DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
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Silver Spring, MD 20993-0002

May 22, 2015

Penumbra, Inc.
Ms. Michaela Mahl
Senior Manager Regulatory Affairs
1351 Harbor Bay Parkway
Alameda, California 94502

Re: K142458
Trade/Device Name: Penumbra System ACE 64 and ACE 68 Reperfusion Catheters
Regulation Number: 21 CFR 870.1250
Regulation Name: Percutaneous Catheter
Regulatory Class: Class II
Product Code: NRY
Dated: April 10, 2015
Received: April 13, 2015

Dear Ms. Michaela Mahl,

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you; however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in

the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please contact the Division of Industry and Consumer Education at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm for the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

You may obtain other general information on your responsibilities under the Act from the Division of Industry and Consumer Education at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm.

Sincerely yours,

Carlos L. Pena -S

Carlos L. Peña, PhD, MS
Director
Division of Neurological
and Physical Medicine Devices
Office of Device Evaluation
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: January 31, 2017
See PRA Statement below.

510(k) Number *(if known)*
K142458

Device Name
Penumbra System ACE 64 and ACE 68 Reperfusion Catheters

Indications for Use *(Describe)*
The Penumbra System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset. The Reperfusion Catheters ACE 64 and ACE 68 are intended for use in revascularization within the Internal Carotid Artery (ICA) within 8 hours of symptom onset.

Type of Use *(Select one or both, as applicable)*

☒ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

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510(k) Summary

(as required by 21 CFR 807.92)

Pursuant to Section 12, Part (a)(i)(3A) of the Safe Medical Devices Act of 1990, Penumbra Inc. is providing the summary of Substantial Equivalence for the Penumbra System ACE 64 and ACE 68 Reperfusion Catheters.

1 Sponsor/Applicant Name and Address

Penumbra, Inc.
1351 Harbor Bay Parkway
Alameda, CA 94502 USA

2 Sponsor Contact Information

Michaela Mahl
Senior Manager, Regulatory Affairs
Phone: (510) 748-3288
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Email: michaela.mahl@penumbrainc.com

3 Date of Preparation of 510(k) Summary

May 07, 2015

4 Device Trade or Proprietary Name

Penumbra System ACE 64 and ACE 68 Reperfusion Catheters

5 Device Classification

Regulatory Class:	II
Classification Panel:	Neurology
Classification Name:	Percutaneous Catheter
Regulation Number:	21 CFR §870.1250
Product Code:	NRY (Catheter, Thrombus Removal)

6 Predicate Devices

510(k) Number / Clearance Date	Name of Predicate Device	Name of Manufacturer
K072718 [28Dec2007], K090752 [21Sep2009], K100769 [21May2010], K113163 [28NOV2011], K133317 [13MAY2014]	Penumbra System / ® Penumbra System MAX	Penumbra, Inc. 1351 Harbor Bay Parkway Alameda, CA 94502 USA

7 Predicate Comparison

System Name	Penumbra System Reperfusion Catheter	Penumbra System ACE Reperfusion Catheter	
Device Name	**5MAX ACE**	**ACE 64**	**ACE 68**
510(k) No.	K090752	K142458	
Classification	Class II, NRY	SAME	
Indication	The Penumbra System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset.	The Penumbra System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset. The Reperfusion Catheters ACE 64 and ACE 68 are intended for use in revascularization within the Internal Carotid Artery (ICA) within 8 hours of symptom onset.	
Materials			
Proximal hub	Grilamid (TR55-LX)	SAME	
Strain Relief [Hub Sleeve]	Grilamid (TR55)	SAME	
Strain Relief	Stainless Steel, 304	SAME	
ID Band	Polyolefin, PET yellow [black ink]	SAME	
Catheter Shaft			
Distal Extrusions	Tecoflex 80A, Pellethane 80A, Pebas 35D, Pebax 35D/40D Blend, Pebax 40D, Pebax 55D, Pebax 63D	Pellethane 80A, Tecoflex 80A, Tecoflex 80A/Pebax 35D, Pebax 35D, Pebax 35D/40D Blend, Pebax 40D, Pebax 40D/55D Blend, Pebax 55D, Pebax 63D	
Proximal Extrusions	Pebax 55D, Pebax 72D, Vestamid	Pebax 55D, Pebax 72D, Vestamid	Pebax 55D/72D Blend, Pebax 72D, Vestamid
Proximal Coil Reinformcement	SS flat (0.002 in x 0.007 in)	SS flat (0.0015 in x 0.006 in) and SS round (0.0025 in)	SS flat (0.0015 in x 0.006 in) and NiTi round (0.0025 in)
Extrusion Colorants	Clear/ Natural or Purple	SAME	
Tip Shape	Straight	SAME	
Markerband	C-cut Pt/Ir band	SAME	
Coating	SRDX Harmony (proprietary)	SAME	
Dimensions			
Proximal OD	0.083 in Max	0.084 in Max	0.084 in Max
Proximal ID	0.068 in Min	0.068 in Min	0.068 in Min
Distal OD	0.074 in Max	0.080 in Max	0.084 in Max

System Name	Penumbra System Reperfusion Catheter	Penumbra System ACE Reperfusion Catheter	
Device Name	**5MAX ACE**	**ACE 64**	**ACE 68**
Distal ID	0.060 in Min	0.064 in Min	0.068 in Min
Effective Length	125, 127, 132 cm	115, 120, 125, 127, 132 cm	
Coating Length	30 cm	SAME	
Accessories			
Peelable Sheath	PTFE	SAME	
Rotating Hemostasis Valve	Polycarbonate, silicone o-ring	SAME	
Shaping Mandrel	0.038in OD	SAME	
Packaging Materials			
Pouch	Polyester/Polyethylene/ Tyvek®	SAME	
Packaging Hoop	Polyethylene	SAME	
Packaging Card	Polyethylene	SAME	
Display Carton	SBS Paperboard	SAME	
Packaging Configuration	Individual	SAME	
Sterilization	EO	SAME	
Shelf-Life	36 Months	SAME	

8 Device Description

The Penumbra System ACE components are additional components to the currently available Penumbra System / Penumbra System MAX. The Penumbra System ACE components provide a larger lumen to assist in the removal of thrombus from the neurovasculature. The devices are provided sterile, non-pyrogenic, and intended for single use only.

9 Indications for Use

The Penumbra System is intended for use in the revascularization of patients with acute ischemic stroke secondary to intracranial large vessel occlusive disease (within the internal carotid, middle cerebral – M1 and M2 segments, basilar, and vertebral arteries) within 8 hours of symptom onset. The Reperfusion Catheters ACE 64 and ACE 68 are intended for use in revascularization within the Internal Carotid Artery (ICA) within 8 hours of symptom onset.

10 Summary of Non-Clinical Data

As required under Section 12, Part (a)(i)(3A) of the Safe Medical Devices Act of 1990, a summary of any information regarding substantial equivalence of the device follows.

Included in this section are summary descriptions of the testing, which substantiates the performance of the subject Penumbra System ACE 64 and ACE 68 as well as its substantial equivalence to the predicate devices:

- Biocompatibility
- Design Verification (Bench-Top Testing)
- Design Validation (GLP Animal Testing)

The subject Penumbra System ACE 64 and ACE 68 devices met all established requirements.

10.1 Biocompatibility Testing

Biocompatibility tests conducted on the materials of the Penumbra System ACE devices were selected in accordance with EN ISO 10993 -1 guidelines (Biological Evaluation of Medical Devices) for limited duration (<24 hours), external communicating devices, contacting circulating blood. All studies were conducted pursuant to 21 CFR, Part 58, Good Laboratory Practices. In summary, non-clinical testing found the Penumbra System ACE devices to be biocompatible according to the requirements of EN ISO 10993 requirements. The following tests were performed and all tests passed successfully:

Test	Acceptance Criteria	Results	Pass / Fail
In Vitro Cytotoxicity	Sample extracts must yield cell lysis grade 2 or lower	Grade 1: Slight	Pass
Sensitization	Test Group shall yield Grade < 1 score on Magnusson and Kligman scale (provided control Grade < 1)	Grade 0: No visible change	Pass
Acute Intracutaneous Reactivity (Irritation)	The difference in the mean test article and mean control score must be grade 1.0 or lower	Grade ≤ 1.0 difference between mean test article and mean control score	Pass
Systemic Toxicity			
Acute Systemic Toxicity	Sample extracts must not cause the following: • > 10% weight loss in 3 or more test animals • Mortality of 2 or more test animals • Abnormal behavior in 2 or more test animals	No evidence of systemic toxicity from sample extracts • No weight loss (all gained weight) • No death • All test animals appeared normal	Pass

Test	Acceptance Criteria	Results	Pass / Fail
Rabbit Pyrogen Study	Sample Extracts must not cause a total rise in body temperature of ≥0.5°C	Non-pyrogenic: No evidence of material-mediated pyrogenicity; no single animal had a total body temperature rise of ≥0.5°C	Pass
Hemocompatibility			
In Vitro Hemolysis	Sample extracts must be non-hemolytic (≤ 2% hemolytic index)	Non-hemolytic: Hemolytic Index = 0.70% Corrected Hemolytic index = 0.00%	Pass
Complement Activation	The concentrations of C3a and SC5b-9 in the test samples are statistically similar to the predicate (Exposure Control & Ref Material) control and statistically lower than the positive control for all exposure times	The test sample concentrations of C3a and SC5b-9 were statistically similar or lower than the predicate control sample concentrations, and statistically lower than the positive control sample concentrations at all three exposure times	Pass
Dog Thrombogenicity	The device must be non-thrombogenic after 4 hours *in vivo* when compared to a control device (Boston Scientific Excelsior SL-10 microcatheter)	No significant thrombosis with a Grade of 0 was observed in 2 out 2 test site and 2 out of 2 control sites. Based on the evaluation criteria, the amount of thrombosis was not considered significant	Pass

In summary non-clinical testing substantiates that the Penumbra System ACE devices are non-cytotoxic, non-sensitizing, non-irritating, non-toxic, non-pyrogenic, non-hemolytic, and non-thrombogenic.

10.2 Bench-top Testing

The physical and mechanical properties of the Penumbra System ACE devices were assessed using standard test methods and pre-determined acceptance criteria. The following tests were performed and all tests passed successfully:

Attribute	Specification	Acceptance Criteria	Results
Dimensional/ Visual Inspection	These evaluations confirm that the units used in this Design Verification testing meet all inspection criteria for release of finished goods (clinically acceptable) product.		Pass

Attribute	Specification	Acceptance Criteria	Results
Simulated Use (Intracranial Access, Vessel Access Entry Performance & Clot Removal)	Simulated use testing of the Reperfusion Catheter and Separator was performed with accessory devices in an anatomical model which simulated the tortuosity of the neurovasculature. Devices were delivered through the tortuous anatomical model to evaluate the effectiveness of the devices to remove clots and that the Reperfusion Catheter does not collapse under vacuum.		100% Pass
Torsion (Reperfusion Catheter)	Number of turns will be recorded	<u>Data was recorded for informational purposes only</u>	
Injection Flow Rate	Injection flow rate will be recorded for various pressure settings	<u>Data was recorded for informational purposes only</u>	
Flow Rate	Flow rate (cc/min) with and without Separator in test article lumen will be reported	Data was recorded for informational purposes only	
Reperfusion Catheter Tip Pressure	Aspiration (Suction) Pressure and Pump MAX vacuum pressure will be reported	Data was recorded for informational purposes only	
Coating Integrity	Coating has not delaminated, peeled, or flaked after simulated use	100% Must meet Specification	100% Pass
Particulate Testing (Reperfusion Catheter Hydrophilic Coating)	The maximum number of particles: ≥ 10 µm will be ≤ 6000 particles ≥ 25 µm will be ≤ 600 particles.	100% Must meet Specification	<u>10µm</u> 100% Pass <u>25µm</u> 100% Pass
	≥ 75 µm & ≥ 125 µm will be recorded	<u>Data was recorded for informational purposes only</u>	
Particulate Testing (Reperfusion Catheter /Separator)	The maximum number of particles: ≥ 10 µm will be ≤ 6000 particles ≥ 25 µm will be ≤ 600 particles.	100% Must meet Specification	<u>10µm</u> 100% Pass <u>25µm</u> 100% Pass
	≥ 75 µm & ≥ 125 µm will be recorded	<u>Data was recorded for informational purposes only</u>	
Coating Integrity	Coating is not grossly damaged after undergoing particulate testing	100% Must meet Specification	100% Pass
Hub/Catheter Air Aspiration	When negative pressure is pulled, no air may leak into hub	100% Must meet Specification	100% Pass
Pressure Test	45 psi for 30 sec MIN	100% Must meet Specification	100% Pass

Attribute	Specification	Acceptance Criteria	Results
Reperfusion Catheter/Sheath or 8F Guide & 0.014" Guidewire compatibility (Friction Force)	Maximum value per specification	100% Must meet Specification	100% Pass
Markerband Section Bond Strength	Minimum value per specification	100% Must meet Specification	100% Pass
Joint Sections Bond Strength	Minimum value per specification	100% Must meet Specification	100% Pass
Hub to Shaft & Hub to Hypotube Bond Strength	Minimum value per specification	100% Must meet Specification	100% Pass
Steam-Shaped Distal Tip Tensile	Minimum value per specification	100% Must meet Specification	100% Pass
Elongation to Failure – Reperfusion Catheter	% Elongation $\geq$ 5%	100% Must meet Specification	100% Pass
Kink Resistance	No kinking when formed in a defined radius	100% Must meet Specification	100% Pass
Corrosion	No visible corrosion on Reperfusion Catheter immediately after Corrosion Testing procedure	100% Must meet Specification	100% Pass

The results of the tests appropriately address the physical and mechanical performance expectations of the device. This is further supported by the surgical handling and performance results reported in the *in vivo* study. Based on these overall results, the physical and mechanical properties of the subject Penumbra System ACE devices are acceptable for the intended use and substantially equivalent to the predicate device.

10.3 Animal Study

An animal study was conducted to evaluate the safe use of the Penumbra System ACE devices in a swine model. The study concluded that:

- No vessel injury was noted on the final angiograms following the vessel response procedure.
- No abnormal gross or histology findings were noted in test vessel segments.

- The use of the Penumbra System ACE devices resulted in no significant vascular response in these experimental conditions.

10.4 Summary of Substantial Equivalence

The subject Penumbra System ACE devices are substantially equivalent to the predicate device with regard to intended use, operating principle, design concept, materials, shelf-life, packaging and sterilization processes.