CathRAD®

The Software for Predicting & Optimizing
Marker Band Visibility

Roth Technologies, LLC

CathRAD® Software

- Fundamentals for CathRAD® Software
  - X-Ray Absorption
  - Exponential Attenuation Law
  - Marker Band Designs
- Radiopacity Index
- Standard Material Library
- CathRAD® Example
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X-Ray Absorption

- Ability of a material to attenuate an X-Ray beam depends on the following factors:
  - Marker Band Geometry
  - Marker Band Thickness
  - Material
  - X-Ray Energy
- Actual Contrast also depends on the following:
  - Anatomical region being visualized
  - Patient Size

Exponential Attenuation Law

- A narrow beam of monoenergetic photons penetrating a layer of material is modeled by the Exponential Attenuation Law:

$$I = I_o \exp[-\mu L]$$

- Io = Incident Intensity
- I = Emerging Intensity
- L = Material thickness
- μ = Attenuation Coefficient

Marker Band Geometry

- The Geometry of a Marker Band may be fully described by the following items:
  - Inner Diameter (ID)
  - Outer Diameter (OD)
  - Wall Thickness
  - Length
- CathRAD® allows a marker band geometry to be described dimensionally as follows:
  - ID/OD (Wall reference only)
  - ID/Wall (OD reference)
  - OD/Wall (ID reference)

Radiopacity Index

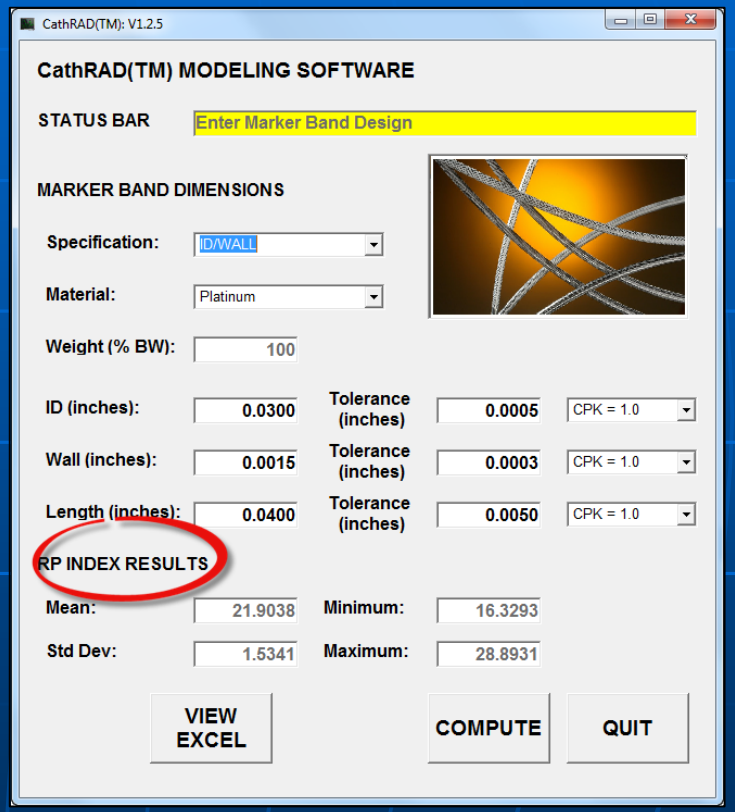
- CathRAD® computes a RP Index for a specific Marker Band Dimension and Material
- RP Index is a function of the following factors:
  - Marker Band Material
  - Marker Band Thickness
  - Marker Band Geometry (OD and Length)
- RP Index is a direct indication of Radiopacity
  - RP Index=20 is twice as visible as RP Index=10
- Monte Carlo Simulation
  - Tolerances can result in wide RP Index ranges
  - CathRAD® includes a Monte Carlo simulation engine in the software
  - CathRAD® computes the expected RP Index Mean, Standard Deviation, Min, and Max RP Index for a given marker band design based on the marker band tolerances

Standard Material Library

- CathRAD® comes with a Standard Material Library
  - Platinum and Platinum/Iridium
  - Gold (24K and 18K)
  - Tungsten
  - Nickel
  - Silver
  - Stainless Steel
  - Radiopaque Polymer Formulations ($BaSO_4$, Bi_2O_3, $Bi_2O_2CO_3$)
- The CathRAD® Standard Material Library is Dynamic
  - New Materials and Composites Materials can be loaded without recompiling the program
  - The Standard Material Library can be customized for your company

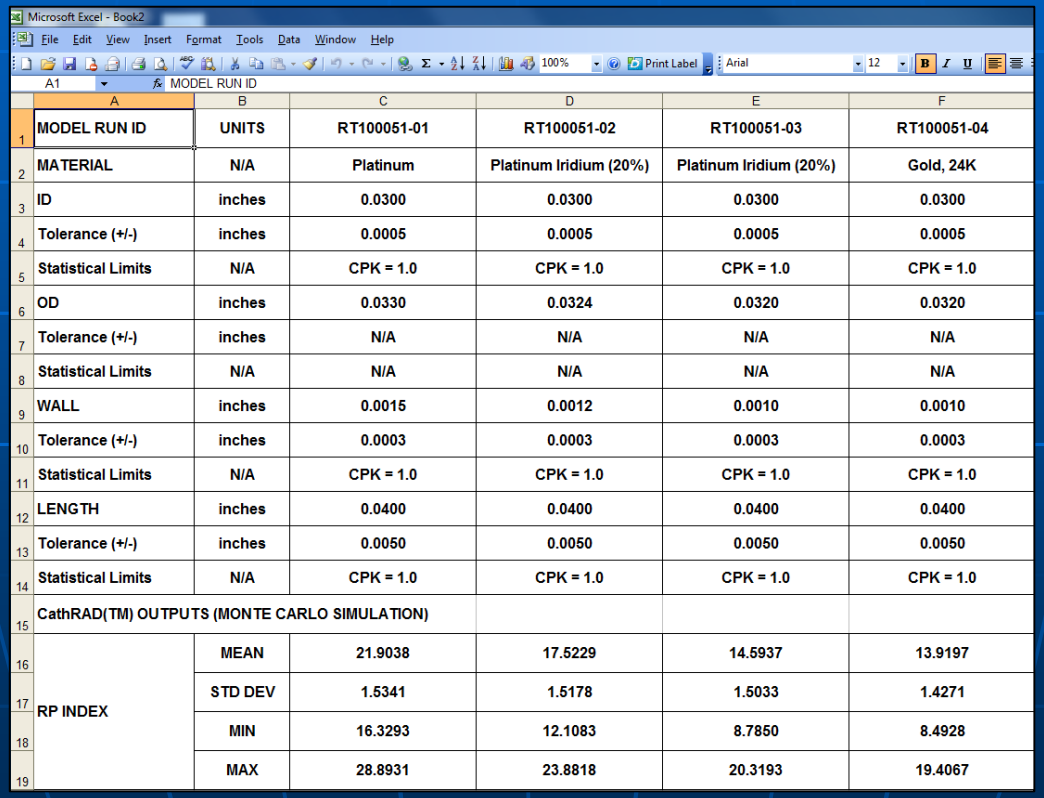
CathRAD® EXAMPLE

- Enter the Specification
- Enter the Material
- Enter Material Loading
- Enter the MB Geometry
- Select Compute button
- View the numerical outputs for your design
- Export to Microsoft Excel



MicroSoft Excel Integration

CathRAD® results may be exported to Microsoft Excel with a simple push of the EXPORT Menu Button. And the results are already formatted!



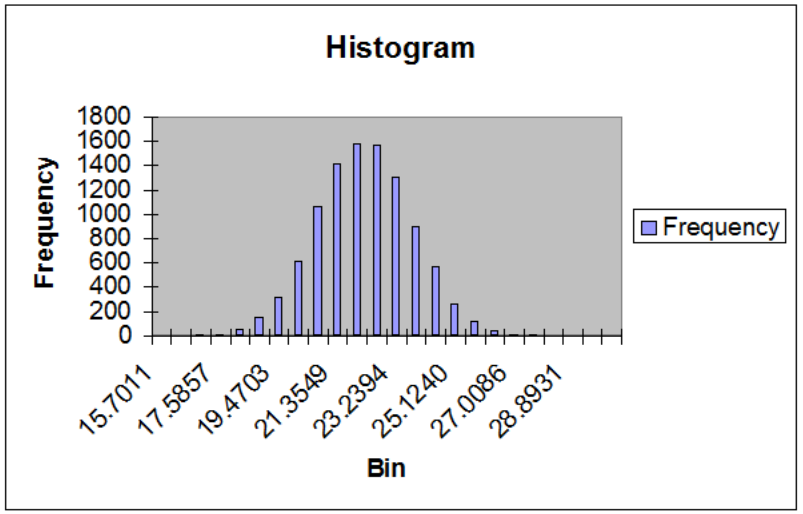
	A	B	C	D	E	F
1	MODEL RUN ID	UNITS	RT100051-01	RT100051-02	RT100051-03	RT100051-04
2	MATERIAL	N/A	Platinum	Platinum Iridium (20%)	Platinum Iridium (20%)	Gold, 24K
3	ID	inches	0.0300	0.0300	0.0300	0.0300
4	Tolerance (+/-)	inches	0.0005	0.0005	0.0005	0.0005
5	Statistical Limits	N/A	CPK = 1.0	CPK = 1.0	CPK = 1.0	CPK = 1.0
6	OD	inches	0.0330	0.0324	0.0320	0.0320
7	Tolerance (+/-)	inches	N/A	N/A	N/A	N/A
8	Statistical Limits	N/A	N/A	N/A	N/A	N/A
9	WALL	inches	0.0015	0.0012	0.0010	0.0010
10	Tolerance (+/-)	inches	0.0003	0.0003	0.0003	0.0003
11	Statistical Limits	N/A	CPK = 1.0	CPK = 1.0	CPK = 1.0	CPK = 1.0
12	LENGTH	inches	0.0400	0.0400	0.0400	0.0400
13	Tolerance (+/-)	inches	0.0050	0.0050	0.0050	0.0050
14	Statistical Limits	N/A	CPK = 1.0	CPK = 1.0	CPK = 1.0	CPK = 1.0
15	CathRAD(TM) OUTPUTS (MONTE CARLO SIMULATION)					
16	RP INDEX	MEAN	21.9038	17.5229	14.5937	13.9197
17		STD DEV	1.5341	1.5178	1.5033	1.4271
18		MIN	16.3293	12.1083	8.7850	8.4928
19		MAX	28.8931	23.8818	20.3193	19.4067

MicroSoft Excel Integration

The Monte Carlo Simulation results from CathRAD® are summarized in a Histogram

RT100051-01 Roth Technologies, LLC printed on 6/2/2013 at 2:24 PM

Bin	Frequency
15.7011	0
16.3293	1
16.9575	5
17.5857	12
18.2139	58
18.8421	157
19.4703	321
20.0985	616
20.7267	1056
21.3549	1412
21.9830	1575
22.6112	1568
23.2394	1306
23.8676	893
24.4958	569
25.1240	265
25.7522	119
26.3804	50
27.0086	10
27.6368	4
28.2649	2
28.8931	1
29.5213	0
More	0



MATERIAL: Platinum

DESIGN	UNITS	ID	OD	WALL	LENGTH
MEAN	inches	0.0300	0.0330	0.0015	0.0400
TOLERANCE	inches	0.0005	N/A	0.0003	0.0050
CPK	N/A	CPK = 1.0	N/A	CPK = 1.0	CPK = 1.0

Software Validation

The CathRAD® Software has been developed and subjected to a Written Software Validation.

A summary of this Validation Report is available on our website (www.cathrad.com)

CathRAD® Software Use

- Engineering: Optimize New Product Designs
  - Understand marker band visibility as a function of material, dimensions, and tolerances
  - Optimize Cost vs. Marker Band Visibility
- Manufacturing Operations
  - Evaluate "off the shelf" marker band parts in situations where you run out of parts or quality issues
- Existing Products – Cost Savings
  - 2013.05.31: Platinum was $1,450/oz, Gold was $1,387/oz
  - Software may be utilize to evaluate alternate marker band materials and/or optimize current designs to save $

Contact Informaton

Visit our Website at www.cathrad.com for more Information

Contact us via email at sales@cathrad.com for information regarding our product demo program and software licensing fees

Learn about our catheter design program, CathCAD®, at www.cathcad.com