur totale de l'ossature exprimée en millimètres et E est le module d'Young du matériau composant l'ossature exprimé en GPa.

4. Essuie-glace (10) composé d'une ossature de forme allongée et courbée (12) faite d'un matériau résilient flexible avec un module d'Young compris entre 50 GPa et 350 GPa, l'ossature ayant un profil de section sensiblement uniforme sur sensiblement la totalité de sa longueur, **caractérisé en ce que** le rapport de la dimension en épaisseur au point sensiblement le plus épais le long de l'ossature, la longueur totale L de l'ossature, R_t, est au maximum 0.0007-(0.0027407* E-1,37814)/L, où L est la longueur totale de l'ossature exprimée en millimètres et E est le module d'Young du matériau composant l'ossature exprimé en GPa.

5. Essuie-glace selon la revendication 1, **caractérisé en ce que** le matériau de l'ossature est un matériau composite, le module d'Young étant celui du matériau composite.

6. Essuie-glace selon la revendication 3, **caractérisé en ce que** le matériau de l'ossature est un matériau composite, le module d'Young étant celui du matériau composite.

7. Essuie-glace selon la revendication 1, **caractérisé en ce que** l'ossature est d'une largeur et d'une épaisseur variable sur sa longueur.

8. Essuie-glace selon la revendication 1, **caractérisé en ce que** l'ossature présente une courbure de forme libre dans un plan.

9. Essuie-glace selon la revendication 1, **caractérisé en ce que** l'ossature présente une courbure complexe.

10. Essuie-glace selon la revendication 3, **caractérisé en ce que** l'ossature est d'une largeur et d'une épaisseur variable sur sa longueur.

11. Essuie-glace selon la revendication 3, **caractérisé en ce que** l'ossature présente une courbure de forme libre dans un plan.

12. Essuie-glace selon la revendication 1, **caractérisé en ce que** l'ossature présente une courbure complexe.

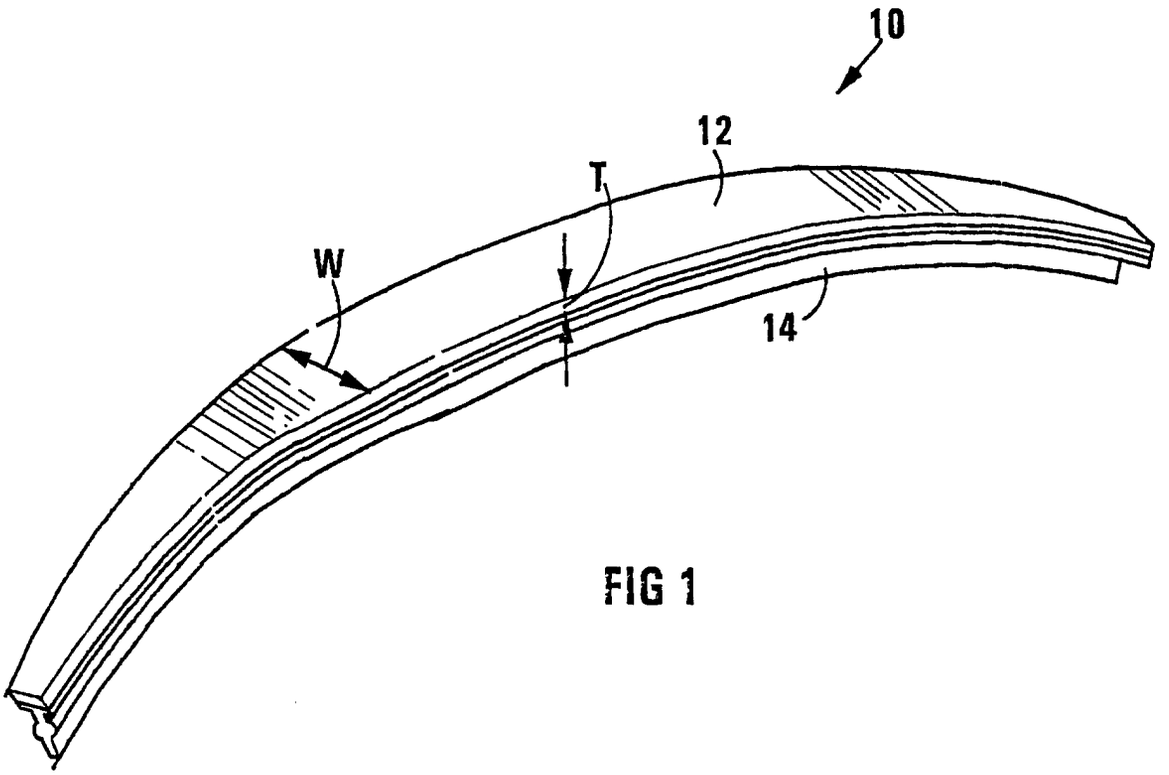

FIG 1

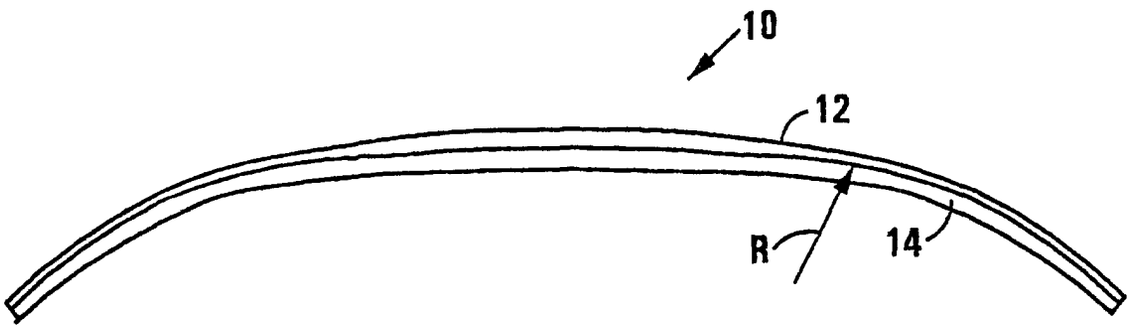

FIG 2

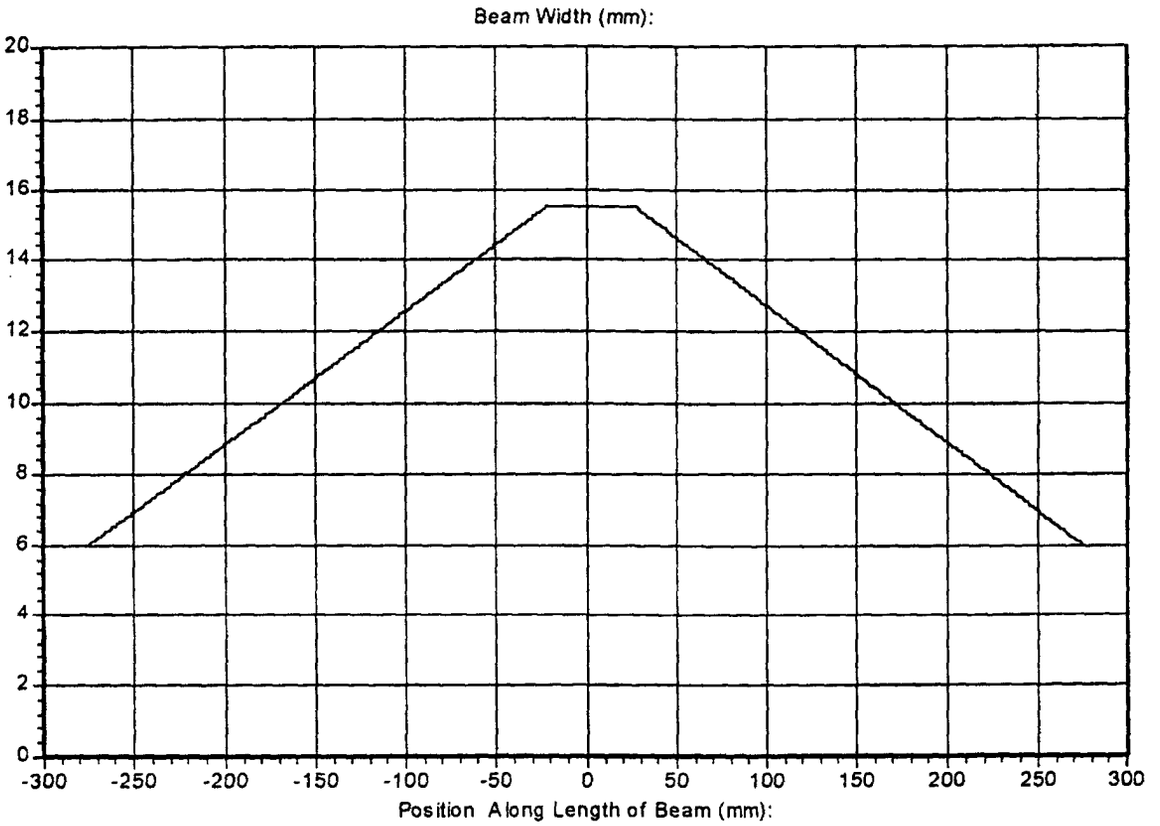
Beam Width (mm):
20
18
16
14
12
10
8
6
4
2
0
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300
Position Along Length of Beam (mm):

FIGURE 3

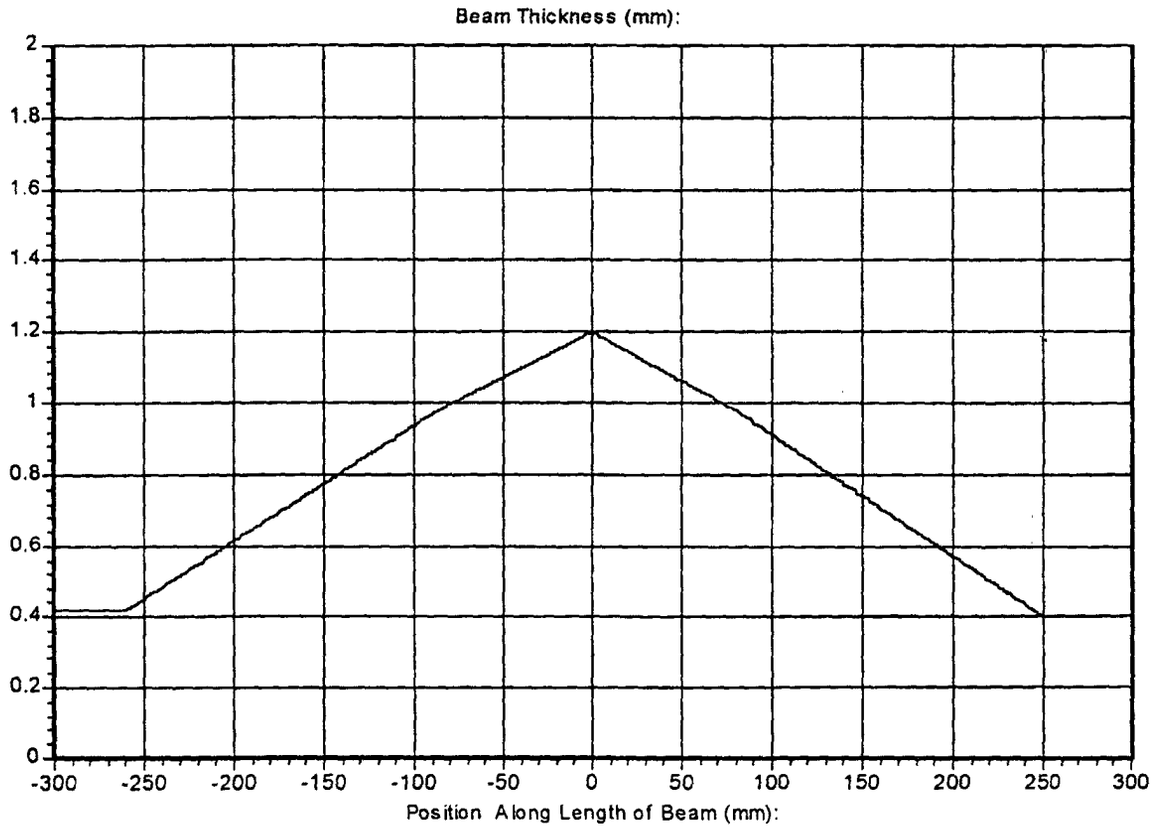
Beam Thickness (mm):
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300
Position Along Length of Beam (mm):

FIGURE 4

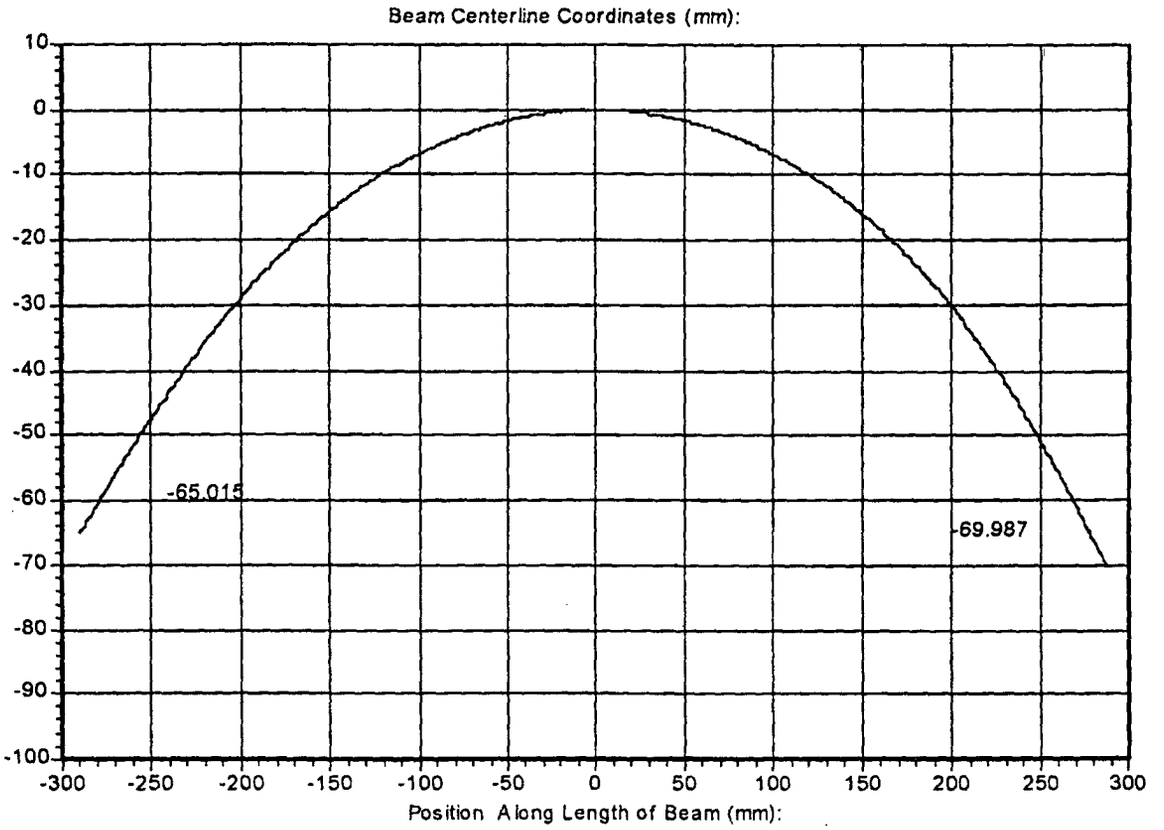
Beam Centerline Coordinates (mm):
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-65.015
-69.987
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300
Position Along Length of Beam (mm):

FIGURE 5