Fuel Cell Research Materials

A.) Catalysts

B.) Gas Diffusion Electrodes (GDE)

C.) Gas Diffusion Layers (GDL)

D.) Membrane

E.) Membrane Electrode Assemblies (MEAs)

A. Catalysts

No.	Item	Description
1.	5g Platinum Black	*Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electro-catalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. - 5 grams of Platinum Black (Pure; High Grade) catalyst *Specification:* Pt Surface Area: 29 m2/g Bulk Density: 0.68 g/ml ICP Purity: 99.985% Avg Particle Size: 13um
2.	5g Platinum on Carbon - 10%	*Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. - 5 grams of Platinum on Carbon 10% catalyst *Specification:* Platinum: 10.240% Metal Area, Pt: 148.43 m2/g Moisture: 0.89% XRD Crystallite Size: 2.5nm
3.	5g Platinum on Carbon - 20%	*Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. - 5 grams of Platinum on Carbon 20% catalyst

		Specification: Pt Surface Area: 100 m2/g Pt Crystallite Size: 2.0-3.0nm Catalyst Surface Area: 180 m2/g Final Catalyst Powder Size: 74 microns
4.	5g Platinum on Carbon - 40%	*Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. - 5 grams of Platinum on Carbon 40% catalyst *Specification:* Pt Surface Area: 70 m2/g Pt Crystallite Size: 3.0-4.0nm Catalyst Surface Area: 140 m2/g Final Catalyst Powder Size: 74 microns
5.	5g Platinum on Carbon - 60%	*Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. - 5 grams of Platinum on Carbon 60% catalyst *Specification:* Pt Surface Area: 60 m2/g Pt Crystallite Size: 4.0-5.5nm Catalyst Surface Area: 90 m2/g Final Catalyst Powder Size: 74 microns
6.	5g Platinum Ruthenium	*Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. -5 grams of Platinum Ruthenium Catalyst (50:50; 1:1) *Specification:* Pt Crystallite Size: 3.0 - 5.0nm Pt-Ru Surface Area: ~75 m2/g.Pt

7.	Carbon Black Vulcan XC-72R 250g	*Product Overview:* Black carbon powder for fuel cell application. *Additional Information:* 250 grams is the approximate weight of the container and carbon powder.
8.	HP 10% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer. *Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Details:* Packing: 1g Adjust quantity in shopping cart to reflect how many grams you want to purchase. *Technical Specifications:* Pt particle size in angstroms. * Surface area is platinum only. * Vulcan XC-72 surface area is approximately 250m2/gm.Typical metal on carbon loading * <=5% Pt for recombination or sensors * 10% Pt for PAFC * 20-50% Pt for PEMFC * 50-80% Pt for DMFC or other specialized systems Catalyst Pt Particle Pt (m2/g)* SPECIFICATIONS % Pt size in Angstroms Pt (m2/g) 10% Pt 20 141 20% Pt 22 128 30% Pt 25 112 40% Pt 29 100 50% Pt 33 86 60% Pt 37 76 80% Pt 49 57 *Approximate
9.	HP 10% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation. Description High dispersion of an alloy on carbon. With this new HP catalyst we have continued the E-TEK tradition of introducing innovative products. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures.

		Suggested Uses: Pt:Ru supported alloy electrocatalysts have shown improved tolerance to CO contaminated hydrogen fuel streams as compared to Pt at the anode of low temperature (PEM) fuel cells. This alloy has also found use as the catalyst for methanol oxidation in DMFC. *Product Technical Information:* X-ray diffraction analysis confirms the formation of a uniform Pt:Ru alloy phase with an average crystallite particle size of 20-30A even for the higher loaded catalysts. Available in weight ranges of 5-80% Pt:Ru on carbon. Standard 1:1 atomic ratio
10.	HP 20% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer. *Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. DESCRIPTION The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Details:* Packing: 1g Adjust quantity in shopping cart to reflect how many grams you want to purchase. *Technical Specifications:* Pt particle size in angstroms. * Surface area is platinum only. * Vulcan XC-72 surface area is approximately 250m2/gm.Typical metal on carbon loading * <=5% Pt for recombination or sensors * 10% Pt for PAFC * 20-50% Pt for PEMFC * 50-80% Pt for DMFC or other specialized systems Catalyst Pt Particle Pt (m2/g)* SPECIFICATIONS % Pt size in Angstroms Pt (m2/g) 10% Pt 20 141 20% Pt 22 128 30% Pt 25 112 40% Pt 29 100 50% Pt 33 86 60% Pt 37 76 80% Pt 49 57 *Approximate
11.	HP 20% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation.

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12.	HP 30% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer. *Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Details:* Packing: 1g Adjust quantity in shopping cart to reflect how many grams you want to purchase. *Technical Specifications:* Pt particle size in angstroms. * Surface area is platinum only. * Vulcan XC-72 surface area is approximately 250m2/gm.Typical metal on carbon loading * <=5% Pt for recombination or sensors * 10% Pt for PAFC * 20-50% Pt for PEMFC * 50-80% Pt for DMFC or other specialized systems Catalyst Pt Particle Pt (m2/g)* SPECIFICATIONS % Pt size in Angstroms Pt (m2/g) 10% Pt 20 141 20% Pt 22 128 30% Pt 25 112 40% Pt 29 100 50% Pt 33 86 60% Pt 37 76 80% Pt 49 57 *Approximate

13.	HP 30% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation. *Description:* High dispersion of an alloy on carbon. With this new HP catalyst we have continued the E-TEK tradition of introducing innovative products. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Suggested Uses:* Pt:Ru supported alloy electrocatalysts have shown improved tolerance to CO contaminated hydrogen fuel streams as compared to Pt at the anode of low temperature (PEM) fuel cells. This alloy has also found use as the catalyst for methanol oxidation in DMFC. *Technical Specifications:* X-ray diffraction analysis confirms the formation of a uniform Pt:Ru alloy phase with an average crystallite particle size of 20-30A even for the higher loaded catalysts. Available in weight ranges of 5-80% Pt:Ru on carbon. Standard 1:1 atomic ratio
14.	HP 40% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer. *Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Details:* Packing: 1g Adjust quantity in shopping cart to reflect how many grams you want to purchase.

		Technical Specifications: Pt particle size in angstroms. * Surface area is platinum only. * Vulcan XC-72 surface area is approximately 250m2/gm.Typical metal on carbon loading * <=5% Pt for recombination or sensors * 10% Pt for PAFC * 20-50% Pt for PEMFC * 50-80% Pt for DMFC or other specialized systems Catalyst Pt Particle Pt (m2/g)* SPECIFICATIONS % Pt size in Angstroms Pt (m2/g) 10% Pt 20 141 20% Pt 22 128 30% Pt 25 112 40% Pt 29 100 50% Pt 33 86 60% Pt 37 76 80% Pt 49 57 *Approximate
15.	HP 40% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation. *Description:* High dispersion of an alloy on carbon. With this new HP catalyst we have continued the E-TEK tradition of introducing innovative products. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Suggested Uses:* Pt:Ru supported alloy electrocatalysts have shown improved tolerance to CO contaminated hydrogen fuel streams as compared to Pt at the anode of low temperature (PEM) fuel cells. This alloy has also found use as the catalyst for methanol oxidation in DMFC. *Technical Specifications:* X-ray diffraction analysis confirms the formation of a uniform Pt:Ru alloy phase with an average crystallite particle size of 20-30A even for the higher loaded catalysts. Available in weight ranges of 5-80% Pt:Ru on carbon. Standard 1:1 atomic ratio
16.	HP 50% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer. *Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes.

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17.	HP 50% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation. *Description:* High dispersion of an alloy on carbon. With this new HP catalyst we have continued the E-TEK tradition of introducing innovative products. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Suggested Uses:* Pt:Ru supported alloy electrocatalysts have shown improved tolerance to CO contaminated hydrogen fuel streams as compared to Pt at the anode of low temperature (PEM) fuel cells. This alloy has also found use as the catalyst for methanol oxidation in DMFC. *Technical Specifications:* X-ray diffraction analysis confirms the formation of a uniform Pt:Ru alloy phase with an average crystallite particle size of 20-30A even for the higher loaded catalysts. Available in weight ranges of 5-80% Pt:Ru on carbon. Standard 1:1 atomic ratio
18.	HP 60% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer.

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19.	HP 60% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation. *Description:* High dispersion of an alloy on carbon. With this new HP catalyst we have continued the E-TEK tradition of introducing innovative products. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Suggested Uses:* Pt:Ru supported alloy electrocatalysts have shown improved tolerance to CO contaminated hydrogen fuel streams as compared to Pt at the anode of low temperature (PEM) fuel cells. This alloy has also found use as the catalyst for methanol oxidation in DMFC. *Technical Specifications:* X-ray diffraction analysis confirms the formation of a uniform Pt:Ru alloy phase with an average crystallite particle size of 20-30A even for the higher loaded catalysts. Available in weight ranges of 5-80% Pt:Ru on carbon. Standard 1:1 atomic ratio
20.	HP 80% Platinum on Vulcan XC-72 1g	*Product Overview:* General Information: Platinum has proven to be the standard catalyst for many oxidation and reduction reactions in both acidic and basic electrolytes and would be an ideal candidate for process feasibility studies. We call this next generation catalyst "HP" for High Power catalysts. Typically, as the platinum loading on a carbon support increases, the platinum particles grow in size, especially at the higher loadings, ultimately reducing the available active surface area of the platinum. However, this new platinum catalyst resists this trend, and is evident under the Technical

		Information section below, the new series maintains a small platinum crystallite size even at the high metal loadings. Amazingly, at these higher loadings we are able to maintain relatively high platinum surface areas, thus only moderately reducing the available active surface area of the platinum. For this new catalyst series the tap density continues to more closely resemble that of the uncatalyzed carbon. Tap density is often used as a general indicator of the quality of electrode formation, whereby the greater carbon character foretells of a well dispersed electrode layer. *Suggested Uses:* Most commonly used catalyst for PEMFC and Phosphoric Acid Fuel Cell, Cathode catalyst, Anode catalyst. Also used as a recombination catalyst for hydrogen elimination. Can be used as a building block for sensor elements. *Description:* The ability to prepare well dispersed, high surface area electrocatalysts containing platinum has significantly increased the viability of many electrochemical processes. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Details:* Packing: 1g Adjust quantity in shopping cart to reflect how many grams you want to purchase. *Technical Specifications:* Pt particle size in angstroms. * Surface area is platinum only. * Vulcan XC-72 surface area is approximately 250m2/gm.Typical metal on carbon loading * <=5% Pt for recombination or sensors * 10% Pt for PAFC * 20-50% Pt for PEMFC * 50-80% Pt for DMFC or other specialized systems Catalyst Pt Particle Pt (m2/g)* SPECIFICATIONS % Pt size in Angstroms Pt (m2/g) 10% Pt 20 141 20% Pt 22 128 30% Pt 25 112 40% Pt 29 100 50% Pt 33 86 60% Pt 37 76 80% Pt 49 57 *Approximate
21.	HP 80% Pt:Ru on Vulcan XC-72 1g	*Product Overview:* General Information A new HP process produces highly dispersed crystallites of a Pt-Ru alloy supported on carbon. These new catalysts are available with a standard Pt:Ru atomic ratio of 1:1 and from 5wt.% to 80wt.% total metal loading. The new HP alloys were released June 2003 and provided for a highly alloyed mixture of platinum and ruthenium without sacrificing particle size. These have been found to be superior to our older alloy for CO tolerance and methanol oxidation. *Description:* High dispersion of an alloy on carbon. With this new HP catalyst we have continued the E-TEK tradition of introducing innovative products. Our new HP process provides an outstanding, high purity catalyst that is amenable to forming highly uniform electrode structures. *Suggested Uses:* Pt:Ru supported alloy electrocatalysts have shown improved tolerance to CO contaminated hydrogen fuel streams as compared to Pt at the anode of low temperature (PEM) fuel cells. This alloy has also found use as the catalyst for methanol oxidation in DMFC. *Technical Specifications:* X-ray diffraction analysis confirms the formation of a uniform Pt:Ru alloy phase with an average crystallite particle size of 20-30A even for the higher loaded catalysts. Available in weight ranges of 5-80% Pt:Ru on carbon. Standard 1:1 atomic ratio

B. Gas Diffusion Electrodes (GDE)

No.	Item	Description
1.	0.03 mg/cm2 20% Pt/C - 2.2 x 2.2 cm	• 0.03 mg/cm2 20% Platinum (20% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
2.	0.3 mg/cm2 40% Pt/C - 2.2 x 2.2 cm	• 0.3 mg/cm2 40% Platinum (40% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
3.	0.5 mg/cm2 60% Pt/C - 2.2 x 2.2 cm	• 0.5 mg/cm2 60% Platinum (60% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
4.	2 mg/cm2 PtB - 2.2 x 2.2 cm	• 2 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
5.	4 mg/cm2 Pt Black - 2.2 x 2.2 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
6.	4 mg/cm2 PtRu Black - 2.2 x 2.2 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Ruthenium Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
7.	0.03 mg/cm2 20% Pt/C - 5 x 5 cm	• 0.03 mg/cm2 20% Platinum (20% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
8.	0.3 mg/cm2 40% Pt/C - 5 x 5 cm	• 0.3 mg/cm2 40% Platinum (40% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
9.	0.5 mg/cm2 60% Pt/C - 5 x 5 cm	• 0.5 mg/cm2 60% Platinum (60% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE

		may not be justified.
10.	2 mg/cm2 PtB - 5 x 5 cm	• 2 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
11.	4 mg/cm2 Pt Black - 5 x 5 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
12.	4 mg/cm2 PtRu Black - 5 x 5 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Ruthenium Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
13.	0.03 mg/cm2 20% Pt/C - 10 x 10 cm	• 0.03 mg/cm2 20% Platinum (20% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
14.	0.3 mg/cm2 40% Pt/C - 10 x 10 cm	• 0.3 mg/cm2 40% Platinum (40% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
15.	0.5 mg/cm2 60% Pt/C - 10 x 10 cm	• 0.5 mg/cm2 60% Platinum (60% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
16.	2 mg/cm2 PtB - 10 x 10 cm	• 2 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
17.	4 mg/cm2 Pt Black - 10 x 10 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
18.	4 mg/cm2 PtRu Black - 10 x 10 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Ruthenium Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material

19.	0.03 mg/cm2 20% Pt/C - 20 x 20 cm	• 0.03 mg/cm2 20% Platinum (20% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
20.	0.3 mg/cm2 40% Pt/C - 20 x 20 cm	• 0.3 mg/cm2 40% Platinum (40% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
21.	0.5 mg/cm2 60% Pt/C - 20 x 20 cm	• 0.5 mg/cm2 60% Platinum (60% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
22.	2 mg/cm2 PtB - 20 x 20 cm	• 2 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
23.	4 mg/cm2 Pt Black - 20 x 20 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
24.	4 mg/cm2 PtRu Black - 20 x 20 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Ruthenium Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
25.	0.03 mg/cm2 20% Pt/C - 20 x 30 cm	• 0.03 mg/cm2 20% Platinum (20% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
26.	0.3 mg/cm2 40% Pt/C - 20 x 30 cm	• 0.3 mg/cm2 40% Platinum (40% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
27.	0.5 mg/cm2 60% Pt/C - 20 x 30 cm	• 0.5 mg/cm2 60% Platinum (60% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
28.	2 mg/cm2 PtB - 20 x 30 cm	• 2 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material

		• Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
29.	4 mg/cm2 Pt Black - 20 x 30 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
30.	4 mg/cm2 PtRu Black - 20 x 30 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Ruthenium Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
31.	0.03 mg/cm2 20% Pt/C - 30 x 30 cm	• 0.03 mg/cm2 20% Platinum (20% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
32.	0.3 mg/cm2 40% Pt/C - 30 x 30 cm	• 0.3 mg/cm2 40% Platinum (40% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
33.	0.5 mg/cm2 60% Pt/C - 30 x 30 cm	• 0.5 mg/cm2 60% Platinum (60% on Carbon) • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
34.	2 mg/cm2 PtB - 30 x 30 cm	• 2 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material • Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.
35.	4 mg/cm2 Pt Black - 30 x 30 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
36.	4 mg/cm2 PtRu Black - 30 x 30 cm	A high performance GDE use where the best performance and durability is required. Typical applications include Hydrogen Oxygen fuel cells, aerospace industry or as Cathode material in Direct Methanol (DMFC). • 4 mg/cm2 Platinum Ruthenium Black • Nafion Post Coat for improved water management and adhesion to the membrane • On our GDL-CT gas diffusion material
37.	Standard 0.5 mg/cm2 GDE 10 cm x 10 cm	*Product Details:* 0.5 mg/cm2 Platinum (60% Pt supported on Vulcan)

Nafion Post Coat for improved water management and adhesion to the membrane on GDL-CT gas diffusion material (an equivalent to the discontinued ELAT LT1410W)

Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.

Property		Units	Method	GDL-CT
Thickness		um	Using TECLOCK SM-114	410
Basic Weight		g/m^2	ASTM D-646	180
Air Permeability		s	Gurley Mehod*	< 8
Through-Plate Resistance		$m\Omega cm^2$	Based on ASTM C-611**	< 13
Tensile Strength	MD	N/cm	ASTM D-828***	> 10
	XD	N/cm		> 5
Flexural Modulus	MD	MPa	ASTM D-790	-
	XD	MPa		-

* Test Condition: 300 cc, 0.1sq in orifice, CFY-030
** 4-probe measurement, circular (50mm diam.) copper-plated contacts under 200psi
*** Sample width: 25.4mm; Effective Specimen Length: 45mm, Rate of Grip Separation: 6.35 mm/min

Properties listed are typical and cannot be used as accept/reject specifications.

38. Standard 0.5 mg/cm2 GDE 20 cm x 30 cm

Product Details:

0.5 mg/cm2 Platinum (60% Pt supported on Vulcan)

Nafion Post Coat for improved water management and adhesion to the membrane on GDL-CT gas diffusion material (an equivalent to the discontinued ELAT LT1410W)

Perfect for Hydrogen/Air Fuel Cells where the extra cost of the High Performance GDE may not be justified.

Property		Units	Method	GDL-CT
Thickness		um	Using TECLOCK SM-114	410
Basic Weight		g/m^2	ASTM D-646	180
Air Permeability		s	Gurley Mehod*	< 8
Through-Plate Resistance		$m\Omega cm^2$	Based on ASTM C-611**	< 13
Tensile Strength	MD	N/cm	ASTM D-828***	> 10
	XD	N/cm		> 5
Flexural Modulus	MD	MPa	ASTM D-790	-
	XD	MPa		-

* Test Condition: 300 cc, 0.1sq in orifice, CFY-030
** 4-probe measurement, circular (50mm diam.) copper-plated contacts under 200psi
*** Sample width: 25.4mm; Effective Specimen Length: 45mm, Rate of Grip Separation: 6.35 mm/min

Properties listed are typical and cannot be used as accept/reject specifications.

C. Gas Diffusion Layers (GDL)

No.	Item	Description
1.	Freudenberg C2: 10cm x 10cm	*Specification:* Thickness (um): 250 Basic Weight (g/m2): 135 Air Permeability (s): 70 Tensile Strength (N/50mm): 80 Through-Plate Resistance (mΩcm2): < 13
2.	Freudenberg I2 C3: 10cm x 10cm	*Specification:* Thickness (um): 290 Basic Weight (g/m2): 150 Air Permeability (s): 35 Tensile Strength (N/50mm): 110 Through-Plate Resistance (mΩcm2): < 12
3.	GDL-CT: 10cm x 10cm	*Specification:* Thickness (um): 410 Basic Weight (g/m2): 180 Air Permeability (s): < 8 Through-Plate Resistance (mΩcm2): < 13 Tensile Strength (N/cm) : MD: >10 XD: >5
4.	Freudenberg C2: 15cm x 15cm	*Specification:* Thickness (um): 250 Basic Weight (g/m2): 135 Air Permeability (s): 70 Tensile Strength (N/50mm): 80 Through-Plate Resistance (mΩcm2): < 13
5.	Freudenberg I2 C3: 15cm x 15cm	*Specification:* Thickness (um): 290 Basic Weight (g/m2): 150 Air Permeability (s): 35 Tensile Strength (N/50mm): 110 Through-Plate Resistance (mΩcm2): < 12
6.	GDL-CT: 15cm x 15cm	*Specification:* Thickness (um): 410 Basic Weight (g/m2): 180 Air Permeability (s): < 8 Through-Plate Resistance (mΩcm2): < 13 Tensile Strength (N/cm) : MD: >10 XD: >5
7.	Freudenberg C2: 20cm x 20cm	*Specification:* Thickness (um): 250 Basic Weight (g/m2): 135 Air Permeability (s): 70 Tensile Strength (N/50mm): 80 Through-Plate Resistance (mΩcm2): < 13

8.	Freudenberg I2 C3: 20cm x 20cm	*Specification:* Thickness (um): 290 Basic Weight (g/m2): 150 Air Permeability (s): 35 Tensile Strength (N/50mm): 110 Through-Plate Resistance (mΩcm2): < 12
9.	GDL-CT: 20cm x 20cm	*Specification:* Thickness (um): 250 Basic Weight (g/m2): 135 Air Permeability (s): 70 Tensile Strength (N/50mm): 80 Through-Plate Resistance (mΩcm2): < 13
10.	Freudenberg C2: 25cm x 25cm	*Specification:* Thickness (um): 410 Basic Weight (g/m2): 180 Air Permeability (s): < 8 Through-Plate Resistance (mΩcm2): < 13 Tensile Strength (N/cm) : MD: >10 XD: >5
11.	Freudenberg I2 C3: 25cm x 25cm	*Specification:* Thickness (um): 290 Basic Weight (g/m2): 150 Air Permeability (s): 35 Tensile Strength (N/50mm): 110 Through-Plate Resistance (mΩcm2): < 12
12.	GDL-CT: 25cm x 25cm	*Specification:* Thickness (um): 410 Basic Weight (g/m2): 180 Air Permeability (s): < 8 Through-Plate Resistance (mΩcm2): < 13 Tensile Strength (N/cm) : MD: >10 XD: >5
13.	Freudenberg C2: 29.7cm x 30cm	*Specification:* Thickness (um): 250 Basic Weight (g/m2): 135 Air Permeability (s): 70 Tensile Strength (N/50mm): 80 Through-Plate Resistance (mΩcm2): < 13
14.	Freudenberg I2 C3: 29.7cm x 30cm	*Specification:* Thickness (um): 290 Basic Weight (g/m2): 150 Air Permeability (s): 35 Tensile Strength (N/50mm): 110 Through-Plate Resistance (mΩcm2): < 12

15.	GDL-CT: 30cm x 30cm	*Specification:* Thickness (um): 410 Basic Weight (g/m2): 180 Air Permeability (s): < 8 Through-Plate Resistance (mΩcm2): < 13 Tensile Strength (N/cm) : MD: >10 XD: >5
16.	Avcarb 1071HCB 1 sq Meter	*Product Overview:* The first step in the process of producing high performance carbon fabrics is the conversion of PAN to a highly thermoset ladder polymer called Avox Oxidized PAN. The Avox fiber, the basic building block for AvCarb carbon fabrics, is then converted into long worsted staple fiber yarns that are woven into the construction designed for the application. To meet the demanding needs of the many potential applications, the Avox fabrics are first carbonized in Ballard's proprietary AccuCarb continuous carbonization process. At this stage, the fabrics have an 88-95% carbon content and are called HC grade fabrics. Vacuum batch baking at extremely high temperature results in our HC grade fabric, a 99+% carbon fabric with graphitic type properties. Produced in long continuous rolls, AvCarb carbon fabrics are easy to store, handle, and use. Their uniform properties over the length and width of each roll, and from roll to roll not only assure product consistency but also lend themselves to easy integration with continuous manufacturing processes. Like all Ballard carbon fiber products, AvCarb carbon fabrics are manufactured using processes and quality systems registered by Det Norske Veritas, a major international certifying body, to be in conformance with ISO 9001:1994 and QS-9000, 1998. As a Tier 1 supplier of critical drive train system components to the automotive industry, BMP has demonstrated its ability to provide quality products, on time, with value added. *Details:* Representative AvCarb Carbon Fabric Applications: Fabric Designation Application 1071 HCB Gas Diffusion Layer (PEM Fuel Cells), Other Electrochemical Applications *Technical Specifications:* Grade HCB Diameter (microns): 7.5 Cross-section: Round Density (gm/cc): 1.75 - 1.77 Surface Area (gm/M2): 0.62 Tensile Strength: 192.5 (300)kN/cm2 (ksi) Tensile Modulus: 26.6 (38) mN/cm2 (msi) Elongation @ Break (%): .72 Electrical Resistivity Controllable: 1.1 x 10-3 (ohm-cm) Thermal Oxidative Stability : Oxidizes <1.0 (wgt. loss/hr @500°C in air) Carbon Content (%) : 99.5 Yarn Filament Pr operties :
17.	Avcarb 1071HCB 20 x 20 cm	*Product Overview:* The first step in the process of producing high performance carbon fabrics is the conversion of PAN to a highly thermoset ladder polymer called AvoxÃ¢â€žÂ¢ Oxidized PAN. The AvoxÃ¢â€žÂ¢ fiber, the basic building block for AvCarbÃ¢â€žÂ¢ carbon fabrics, is then converted into long worsted staple fiber yarns that are woven into the construction designed for the application. To meet the demanding needs of the many potential applications, the AvoxÃ¢â€žÂ¢ fabrics are first carbonized in BallardÃ¢â‚¬â„¢s proprietary AccuCarbÃ¢â€žÂ¢ continuous carbonization process. At this stage, the fabrics have an 88-95% carbon

		content and are called Ã¢â‚¬Å“HCÃ¢â‚¬Â grade fabrics. Vacuum batch baking at extremely high temperature results in our Ã¢â‚¬Å“HCBÃ¢â‚¬Â grade fabric, a 99+% carbon fabric with graphitic type properties. Produced in long continuous rolls, AvCarbÃ¢â€žÂ¢ carbon fabrics are easy to store, handle, and use. Their uniform properties over the length and width of each roll, and from roll to roll not only assure product consistency but also lend themselves to easy integration with continuous manufacturing processes. Like all BallardÃ¢â€žÂ¢ carbon fiber products, AvCarbÃ¢â€žÂ¢ carbon fabrics are manufactured using processes and quality systems registered by Det Norske Veritas, a major international certifying body, to be in conformance with ISO 9001:1994 and QS-9000, 1998. As a Tier 1 supplier of critical drive train system components to the automotive industry, BMP has demonstrated its ability to provide quality products, on time, with value added. *Details:* Representative AvCarbÃ¢â€žÂ¢ Carbon Fabric Applications: Fabric Designation Application 1071 HCB Gas Diffusion Layer (PEM Fuel Cells), Other Electrochemical Applications *Technical Specifications:* Grade HCB Diameter (microns): 7.5 Cross-section: Round Density (gm/cc): 1.75 Ã¢â‚¬â€œ 1.77 Surface Area (gm/M2): 0.62 Tensile Strength: 192.5 (300)kN/cm2 (ksi) Tensile Modulus: 26.6 (38) mN/cm2 (msi) Elongation @ Break (%): .72 Electrical Resistivity Controllable: 1.1 x 10-3 (ohm-cm) Thermal Oxidative Stability : Oxidizes <1.0 (wgt. loss/hr @500Ã‚Â°C in air) Carbon Content (%) : 99.5 Yarn Filament Properties :
18.	Avcarb GDS1120 20 x 20 cm	*Product Overview:* GDS-1120 is based on BMPÃ¢â‚¬â„¢s AvCarbÃ¢â€žÂ¢ P50 carbon fiber paper substrate, which is treated to render it hydrophobic, and then coated with a micro-porous layer designed specifically for the P50 substrate for the control of permeability, diffusivity and conductivity at the catalyst interface. The team approach to development of the GDS identified key electrical, mechanical and gas/liquid diffusion properties needed to meet PEM fuel cell requirements. GDS-1120 can be modified for alternate levels of hydrophobic treatment in both the substrate and the micro-porous layer, enabling further design flexibility for water management and gas transport characteristics. The new GDS offers advantages of continuous roll processing, improved thickness and areal weight uniformity and ease of storage and compatibility with subsequent continuous manufacturing processes. Further, BallardÃ¢â‚¬â„¢s AvCarbÃ¢â€žÂ¢ GDS has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. *Typical Properties:* Areal Weight: 95 gm/m2 Thickness: (0.7 N/cm2): 172 microns Compressibility: 14% Tensile Web Strength (md): 1000 N/m Bending Stiffness (Taber): 7 (machine direction) Diffusivity Coefficient - k (kg/m2s): 0.0186 Thru-Plane Permeability (Air): 32 ml/min In-Plane Permeability (Air): 13 ml/min

19.	Avcarb GDS2120 20 x 20 cm	*Product Overview:* GDS-2120 is based on BMP,¬AvCarb P75 carbon fiber paper substrate, which is treated to render it hydrophobic, and then coated with a micro-porous layer for the control of permeability, diffusivity and conductivity at the catalyst interface. The team approach to development of the GDS identified key electrical, mechanical and gas/liquid diffusion properties needed to meet PEM fuel cell requirements. GDS-2120 can be modified for alternate levels of hydrophobic treatment in both the substrate and the micro-porous layer, enabling further design flexibility for water management and gas transport characteristics. The new GDS offers advantages of continuous roll processing, improved thickness and areal weight uniformity and ease of storage and compatibility with subsequent continuous manufacturing processes. Further, Ballard AvCarb GDS has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. *Details:* Availability Roll Lengths: Up to 500 meters Package Core Diameter: 6" ID (152 mm) Roll Widths: Up to 0.800 meters Technical Specifications *Typical Properties:* Areal Weight: 105 g/m2 Thickness: 245 microns (0.7 N/cm2) Compressibility: 10% Tensile Web Strength (md): >4000 N/m Bending Stiffness (Taber): 30 (machine direction) Thru-Plane Permeability (Air): 35 ml/min In-Plane Permeability (Air): 100 ml/min Additional Information
20.	Avcarb GDS2120 40 x 10 m	*Product Overview:* GDS-2120 is based on BMP¬AvCarb P75 carbon fiber paper substrate, which is treated to render it hydrophobic, and then coated with a micro-porous layer for the control of permeability, diffusivity and conductivity at the catalyst interface. The team approach to development of the GDS identified key electrical, mechanical and gas/liquid diffusion properties needed to meet PEM fuel cell requirements. GDS-2120 can be modified for alternate levels of hydrophobic treatment in both the substrate and the micro-porous layer, enabling further design flexibility for water management and gas transport characteristics. The new GDS offers advantages of continuous roll processing, improved thickness and areal weight uniformity and ease of storage and compatibility with subsequent continuous manufacturing processes. Further, Ballard¬ AvCarbGDS has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. *Typical Properties:* Areal Weight: 105 g/m2 Thickness: 245 microns (0.7 N/cm2) Compressibility: 10% Tensile Web Strength (md): >4000 N/m Bending Stiffness (Taber): 30 (machine direction) Thru-Plane Permeability (Air): 35 ml/min In-Plane Permeability (Air): 100 ml/min

21.	Carbon Cloth 20cm x 20cm-Untreated	*Product Overview:* Carbon Cloth-Graphitized Spun Yarn Carbon Fabrics WOVEN CARBON FABRICS are carbon fiber fabrics made from spun yarn. Fabric tailorability results from controlling the yield on rovings and yarns, and allows for a variety of finished composite thicknesses. The spun yarns have many surface fibrils that protrude in various directions at various lengths from the surface. This fiber loft contributes to high cross ply tensiles and interlaminar shear strengths for 2 D composite materials. Contour conformation without wrinkling is another advantage of spun yarn fabrics. Materials undergo a vacuum graphitizing process and long temperature soak, resulting in a very thermally stable and chemically pure fabric with low oxidation rate. WOVEN FABRICS include low cost carbon, carbon materials and other processes where efficient chemical vapor infiltration or prepregging is required. Typical Properties for Standard Fabric Styles *Specification:* Construction Plain Yarn Input 2/27 Count (W X F) 48 X 44 yarns/in Areal Weight 3.4 oz/yd2 Widths up to 33 in Thickness 15 mils Density 1.75 g/cc Carbon Content 99% Oxidation Rate (% per hr) 1.0
22.	Carbon Cloth 40cm x 40cm-Untreated	*Product Overview:* Carbon Cloth-Graphitized Spun Yarn Carbon Fabrics WOVEN CARBON FABRICS are carbon fiber fabrics made from spun yarn. Fabric tailorability results from controlling the yield on rovings and yarns, and allows for a variety of finished composite thicknesses. The spun yarns have many surface fibrils that protrude in various directions at various lengths from the surface. This fiber loft contributes to high cross ply tensiles and interlaminar shear strengths for 2 D composite materials. Contour conformation without wrinkling is another advantage of spun yarn fabrics. Materials undergo a vacuum graphitizing process and long temperature soak, resulting in a very thermally stable and chemically pure fabric with low oxidation rate. WOVEN FABRICS include low cost carbon, carbon materials and other processes where efficient chemical vapor infiltration or prepregging is required. Typical Properties for Standard Fabric Styles *Specification:* Construction Plain Yarn Input 2/27 Count (W X F) 48 X 44 yarns/in Areal Weight 3.4 oz/yd 2 6.5 Widths up to 33 in

		Thickness 15 mils Density 1.75 g/cc Carbon Content 99% Oxidation Rate (% per hr) 1.0 1.0 1.0
23.	Carbon Cloth Wet Proofed 10cm x 10cm	*Product Overview:* Carbon Cloth- Graphitized Spun Yarn Carbon Fabrics WOVEN CARBON FABRICS are carbon fiber fabrics made from spun yarn. Fabric tailorability results from controlling the yield on rovings and yarns, and allows for a variety of finished composite thicknesses. The spun yarns have many surface fibrils that protrude in various directions at various lengths from the surface. This fiber loft contributes to high cross ply tensiles and interlaminar shear strengths for 2 D composite materials. Contour conformation without wrinkling is another advantage of spun yarn fabrics. Materials undergo a vacuum graphitizing process and long temperature soak, resulting in a very thermally stable and chemically pure fabric with low oxidation rate. WOVEN FABRICS include low cost carbon, carbon materials and other processes where efficient chemical vapor infiltration or prepregging is required. Typical Properties for Standard Fabric Styles. Standard wet proofing is 5%, wet proofing of 10%-60% available upon request. *Specification:* Construction Plain Yarn Input 2/27 Count (W X F) 48 X 44 yarns/in Areal Weight 3.4 oz/yd 2 6.5 Widths up to 33 in Thickness 15 mils Density 1.75 g/cc Carbon Content 99% Oxidation Rate (% per hr) 1.0 1.0 1.0
24.	Carbon Cloth Wet Proofed 20cm x 20cm	*Product Overview:* Carbon Cloth- Graphitized Spun Yarn Carbon Fabrics WOVEN CARBON FABRICS are carbon fiber fabrics made from spun yarn. Fabric tailorability results from controlling the yield on rovings and yarns, and allows for a variety of finished composite thicknesses. The spun yarns have many surface fibrils that protrude in various directions at various lengths from the surface. This fiber loft contributes to high cross ply tensiles and interlaminar shear strengths for 2 D composite materials. Contour conformation without wrinkling is another advantage of spun yarn fabrics. Materials undergo a vacuum graphitizing process and long temperature soak, resulting in a very thermally stable and chemically pure fabric with low oxidation rate. WOVEN FABRICS include low cost carbon, carbon materials and other processes where efficient chemical vapor infiltration or prepregging is required. Typical Properties for Standard Fabric Styles.

		Standard wet proofing is 5%, wet proofing of 10%-60% available upon request. *Specification:* Construction Plain Yarn Input 2/27 Count (W X F) 48 X 44 yarns/in Areal Weight 3.4 oz/yd 2 6.5 Widths up to 33 in Thickness 15 mils Density 1.75 g/cc Carbon Content 99% Oxidation Rate (% per hr) 1.0 1.0 1.0
25.	Carbon Cloth Wet Proofed 25cm x 25cm	*Product Details:* Carbon Cloth- Graphitized Spun Yarn Carbon Fabrics WOVEN CARBON FABRICS are carbon fiber fabrics made from spun yarn. Fabric tailorability results from controlling the yield on rovings and yarns, and allows for a variety of finished composite thicknesses. The spun yarns have many surface fibrils that protrude in various directions at various lengths from the surface. This fiber loft contributes to high cross ply tensiles and interlaminar shear strengths for 2 D composite materials. Contour conformation without wrinkling is another advantage of spun yarn fabrics. Materials undergo a vacuum graphitizing process and long temperature soak, resulting in a very thermally stable and chemically pure fabric with low oxidation rate. WOVEN FABRICS include low cost carbon, carbon materials and other processes where efficient chemical vapor infiltration or prepregging is required. Typical Properties for Standard Fabric Styles. Standard wet proofing is 5%, wet proofing of 10%-60% available upon request. *Specification:* Construction Plain Yarn Input 2/27 Count (W X F) 48 X 44 yarns/in Areal Weight 3.4 oz/yd 2 6.5 Widths up to 33 in Thickness 15 mils Density 1.75 g/cc Carbon Content 99% Oxidation Rate (% per hr) 1.0 1.0 1.0
26.	Carbon Paper - 2050-A 10cm x 10 cm	*Product Overview:* 10cm x 10 cm Other sizes are available to 1 m x 1 m Details *Technical Specifications:* Material 2050-A Thickness 0.008 in. (0.20mm) +/- .001 in. Density (g/cc) 0.48 Mean Pore Diameter 28 Flexural Strength (psi) 5,000

		Electrical Resistivity In-plane (cm) 0.012 Through-plane (cm2) 0.07 Gas Permeability (cfm) 45 Compressive Strength (psi) 300
27.	Carbon Paper - 2050-A 40x40 cm	*Product Overview:* 40cm x 40 cm Details *Technical Specifications:* Material 2050-A Thickness 0.008 in. (0.20mm) +/- 0.001 in. Density (g/cc) 0.48 Mean Pore Diameter 28 Flexural Strength (psi) 5,000 Electrical Resistivity In-plane (cm) 0.012 Through-plane (cm2) 0.07 Gas Permeability (cfm) 45 Compressive Strength (psi) 300
28.	Carbon Paper - 2050-L 10cm X 10cm	*Product Overview:* 10cm x 10 cm Details *Technical Specifications:* Material 2050-L Thickness: 0.010 in. (0.26mm) +/- 0.001 in. Density (g/cc) 0.46 Mean Pore Diameter (□□) 30 Flexural Strength (psi) 4,000 Electrical Resistivity In-plane (□□cm) 0.022 Through-plane (□□cm2) 0.15 Gas Permeability (cfm) 70 Compressive Strength (psi) 250
29.	Carbon Paper - 2050-L 40cm x 40cm	*Product Overview:* 40cm x 40 cm Details *Technical Specifications:* Material 2050-L Thickness: 0.010 in. (0.26mm) +/- 0.001 in. Density (g/cc) 0.46 Mean Pore Diameter (?) 30 Flexural Strength (psi) 4,000 Electrical Resistivity In-plane (cm) 0.022 Through-plane (cm2) 0.15 Gas Permeability (cfm) 70 Compressive Strength (psi) 250

30.	Carbon Paper - AvCarb ™ P50T - 20 cm x 25 cm	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb ™ Grade-P50T carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb? P50T is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb ™ continuous carbonization process. Under development for over two years, Ballard's AvCarb ™ P50T has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb ™ P50T is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb ™ P50T is a baseline product that can be design modified to optimize specific performance characteristics. With its hydrophobic coating,the AvCarb ™ P50T minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. *Availablity:-* Roll Lengths: Up to 500 meters Rolls: 10 meters x 0.4 meters Rolls: 50 meters x 0.4 meters Technical Specifications Ballard Material Products AvCarb ™ P50T Carbon Fiber Paper, 20 cm x 25 cm, 175 um thick. Weight: 48gm/m2 Bulk Density: 0.28 gm/cm3 *Thickness:* At 0.7 N/cm2 172 microns At 28 N/cm2 130 microns At 140 N/cm2 108 microns Compressibility: 9.9% Compressive Set: 11.5 microns % Carbon: 99% Tensile Web Strength (md): 1500 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 9.6sec./100 cm3 Thru-Plane Electrical Resistivity: 9.7 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%
31.	Carbon Paper - AvCarb ™ P50T - 40cm x 10 m	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Ã¢â€žÂ¢ Grade-P50T carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb P50T is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb Ã¢â€žÂ¢ continuous carbonization process. Under development for over two years, Ballard's AvCarb Ã¢â€žÂ¢ P50T has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb Ã¢â€žÂ¢ P50T is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb Ã¢â€žÂ¢ P50T is a baseline product that can be design modified to optimize specific performance characteristics. With its hydrophobic coating,the AvCarb Ã¢â€žÂ¢ P50T minimizes the effects of moisture

		exposure, enhances performance, provides durability and facilitates handling. *Availablity:-* Roll Lengths: Up to 500 meters Rolls: 10 meters x 0.4 meters Rolls: 50 meters x 0.4 meters Technical Specifications Ballard Material Products AvCarb Ã¢â€žÂ¢ P50T Carbon Fiber Paper, 20 cm x 25 cm, 175 um thick. Weight: 48gm/m2 Bulk Density: 0.28 gm/cm3 *Thickness:* At 0.7 N/cm2 172 microns At 28 N/cm2 130 microns At 140 N/cm2 108 microns Compressibility: 9.9% Compressive Set: 11.5 microns % Carbon: 99% Tensile Web Strength (md): 1500 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 9.6sec./100 cm3 Thru-Plane Electrical Resistivity: 9.7 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%
32.	Carbon Paper - AvCarb ™ P75T - 20 cm x 20 cm	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Grade-P75T carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb P75T is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb continuous carbonization process. Under development for over two years, Ballard's AvCarb P75T has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb P75T is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb P75T is a baseline product that can be design modified to optimize specific performance characteristics. With its hydrophobic coating,the AvCarb P75T minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. *Technical Specifications:* Ballard Material Products AvCarb P75 Carbon Fiber Paper, 20 cm x 25 cm, 240 um thick. Actual Weight: 84gm/m2 Bulk Density: 0.28 gm/cm3 Compressibility: 9% % Carbon: 99% Tensile Web Strength (md): 2500 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 30 sec./100 cm3 Thru-Plane Electrical Resistivity: 10 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%

33.	Carbon Paper - AvCarb ™ P75T - 40cm x 10m	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Ã¢â€žÂ¢ Grade-P75T carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb P75T is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb Ã¢â€žÂ¢ continuous carbonization process. Under development for over two years, Ballard's AvCarb Ã¢â€žÂ¢ P50T has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb Ã¢â€žÂ¢ P75T is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb Ã¢â€žÂ¢ P75T is a baseline product that can be design modified to optimize specific performance characteristics. With its hydrophobic coating,the AvCarb Ã¢â€žÂ¢ P75T minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. *Availablity:-* Roll Lengths: Up to 500 meters Rolls: 10 meters x 0.4 meters Rolls: 50 meters x 0.4 meters *Technical Specifications:* Ballard Material Products AvCarb P75 Carbon Fiber Paper, 20 cm x 25 cm, 240 um thick. Actual Weight: 84gm/m2 Bulk Density: 0.28 gm/cm3 Compressibility: 9% % Carbon: 99% Tensile Web Strength (md): 2500 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 30 sec./100 cm3 Thru-Plane Electrical Resistivity: 10 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%
34.	Carbon Paper - AvCarb™ P50 - 20 cm x 25 cm	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Grade-P50 carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb P50 is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb continuous carbonization process. Under development for over two years, Ballard's AvCarb P50 has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb P50 is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb P50 is a baseline product that can be design modified to optimize specific performance characteristics. The paper can also be supplied with hydrophobic coating that minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. When supplied with the hydrophobic coating the Grade designation becomes AvCarb P50T. *Availablity:-* Roll Lengths: Up to 500 meters Rolls: 10 meters x 0.4 meters

		Rolls: 50 meters x 0.4 meters *Technical Specifications:* Ballard Material Products AvCarb P50 Carbon Fiber Paper, 20 cm x 25 cm, 175 um thick. Actual Weight: 54gm/m2 Bulk Density: 0.28 gm/cm3 *Thickness:* At 0.7 N/cm2 172 microns At 28 N/cm2 130 microns At 140 N/cm2 108 microns Compressibility: 10% Compressive Set: 11.5 microns % Carbon: 99% Tensile Web Strength (md): 1000 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 30 sec./100 cm3 Thru-Plane Electrical Resistivity: 9.7 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%
35.	Carbon Paper - AvCarb™ P75 - 20 cm x 20 cm	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Grade-P75 carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb P75 is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb continuous carbonization process. Under development for over two years, Ballard's AvCarb P75 has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb P75 is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb P75 is a baseline product that can be design modified to optimize specific performance characteristics. The paper can also be supplied with hydrophobic coating that minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. When supplied with the hydrophobic coating the Grade designation becomes AvCarb P75T. *Technical Specifications:* Ballard Material Products AvCarb P75 Carbon Fiber Paper, 20 cm x 20 cm, 240 um thick. Actual Weight: 84gm/m2 Bulk Density: 0.28 gm/cm3 Compressibility: 9% % Carbon: 99% Tensile Web Strength (md): 2500 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 30 sec./100 cm3 Thru-Plane Electrical Resistivity: 10 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%
36.	Carbon Paper - AvCarb™ P75 - 40cm x 10m	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Grade-P75 carbon fiber

		paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb P75 is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb continuous carbonization process. Under development for over two years, Ballard's AvCarb P75 has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb P75 is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb P75 is a baseline product that can be design modified to optimize specific performance characteristics. The paper can also be supplied with hydrophobic coating that minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. When supplied with the hydrophobic coating the Grade designation becomes AvCarb P75T. *Technical Specifications:* Ballard Material Products AvCarb P75 Carbon Fiber Paper, 20 cm x 25 cm, 240 um thick. Actual Weight: 84gm/m2 Bulk Density: 0.28 gm/cm3 Compressibility: 9% % Carbon: 99% Tensile Web Strength (md): 2500 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 30 sec./100 cm3 Thru-Plane Electrical Resistivity: 10 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1% Additional Information
37.	Carbon Paper- AvCarb ™ P50 .4 m x 10m	*Product Overview:* In combination with Ballard Power Systems' leadership and expertise in the development and manufacturing of proton exchange membrane (PEM) fuel cells, Ballard Material Products (BMP) introduces its AvCarb Ã‚Â® Grade-P50 carbon fiber paper. Specifically developed for gas diffusion layer (GDL) applications in PEM fuel cells and other applications requiring a conductive substrate, AvCarb Ã‚Â® P50 is a carbon particle-filled, polyacrylonitrile (PAN) based carbon fiber paper manufactured utilizing BMP's exclusive AccuCarb Ã‚Â® continuous carbonization process. Under development for over two years, Ballard's AvCarb Ã‚Â® P50 has the potential for becoming the lowest cost GDL available, thus providing a stimulus for the growth of fuel cell applications. AvCarb Ã‚Â® P50 is the result of Ballard identifying key electrical, mechanical and gas/liquid diffusion properties needed by GDL users and designing a product to meet those requirements. AvCarb Ã‚Â® P50 is a baseline product that can be design modified to optimize specific performance characteristics. The paper can also be supplied with hydrophobic coating that minimizes the effects of moisture exposure, enhances performance, provides durability and facilitates handling. When supplied with the hydrophobic coating the Grade designation becomes AvCarb Ã‚Â® P50T. *Availablity:-* Roll Lengths: Up to 500 meters Rolls: 10 meters x 0.4 meters Rolls: 50 meters x 0.4 meters *Technical Specifications:* Ballard Material Products AvCarb P50 Carbon Fiber Paper, 20 cm x 25 cm, 175 um thick. Actual Weight: 54gm/m2 Bulk Density: 0.28 gm/cm3

		Thickness: At 0.7 N/cm2 172 microns At 28 N/cm2 130 microns At 140 N/cm2 108 microns Compressibility: 10% Compressive Set: 11.5 microns % Carbon: 99% Tensile Web Strength (md): 1000 N/m Bending Stiffness (Taber): 7.3(machine direction) Thru-Plane Thermal Conductivity @ 100 C: 1.3 W/m-k Thru-Plane Air Permeability (Gurley): 30 sec./100 cm3 Thru-Plane Electrical Resistivity: 9.7 mohms-cm2 Oxidation Rate (Wt. Loss/hr. @ 500C in air): 0.1%
38.	Toray Carbon Paper TGP-H-030 (10x10cm)	*Product Overview:* TGP-H-030 is a teflon treated carbon fiber paper suitable for use as a catalyst backing layer. The teflon gives the carbon material a hydrophobic property to better function as an electrode backing material. *Details:* Wet proofing of 10%-60% available upon request. Quantity discounts and custom sizes upon requests. *Technical Specifications:* Teflon treated: 5% wt. wet proofing Dimension: 10cm x 10cm Thickness: 100um
39.	Toray Carbon Paper TGP-H-030 (40x40cm)	*Product Overview:* TGP-H-030 is a teflon treated carbon fiber paper suitable for use as a catalyst backing layer. The teflon gives the carbon material a hydrophobic property to better function as an electrode backing material. *Details:* Wet proofing of 10%-60% available upon request. Quantity discounts and custom sizes upon requests. *Technical Specifications:* Teflon treated: 5% wt. wet proofing Dimension: 40cm x 40cm Thickness: 100um

D. Membrane

No.	Item	Description
1.	Nafion XL: 10cm x 10cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
2.	Nafion XL: 15cm x 15cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
3.	Nafion XL: 20cm x 20cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
4.	Nafion XL: 25cm x 25cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
5.	Nafion XL: 30cm x 30cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
6.	Nafion 212: 10cm x 10cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
7.	Nafion 212: 15cm x 15cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
8.	Nafion 212: 20cm x 20cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
9.	Nafion 212: 25cm x 25cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
10.	Nafion 212: 30cm x 30cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
11.	Nafion 115: 10cm x 10cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.

12.	Nafion 115: 15cm x 15cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
13.	Nafion 115: 20cm x 20cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
14.	Nafion 115: 25cm x 25cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
15.	Nafion 115: 30cm x 30cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
16.	Nafion 117: 10cm x 10cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
17.	Nafion 117: 15cm x 15cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
18.	Nafion 117: 20cm x 20cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
19.	Nafion 117: 25cm x 25cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
20.	Nafion 117: 30cm x 30cm	Untreated Nafion Proton Exchnage Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.
21.	Nafion 211 Membrane 100cm2	Nafion 211 Membrane 10 x 10 cm. Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers. *Technical Specifications:* Dimensions: 10 cm x 10 cm Nominal Thickness: 25.4 microns Weight 50 g/m2
22.	Nafion 211 Membrane 900 cm2	Nafion 211 Membrane 30 x 30 cm. Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers.

		Technical Specifications: Dimensions: 30 cm x 30 cm Nominal Thickness: 25.4 microns Weight 50 g/m2
23.	Nafion NRE212 Membrane 100cm 2	Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers. *Technical Specifications:* Dimensions: 10 cm x 10 cm Nominal Thickness: 0.051 mm Weight Caliper 1.0 g/m2 Density: 2.0 g/cm3 Conductivity: 0.083 S/cm
24.	Nafion NRE212 Membrane 900cm 2	*Product Overview:* Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers. Details *Technical Specifications:* Dimensions: 30 cm x 30 cm Nominal Thickness: 0.051 mm Weight Caliper 1.0 g/m2 Density: 2.0 g/cm3 Conductivity: 0.083 S/cm
25.	Nafion® 117CS Membrane 100cm2	*Product Overview:* Nafion Membrane is used to separate the anode and cathode compartment of Proton Exchange Membrane fuel cells and water electrolyzers. The thickness of this particular membrane makes it suitable for Direct Methanol Fuel Cells (DMFC). *Technical Specifications:* Dimensions: 10 cm x 10 cm Nominal Thickness: 0.183 mm Weight Caliper 3.6 g/m2 Density: 2.0 g/cm3 Conductivity: 0.083 S/cm
26.	Nafion® 117CS Membrane 900 sq cm	*Product Overview:* Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers *Technical Specifications:* Length: 30cm Width: 30cm
27.	Nafion® solution DE1021 10wt.% 250 ml	*Product Overview:* Nafion solution is used to coat the catalyst side of the electrode before attaching it to the membrane of the MEA. Can also be used to load the electrode with a catalyst that is in powdered form.
28.	Nafion® solution DE1021 10wt.% 500 ml	*Product Overview:* Nafion solution is used to coat the catalyst side of the electrode before attaching it to the membrane of the MEA. Can also be used to load the electrode with a catalyst that is in powdered form.

29.	Nafion® 115CS Membrane 100cm2	*Product Overview:* Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers. *Technical Specifications:* Dimensions: 10 cm x 10 cmNominal Thickness: 0.127 mm Weight Caliper 2.5 g/m2 Density: 2.0 g/cm3 Conductivity: 0.083 S/cm
30.	Nafion® 115CS Membrane 900cm 2	*Product Overview:* Untreated Nafion Membrane used to separate the anode and cathode compartment of Proton Exchange Membrane (PEM) fuel cells and water electrolyzers
31.	Nafion® solution DE1021 10wt.% 100 ml	*Product Overview:* Nafion solution is used to coat the catalyst side of the electrode before attaching it to the membrane of the MEA. Can also be used to load the electrode with a catalyst that is in powdered form.
32.	Nafion® solution DE1021 10wt.% 50 ml	*Product Overview:* Nafion solution is used to coat the catalyst side of the electrode before attaching it to the membrane of the MEA. Can also be used to load the electrode with a catalyst that is in powdered form.

E. Membrane Electrode Assemblies (MEAs)

No.	Item	Description
1.	Direct Methanol MEA - Active Area of 5 cm2	Methanol (MeOH) can be utilized directly (without the need for a reformer) with these MEAs. This allows a liquid fuel to be used directly in a fuel cell. This is often useful in lower power applications. We are currently developing next generation MEAs that are promising unprecedented fuel utilization and energy densities. *Specification:* Active Area: 5 cm2 Membrane Area: 100 cm2 Anode Catalyst: 4 mg/cm2 PtRu Cathode Catalyst: 4 mg/cm2 PtBlack Nafion Type: N117
2.	Electrolyzer MEA - Active Area of 5 cm2	Our Electrolyzer MEAs are some of the highest quality and most efficient on the market. Infact, many of our customers use our MEAs as their gold standard in developing their own product line of hydrogen generation equipment. *Specification:* Active Area: 5 cm2 Membrane Area: 100 cm2 Anode Catalyst: 3 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115

3.	Hydrogen Air MEA - Active Area of 5 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 5 cm2 Membrane Area: 100 cm2 Anode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Cathode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Nafion Type: N212
4.	Hydrogen Oxygen 3 Layer MEA - Active Area of 5 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 5 cm2 Membrane Area: 100 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
5.	Hydrogen Oxygen 5 Layer MEA - Active Area of 5 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 5 cm2 Membrane Area: 100 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
6.	Reversible MEA - Active Area of 5 cm2	Our Reversible MEA combines the features of our high performance Fuel Cell and Electrolyzer MEAs into a single MEA that can be used for either Electrolysis or as a Fuel Cell. These MEAs are excellent for demonstrating the electrochemical principals behind Fuel Cells and Electrolyzers. They can also be used to build systems that can either generate hydrogen (and consume power) or generate power (and consume Hydrogen). *Specification:* Active Area: 5 cm2 Membrane Area: 100 cm2 Anode Catalyst: 1.5 mg/cm2 PtBlack and 1.5 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115

7.	Direct Methanol MEA - Active Area of 25 cm2	Methanol (MeOH) can be utilized directly (without the need for a reformer) with these MEAs. This allows a liquid fuel to be used directly in a fuel cell. This is often useful in lower power applications. We are currently developing next generation MEAs that are promising unprecedented fuel utilization and energy densities. *Specification:* Active Area: 25 cm2 Membrane Area: 100 cm2 Anode Catalyst: 4 mg/cm2 PtRu Cathode Catalyst: 4 mg/cm2 PtBlack Nafion Type: N117
8.	Electrolyzer MEA - Active Area of 25 cm2	Our Electrolyzer MEAs are some of the highest quality and most efficient on the market. Infact, many of our customers use our MEAs as their gold standard in developing their own product line of hydrogen generation equipment. *Specification:* Active Area: 25 cm2 Membrane Area: 100 cm2 Anode Catalyst: 3 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115
9.	Hydrogen Air MEA - Active Area of 25 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 25 cm2 Membrane Area: 100 cm2 Anode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Cathode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Nafion Type: N212
10.	Hydrogen Oxygen 3 Layer MEA - Active Area of 25 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 25 cm2 Membrane Area: 100 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
11.	Hydrogen Oxygen 5 Layer MEA - Active Area of 25 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities.

		Specification: Active Area: 25 cm2 Membrane Area: 100 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
12.	Reversible MEA - Active Area of 25 cm2	Our Reversible MEA combines the features of our high performance Fuel Cell and Electrolyzer MEAs into a single MEA that can be used for either Electrolysis or as a Fuel Cell. These MEAs are excellent for demonstrating the electrochemical principals behind Fuel Cells and Electrolyzers. They can also be used to build systems that can either generate hydrogen (and consume power) or generate power (and consume Hydrogen). *Specification:* Active Area: 25 cm2 Membrane Area: 100 cm2 Anode Catalyst: 1.5 mg/cm2 PtBlack and 1.5 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115
13.	Direct Methanol MEA - Active Area of 50 cm2	Methanol (MeOH) can be utilized directly (without the need for a reformer) with these MEAs. This allows a liquid fuel to be used directly in a fuel cell. This is often useful in lower power applications. We are currently developing next generation MEAs that are promising unprecedented fuel utilization and energy densities. *Specification:* Active Area: 50 cm2 Membrane Area: 169 cm2 Anode Catalyst: 4 mg/cm2 PtRu Cathode Catalyst: 4 mg/cm2 PtBlack Nafion Type: N117
14.	Electrolyzer MEA - Active Area of 50 cm2	Our Electrolyzer MEAs are some of the highest quality and most efficient on the market. Infact, many of our customers use our MEAs as their gold standard in developing their own product line of hydrogen generation equipment. *Specification:* Active Area: 50 cm2 Membrane Area: 100 cm2 Anode Catalyst: 3 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115
15.	Hydrogen Air MEA - Active Area of 50 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 50 cm2 Membrane Area: 169 cm2 Anode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Cathode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Nafion Type: N212

16.	Hydrogen Oxygen 3 Layer MEA - Active Area of 50 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 50 cm2 Membrane Area: 169 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
17.	Hydrogen Oxygen 5 Layer MEA - Active Area of 50 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 50 cm2 Membrane Area: 169 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
18.	Reversible MEA - Active Area of 50 cm2	Our Reversible MEA combines the features of our high performance Fuel Cell and Electrolyzer MEAs into a single MEA that can be used for either Electrolysis or as a Fuel Cell. These MEAs are excellent for demonstrating the electrochemical principals behind Fuel Cells and Electrolyzers. They can also be used to build systems that can either generate hydrogen (and consume power) or generate power (and consume Hydrogen). *Specification:* Active Area: 50 cm2 Membrane Area: 100 cm2 Anode Catalyst: 1.5 mg/cm2 PtBlack and 1.5 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115
19.	Direct Methanol MEA - Active Area of 100 cm2	Methanol (MeOH) can be utilized directly (without the need for a reformer) with these MEAs. This allows a liquid fuel to be used directly in a fuel cell. This is often useful in lower power applications. We are currently developing next generation MEAs that are promising unprecedented fuel utilization and energy densities. *Specification:* Active Area: 100 cm2 Membrane Area: 169 cm2 Anode Catalyst: 4 mg/cm2 PtRu Cathode Catalyst: 4 mg/cm2 PtBlack Nafion Type: N117

20.	Electrolyzer MEA - Active Area of 100 cm2	Our Electrolyzer MEAs are some of the highest quality and most efficient on the market. Infact, many of our customers use our MEAs as their gold standard in developing their own product line of hydrogen generation equipment. *Specification:* Active Area: 100 cm2 Membrane Area: 169 cm2 Anode Catalyst: 3 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115
21.	Hydrogen Air MEA - Active Area of 100 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 100 cm2 Membrane Area: 169 cm2 Anode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Cathode Catalyst: 0.5 mg/cm2 60wt% Pt on Carbon Nafion Type: N212
22.	Hydrogen Oxygen 3 Layer MEA - Active Area of 100 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 100 cm2 Membrane Area: 169 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
23.	Hydrogen Oxygen 5 Layer MEA - Active Area of 100 cm2	These MEAs are recognized worldwide as some of the highest quality MEAs currently available. In addition to our high quality, we also over extensive customization and can produce MEAs to your specifications. We can provide MEAs with virtually any size, shape, catalyst type or loading. And we can provide them in quantities from single units for prototyping or R&D purposes to production level quantities. *Specification:* Active Area: 100 cm2 Membrane Area: 169 cm2 Anode Catalyst: 4 mg/cm2 PtB Cathode Catalyst: 4 mg/cm2 PtB Nafion Type: N115
24.	Reversible MEA - Active Area of 100 cm2	Our Reversible MEA combines the features of our high performance Fuel Cell and Electrolyzer MEAs into a single MEA that can be used for either Electrolysis or as a Fuel Cell. These MEAs are excellent for demonstrating the electrochemical principals behind Fuel Cells and Electrolyzers. They can also be used to build systems that can either generate hydrogen (and

		consume power) or generate power (and consume Hydrogen). *Specification:* Active Area: 100 cm2 Membrane Area: 169 cm2 Anode Catalyst: 1.5 mg/cm2 PtBlack and 1.5 mg/cm2 IrRuOx Cathode Catalyst: 3 mg/cm2 PtBlack Nafion Type: N115
25.	5L SP-DMFC MEA 5cm 2	*Product Overview:* DMFC MEA with GDL Membrane Nafion 117 Catalysts Cathode: 4.0mg/cm2 Platinum Black Anode: 4.0mg/cm2 Platinum Ruthenium Black Gas Diffusion Layer Cathode: ETEK ELAT® Anode: Carbon Cloth *Details:* We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables. *Technical Specifications:* Active Area 2.24cm x 2.24cm Total Area 7.37cm x 7.37cm
26.	5L DMFC MEA 25cm 2	*Product Overview:* Membrane electrode assembly with GDL for use in direct methanol fuel cells. *Details:* We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables *Technical Specifications:* 25 cm25 Layer DMFC Membrane Electrode Assembly. Membrane Thickness: N-117 Electrode Area (Active Area): 5 x 5 cm Membrane Area: 8 x 8 cm. Cathode Loading: 2.0 mg Pt/cm2 Anode Loading: 4.0 mg Pt-Ru /cm2
27.	5L SP-DMFC MEA 25cm 2	*Product Overview:* DMFC MEA with GDL Membrane Nafion 117 Catalysts Cathode: 4.0mg/cm2 Platinum Black Anode: 4.0mg/cm2 Platinum Ruthenium Black Gas Diffusion Layer Cathode:ETEK ELAT® Anode:Carbon Cloth *Details:* We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

<table>
<tr><td></td><td></td><td><u>Technical Specifications:</u>
Active Area 5.0cm x 5.0cm
Total Area 10.52cm x 10.52cm</td></tr>
<tr><td>28.</td><td>5L DMFC MEA
5cm 2</td><td><u>Product Overview:</u>

Membrane electrode assembly with GDL for use in direct methanol fuel cells.

<u>Details:</u>
The table below gives sample data from single cells of electrode area 25 cm2 with Nafion 117 membrane and 2.5% methanol solution.

<table>
<tr><td>Anode (Pt/Ru)</td><td>Cathode (Pt)</td><td>T (°C)</td><td>Air pressure
psig</td><td colspan="2">Performance (mV)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>100 mA/cm^2</td><td>200 mA/cm^2</td></tr>
<tr><td>2 mg/cm^2</td><td>2 mg/cm^2</td><td>70</td><td>6</td><td>490</td><td>420</td></tr>
<tr><td>4 mg/cm^2</td><td>2 mg/cm^2</td><td>70</td><td>6</td><td>520</td><td>450</td></tr>
</table>
The actual performance obtained by a customer will depend on proper choices of the various operating variables.

<u>Technical Specifications:</u>
5 cm25 Layer DMFC Membrane Electrode Assembly.
Membrane Thickness: N-117
Electrode Area (Active Area): 2.3 x 2.3 cm
Membrane Area: 5.5 x 5.5 cm.
Cathode Loading: 2.0 mg Pt/cm2
Anode Loading: 4.0 mg Pt-Ru /cm2</td></tr>
<tr><td>29.</td><td>5L HP-A MEA
100cm 2</td><td><u>Product Overview:</u>
Hydrogen/Air MEA with GDL
Membrane Nafion 112
Catalysts
Cathode: 0.5mg/cm2 Platinum on Carbon
Anode: 0.5mg/cm2 Platinum on Carbon
Gas Diffusion Layers
Cathode: ETEK ELAT®
Anode: ETEK ELAT®

<u>Details:</u>
We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

<u>Technical Specifications:</u>
Active Area 10cm x 10cm
Total Area 17.78cm x 17.78cm</td></tr>
<tr><td>30.</td><td>5L SP-DMFC MEA
50cm 2</td><td><u>Product Overview:</u>
DMFC MEA with GDL
Membrane Nafion 117
Catalysts
Cathode: 4.0mg/cm2 Platinum Black
Anode: 4.0mg/cm2 Platinum Ruthenium Black
Gas Diffusion Layers
Cathode: ETEK ELAT®
Anode: Carbon Cloth</td></tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td><u>Details:</u>
We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

<u>Technical Specifications:</u>
Active Area 7.08cm x 7.08cm
Total Area 13.28cm x 13.28cm</td>
</tr>
<tr>
<td>31.</td>
<td>5L DMFC MEA
50cm 2</td>
<td><u>Product Overview:</u>
Membrane electrode assembly with GDL for use in direct methanol fuel cells.

<u>Details:</u>
The table below gives sample data from single cells of electrode area 25 cm2 with Nafion 117 membrane and 2.5% methanol solution.
<table>
<tr><td>Anode (Pt/Ru)</td><td>Cathode (Pt)</td><td>T (°C)</td><td>Air pressure
psig</td><td colspan="2">Performance (mV)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>100 mA/cm^2</td><td>200 mA/cm^2</td></tr>
<tr><td>2 mg/cm^2</td><td>2 mg/cm^2</td><td>70</td><td>6</td><td>490</td><td>420</td></tr>
<tr><td>4 mg/cm^2</td><td>2 mg/cm^2</td><td>70</td><td>6</td><td>520</td><td>450</td></tr>
</table>
The actual performance obtained by a customer will depend on proper choices of the various operating variables.

<u>Technical Specifications:</u>
50 cm25 Layer DMFC Membrane Electrode Assembly.
Membrane Thickness: N-117
Electrode Area (Active Area): 7.1 x 7.1 cm
Membrane Area: 10 x 10 cm.
Cathode Loading: 2.0 mg Pt/cm2
Anode Loading: 4.0 mg Pt-Ru /cm2</td>
</tr>
<tr>
<td>32.</td>
<td>5L SP-DMFC MEA
100cm 2</td>
<td><u>Product Overview:</u>
DMFC MEA with GDL
Membrane Nafion 117
Catalysts
Cathode: 4.0mg/cm2 Platinum Black
Anode: 4.0mg/cm2 Platinum Ruthenium Black
Gas Diffusion Layers
Cathode: ETEK ELAT®
Anode: Carbon Cloth

<u>Details:</u>
We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

<u>Technical Specifications:</u>
Active Area 10cm x 10cm
Total Area 17.78cm x 17.78cm</td>
</tr>
<tr>
<td>33.</td>
<td>5L DMFC MEA
100cm 2</td>
<td><u>Product Overview:</u>
Membrane electrode assembly with GDL for use in direct methanol fuel cells.</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td>
<u>Details:</u>
The table below gives sample data from single cells of electrode area 25 cm2 with Nafion 117 membrane and 2.5% methanol solution.
<table>
<tr><td>Anode (Pt/Ru)</td><td>Cathode (Pt)</td><td>T (°C)</td><td>Air pressure
psig</td><td colspan="2">Performance (mV)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>100 mA/cm^2</td><td>200 mA/cm^2</td></tr>
<tr><td>2 mg/cm^2</td><td>2 mg/cm^2</td><td>70</td><td>6</td><td>490</td><td>420</td></tr>
<tr><td>4 mg/cm^2</td><td>2 mg/cm^2</td><td>70</td><td>6</td><td>520</td><td>450</td></tr>
</table>
The actual performance obtained by a customer will depend on proper choices of the various operating variables.

<u>Technical Specifications:</u>
100 cm25 Layer DMFC Membrane Electrode Assembly.
Membrane Thickness: N-117
Electrode Area (Active Area): 10 x 10 cm
Membrane Area: 13 x 13 cm.
Cathode Loading: 2.0 mg Pt/cm2
Anode Loading: 4.0 mg Pt-Ru /cm2
</td>
</tr>
<tr>
<td>34.</td>
<td>5L HP-A MEA
5cm 2</td>
<td>
<u>Product Overview:</u>
Hydrogen/Air MEA with GDL
Membrane Nafion 112
Catalysts
Cathode: 0.5mg/cm2 Platinum on Carbon
Anode: 0.5mg/cm2 Platinum on Carbon
Gas Diffusion Layers
Cathode: ETEK ELAT®
Anode: ETEK ELAT®

<u>Details:</u>
We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

<u>Technical Specifications:</u>
Active Area 2.24cm x 2.24cm
Total Area 7.37cm x 7.37cm
</td>
</tr>
<tr>
<td>35.</td>
<td>5L HP-A MEA
25cm 2</td>
<td>
<u>Product Overview:</u>
Hydrogen/Air MEA with GDL
Membrane Nafion 112
Catalysts
Cathode: 0.5mg/cm2 Platinum on Carbon
Anode: 0.5mg/cm2 Platinum on Carbon
Gas Diffusion Layers
Cathode: ETEK ELAT®
Anode: ETEK ELAT®

<u>Details:</u>
We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

<u>Technical Specifications:</u>
Active Area 5cm x 5cm
Total Area 10.52cm x 10.52cm
</td>
</tr>
</table>

36.	Build Your Own Fuel Cells 5L MEA 10cm 2	*Product Overview:* Membrane electrode assembly with GDL for use in hydrogen air/oxygen fuel cells. This is the MEA recommended for use in the book "Build Your Own Fuel Cells" written by Phillip Hurley. *Technical Specifications:* 12.18 cm2 5 Layer Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 3.49 x 3.49 cm Membrane Area: 5.5 x 5.5 cm. Cathode Loading: 0.5 mg Pt/cm2 Anode Loading: 0.2 mg Pt/cm2
37.	5L SP-O MEA 5cm 2	*Product Overview:* Hydrogen/Oxygen MEA with GDL Membrane Nafion 115 Catalysts Cathode: 4.0mg/cm2 Platinum Black Anode: 4.0mg/cm2 Platinum Black Gas Diffusion Layers Cathode: ETEK ELAT® Anode: ETEK ELAT® *Technical Specifications:* Active Area 2.24cm x 2.24cm Total Area 7.37cm x 7.37cm
38.	5L SP-O MEA 25cm 2	*Product Overview:* Hydrogen/Oxygen MEA with GDL Membrane Nafion 115 Catalysts Cathode: 4.0mg/cm2 Platinum Black Anode: 4.0mg/cm2 Platinum Black *Details:* We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables *Technical Specifications:* Active Area 5cm x 5cm Total Area 10.52cm x 10.52cm
39.	5L SP-O MEA 50cm 2	*Product Overview:* Hydrogen/Oxygen MEA with GDL Membrane Nafion 115 Catalysts Cathode: 4.0mg/cm2 Platinum Black Anode: 4.0mg/cm2 Platinum Black Gas Diffusion Layers Cathode: ETEK ELAT® Anode: ETEK ELAT® *Details:* We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

		Technical Specifications: Active Area 7.08cm x 7.08cm Total Area 13.28cm x 13.28cm
40.	5L SP-O MEA 100cm 2	*Product Overview:* Hydrogen/Oxygen MEA with GDL Membrane Nafion 115 Catalysts Cathode: 4.0mg/cm2 Platinum Black Anode: 4.0mg/cm2 Platinum Black Gas Diffusion Layers Cathode: ETEK ELAT® Anode: ETEK ELAT® *Details:* We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables *Technical Specifications:* Active Area 10cm x 10cm Total Area 17.78cm x 17.78cm
41.	5L Standard MEA 4cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 4 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 2 x 2 cm Membrane Area: 5 x 5 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 GDL: yes
42.	.4 mg/cm 2 Replacement Membrane for the dismantle-able fuel cell.	*Product Overview:* .4 mg/cm2 Replacement Membrane for the dismantle-able fuel cell.
43.	Custom MEAs	*Product Overview:* WE REQUIRE A MINIMUM ORDER OF 5 FOR CUSTOM MEAs. MEAs of different sizes and shapes for operations with humidification ("standard" type) and for operations without humidification ("self-humidified" type). Any proton exchange membrane can be used to make these MEAs. Catalyst loading can vary from a fraction of a milligram to a high of 8 milligram per square cm. These catalysts can be Pt, Pt/Ru, or any other chosen catalysts a customer may have for a specific application. The Company always has in stock the commonly used catalysts: Pt and Pt/Ru. The standard type MEAs can be used for PEM fuel cells and also for direct methanol fuel cells. For quotation on prices, please indicate the MEA type and size, membrane and its size, catalysts and their loadings, and number of MEAs required.

44.	5L Standard MEA 25cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 25 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 5 x 5 cm Membrane Area: 8 x 8 cm. Cathode Loading:0.4 mg Pt/cm2 Anode Loading: 0.2 mg Pt/cm2 GDL: yes
45.	5L Standard MEA 100 cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 100 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 10 x 10 cm Membrane Area: 13 x 13 cm Cathode Loading:0.4 mg Pt/cm2 Anode Loading: 0.2 mg Pt/cm2 GDL: yes
46.	5L HP Self-Humidifying MEA 25cm 2	*Product Overview:* High-Performance Membrane Electrode Assembly with Gas Diffucion Layer for use in PEM Fuel Cells. *Technical Specifications:* 25 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 5 x 5 cm Membrane Area: 8 x 8 cm. Cathode Loading: 1.0 mg Pt/cm2 Anode Loading: 0.2 mg Pt/cm2 GDL: yes Self-Humidifying: yes
47.	5L Standard MEA 100 cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 100 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 10 x 10 cm Membrane Area: 13 x 13 cm Cathode Loading:0.4 mg Pt/cm2 Anode Loading: 0.2 mg Pt/cm2 GDL: yes
48.	5L HP Self-Humidifying MEA 25cm 2	*Product Overview:* High-Performance Membrane Electrode Assembly with Gas Diffucion Layer for use in PEM Fuel Cells. Details

		Technical Specifications: 25 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 5 x 5 cm Membrane Area: 8 x 8 cm. Cathode Loading: 1.0 mg Pt/cm2 Anode Loading: 0.2 mg Pt/cm2 GDL: yes Self-Humidifying: yes
49.	.1 mg/cm 2 Replacement Membrane for the dismantle-able fuel cell.	*Product Overview:* .1 mg/cm2 Replacement Membrane for the dismantle-able fuel cell.
50.	Membrane Electrode Assembly (MEA) Standard 5-Layer 4cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 4 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 2 x 2 cm Membrane Area: 5 x 5 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes
51.	Membrane Electrode Assembly (MEA) Standard 5-Layer 5cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 5 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 2.3 x 2.3 cm Membrane Area: 6 x 6 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes
52.	Membrane Electrode Assembly (MEA) Standard 5-Layer 10cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 10 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 3.2 x 3.2 cm Membrane Area: 6 x 6 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes

53.	Membrane Electrode Assembly (MEA) Standard 5-Layer 50cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 50 cm2 Membrane Electrode Assembly. Membrane Thickness: N-112 Electrode Area (Active Area): 7.1 x 7.1 cm Membrane Area: 10 x 10 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes
54.	Membrane Electrode Assembly (MEA) Standard 5-Layer 4cm 2 N115	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 4 cm2 Membrane Electrode Assembly. Membrane Thickness: N-115 Electrode Area (Active Area): 2 x 2 cm Membrane Area: 5 x 5 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes
55.	Membrane Electrode Assembly (MEA) Standard 5-Layer 50cm N115	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 50 cm2 Membrane Electrode Assembly. Membrane Thickness: N-115 Electrode Area (Active Area): 7.1 x 7.1 cm Membrane Area: 10 x 10 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes
56.	Membrane Electrode Assembly (MEA) Standard 5-Layer 4cm 2 N117	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 4 cm2 Membrane Electrode Assembly. Membrane Thickness: N-117 Electrode Area (Active Area): 2 x 2 cm Membrane Area: 5 x 5 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes

57.	Membrane Electrode Assembly (MEA) Standard 5-Layer 50cm 2 N117	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 50 cm2 Membrane Electrode Assembly. Membrane Thickness: N-117 Electrode Area (Active Area): 7.1 x 7.1 cm Membrane Area: 10 x 10 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg Pt/cm2 Gas Diffusion Layer (GDL): yes
58.	Membrane Electrode Assembly (MEA) DMFC 5-Layer 50cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 50 cm2 Membrane Electrode Assembly. Membrane Thickness: N-117 Electrode Area (Active Area): 7.1 x 7.1 cm Membrane Area: 10 x 10 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg PtRu/cm2 Gas Diffusion Layer (GDL): yes
59.	Membrane Electrode Assembly (MEA) DMFC 5-Layer 100cm 2	*Product Overview:* Standard Membrane Electrode Assembly (MEA) with Gas Diffusion Layer (GDL) for use in PEM Fuel Cells. *Technical Specifications:* 100 cm2 Membrane Electrode Assembly. Membrane Thickness: N-117 Electrode Area (Active Area): 10 x 10 cm Membrane Area: 15 x 15 cm. Cathode Loading:0.5 mg Pt/cm2 Anode Loading: 0.5 mg PtRu/cm2 Gas Diffusion Layer (GDL): yes
60.	3 Layer Electrolyzer MEA 5 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Electrolyzer Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 2.24x2.24 cm Total Area: 6x6cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 3 mg/cm2 IrRuox We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

61.	3 Layer Electrolyzer MEA 25 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Electrolyzer Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 5x5 cm Total Area: 8x8cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 3 mg/cm2 IrRuox We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
62.	3 Layer Electrolyzer MEA 50cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Electrolyzer Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 7.1x7.1 cm Total Area: 10x10cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 3 mg/cm2 IrRuox We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
63.	3 Layer Electrolyzer MEA 100 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Electrolyzer Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 10x10 cm Total Area: 13x13cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 3 mg/cm2 IrRuox We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
64.	3 Layer Direct Methanol MEA 50 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Direct Methanol Membrane Electrode Assembly Membrane Type: Nafion 117 Active Area: 7.1x7.1 cm Total Area: 10x10cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 Pt:Ru

		We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
65.	3 Layer Direct Methanol MEA 5 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Direct Methanol Membrane Electrode Assembly Membrane Type: Nafion 117 Active Area: 2.24x2.24 cm Total Area: 6x6cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 Pt:Ru We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
66.	3 Layer Direct Methanol MEA 100 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Direct Methanol Membrane Electrode Assembly Membrane Type: Nafion 117 Active Area: 10x10 cm Total Area: 13x13cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 Pt:Ru We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
67.	3 Layer Hydrogen Oxygen MEA 5 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Hydrogen Oxygen Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 2.24x2.24 cm Total Area: 6x6cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 PtB We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
68.	3 Layer Hydrogen Oxygen MEA 50 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Hydrogen Oxygen Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 7.1x7.1 cm

		Total Area: 10x10cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 PtB We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
69.	3 Layer Hydrogen Oxygen MEA 100 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Hydrogen Oxygen Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 10x10 cm Total Area: 13x13 cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 PtB We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
70.	3 Layer Reversible MEA 25 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Reversible Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 5x5 cm Total Area: 8x8 cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 1.5 mg/cm2 PtB and IrRuOx We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
71.	3 Layer Reversible MEA 50 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Reversible Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 7.1x7.1 cm Total Area: 10x10 cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 1.5 mg/cm2 PtB and IrRuOx We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
72.	3 Layer Reversible MEA 100 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells.

		Details: 3 Layer Reversible Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 10x10 cm Total Area: 13x13 cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 1.5 mg/cm2 PtB and IrRuOx We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
73.	3 Layer Direct Methanol MEA 25 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Direct Methanol Membrane Electrode Assembly Membrane Type: Nafion 117 Active Area: 5x5 cm Total Area: 8x8cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 Pt:Ru We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
74.	3 Layer Hydrogen Air Membrane Electrode Assembly 5 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Hydrogen Air Membrane Electrode Assembly Membrane Type: Nafion 117 Active Area: 2.24x2.24 cm Total Area: 6x6cm Cathode Loading: .5 mg/cm2 60 wt% Pt Anode Loading: .5 mg/cm2 60 wt% Pt We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
75.	3 Layer Hydrogen Oxygen MEA 25 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Hydrogen Oxygen Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 5x5 cm Total Area: 8x8 cm Cathode Loading: 4 mg/cm2 PtB Anode Loading: 4 mg/cm2 PtB We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables

76.	3 Layer Reversible MEA 5 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Reversible Membrane Electrode Assembly Membrane Type: Nafion 115 Active Area: 2.24x2.24 cm Total Area: 6x6cm Cathode Loading: 3 mg/cm2 PtB Anode Loading: 1.5 mg/cm2 PtB and IrRuOx We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables
77.	3 Layer Hydrogen Air MEA 100 cm2	*Product Overview:* Membrane Electrode Assembly (MEA) for use in PEM Fuel Cells. *Details:* 3 Layer Hydrogen Air Membrane Electrode Assembly Membrane Type: Nafion 212 Active Area: 10x10 cm Total Area: 13x13cm Cathode Loading: .5 mg/cm2 60 wt% Pt Anode Loading: .5 mg/cm2 60 wt% Pt We do not make any claims about performance nor do we guarantee any performance specs. The actual performance obtained by a customer will depend on choices made regarding the various operating variables