Balance-of-Plant Heat Exchanger and Condenser Tubing Eddy Current Inspection Best Practice Document Database

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Nuclear

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BOP Heat Exchanger and Condenser Tubing Eddy Current Inspection Best Practice Document Database

Database Contents:

- 28 HX's with 62 downloadable ETSS and Final EC reports
- 6 Main Condensers with ETSS and Final EC reports
- 12 Metallurgical/Destructive Analysis Reports
- 2 downloadable eddy current inspection related calculators:
  - ASME flaw depth
  - Probe Fill-Factor and Frequency

ETSS = Evaluated Specification Technique Sheet (ETSS)

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28 Heat Exchangers

Component Coolers	Emergency Diesel Generators	Low Pressure Feedwater Heaters	Reactor Cooling Pump Upper Motor Bearing Oil Cooler
Component Cooling Water	Flux Thimble Tubes	Low Pressure Injection System (LPI) Decay System	Reactor Pump Air Cooler
Condenser Heat Exchanger	High Pressure Coolant Injection (HPCI) Systems	Off Gas Recombiner Vent Cooler	Residual Heat Removal
Containment Spray	High Pressure Feedwater Heaters	Reactor Building Cooling Unit	Safety Shutdown Facility Diesel Lube Oil Cooler
Control Room AC Units	Isolation Condensers	Reactor Building Heat Exchanger	Seal Oil Cooler
Drywell Equipment Tank	Letdown and Access Letdown	Reactor Containment Fan Coolers	SSF HVAC Condenser
Emergency Diesel Generator Jacket Water and Lube Oil Cooler	Low Pressure Coolant Injection (LPCI) Systems	Reactor Cooling Pump Motor Air Cooler	Turbine Building Heat Exchanger

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28 Heat Exchangers – 15 Different Common Material Type

Admiralty Brass
AL6XN
Arsenical Copper
304 Stainless Steel
316 Stainless Steel
321 Stainless Steel
AL6XN
Titanium
90/10 CuNi
70/30 CuNi
Inconel 600
Admiralty Brass with Low Fins
90/10 CuNi with External Fins
90/10 CuNi with Helical Wound Copper Fins
Copper with Integral Fins

62 downloadable Eddy Current Final Reports and Technique Sheets (ETSS)

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5 Condensers – 3 Different Common Material Type

90/10 CuNi
SeaCure
Titanium

5 downloadable Eddy Current Final Reports and Technique Sheets (ETSS)

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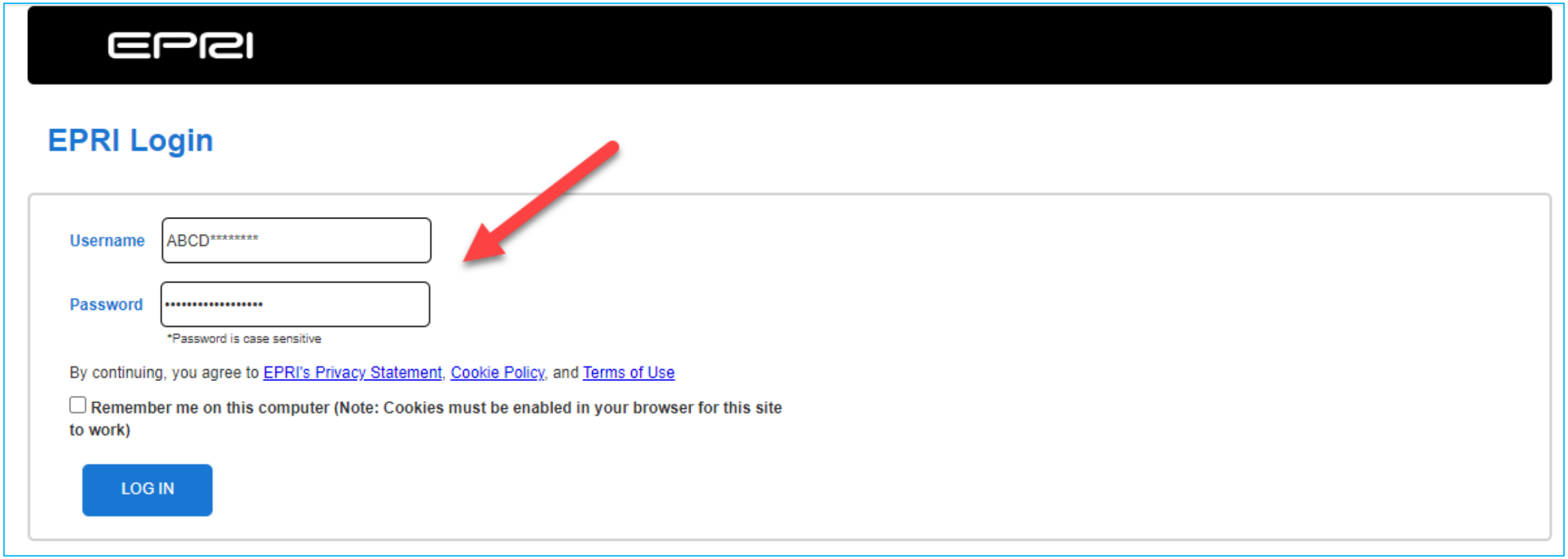
Log In Information

- Log in with EPRI Credentials



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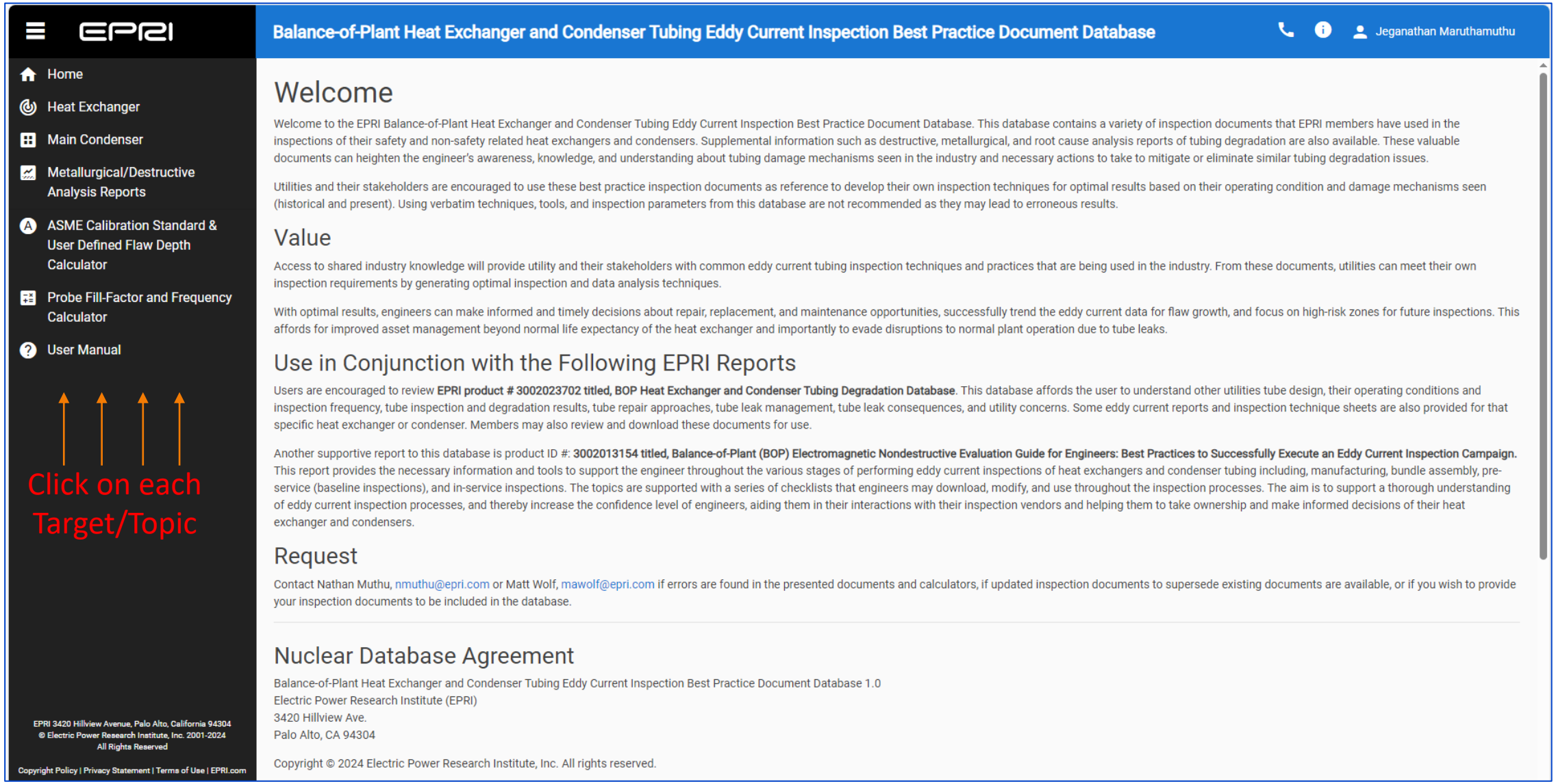
Database Home Page



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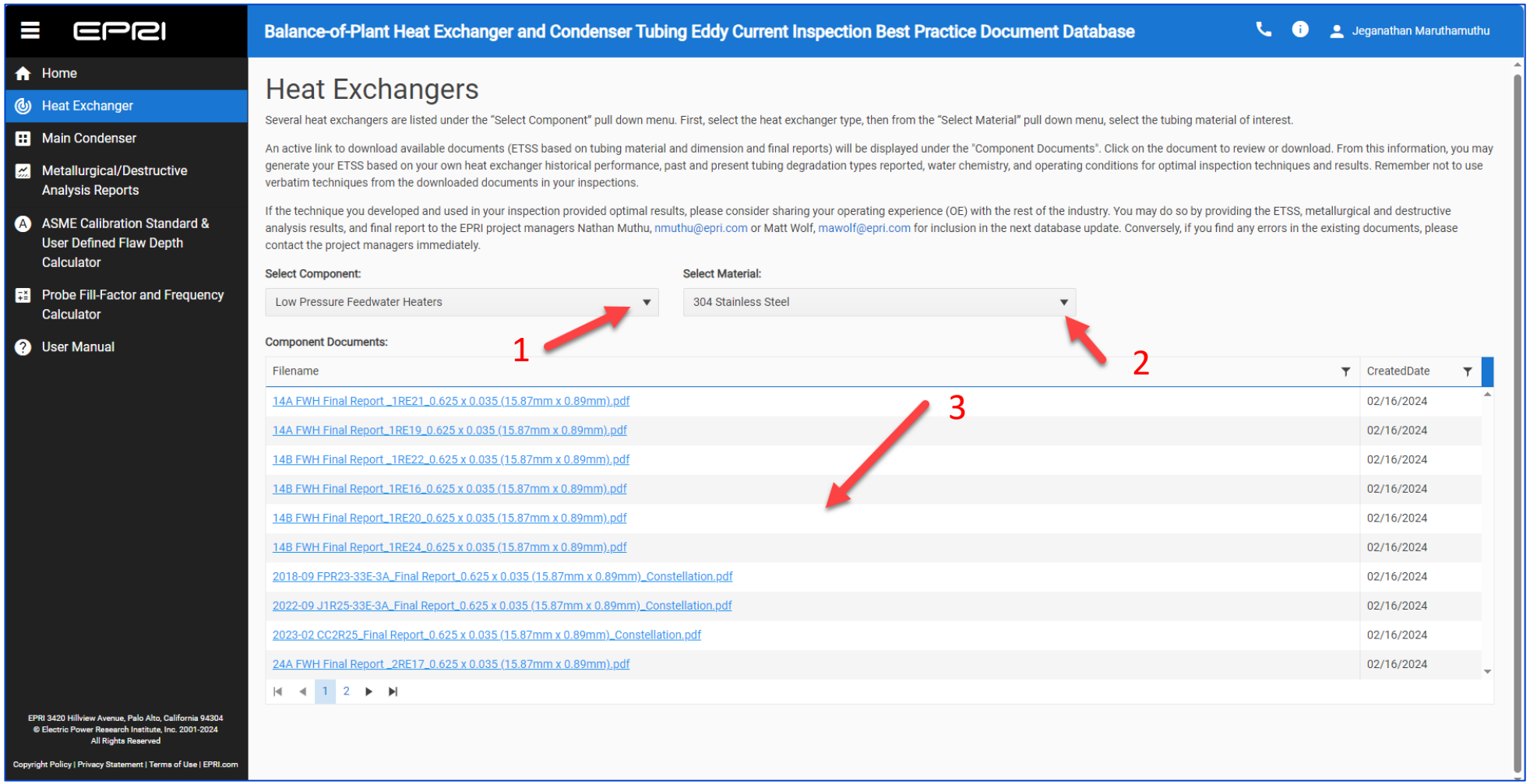
Heat Exchanger Page

1) Select Component
2) Select Material
3) Download Documents for Review



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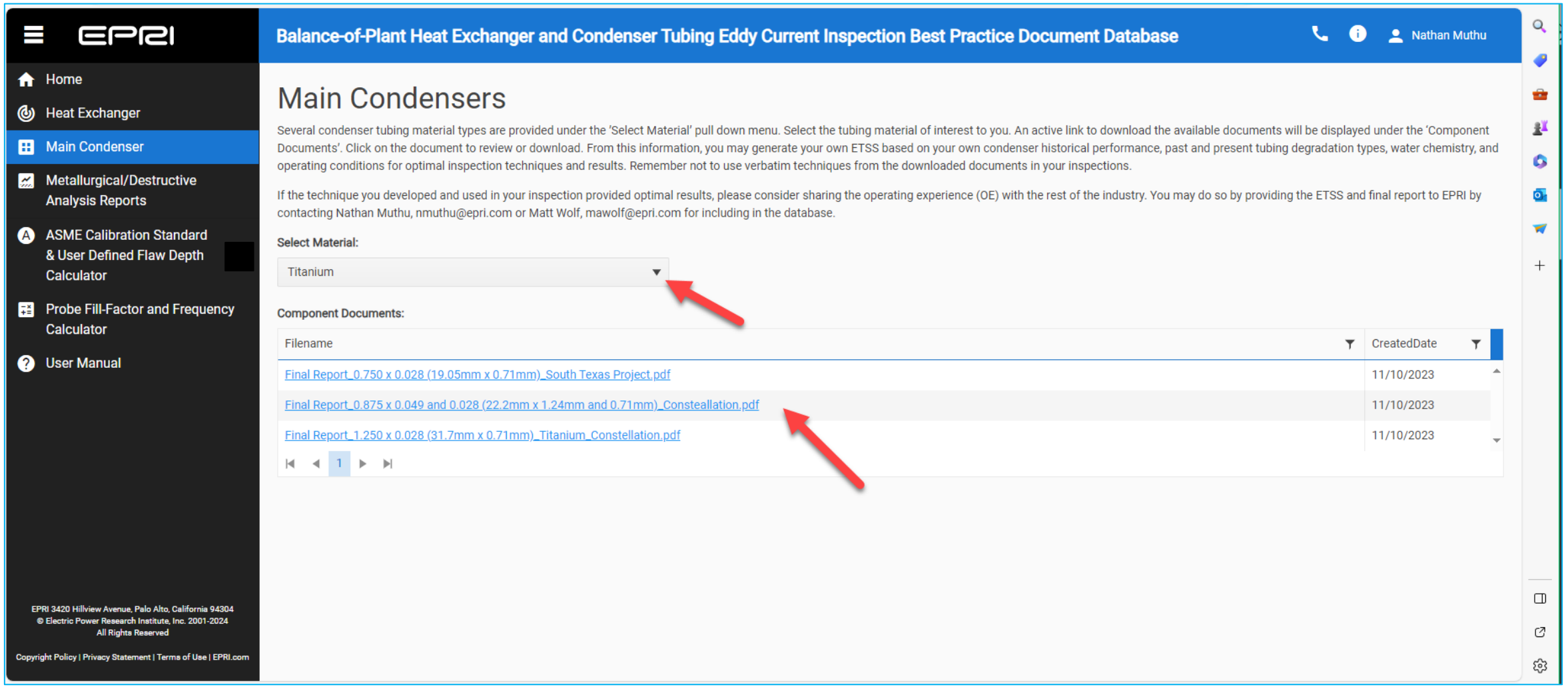
Condenser Page

1) Select Material
2) Download Document for Review



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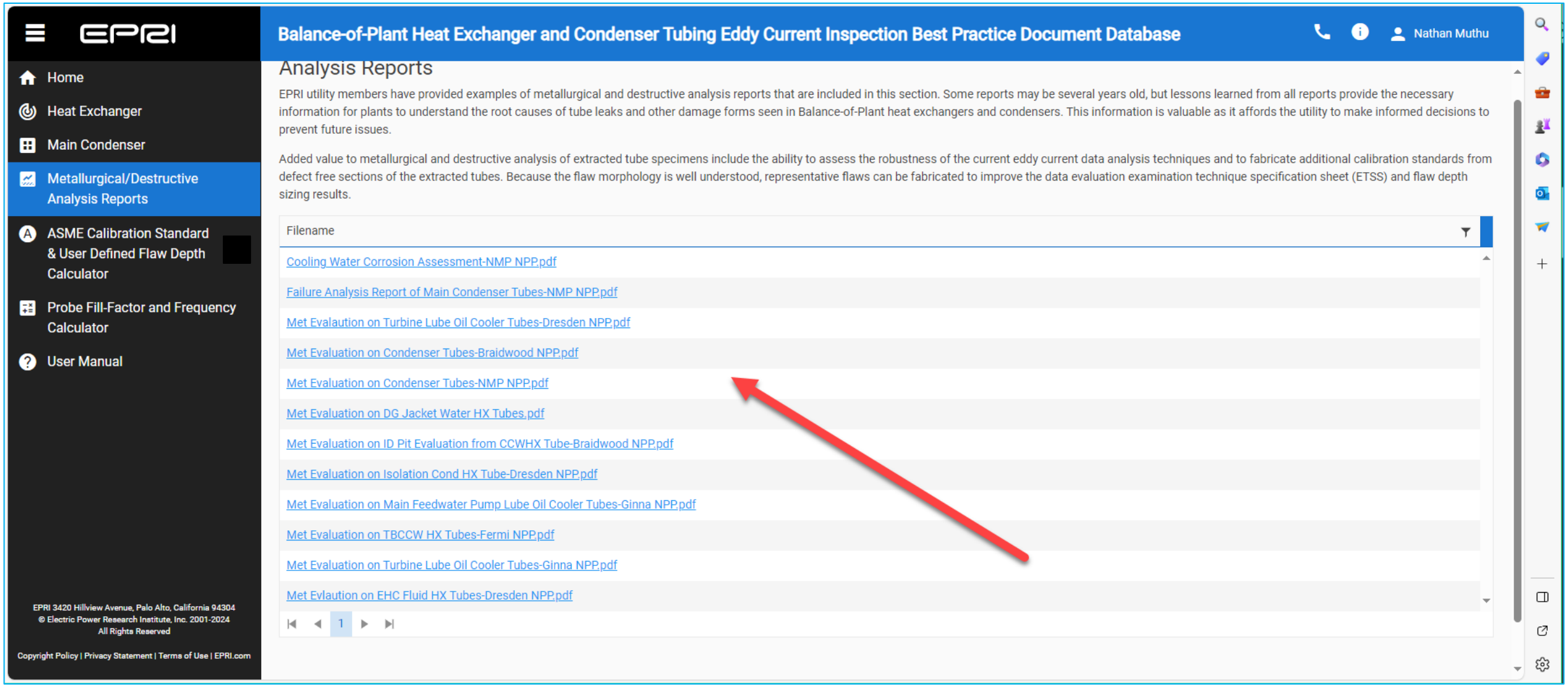
Metallurgical / Destructive Analysis Reports Page

1) Download Document for Review of Flaw Damage Forensics



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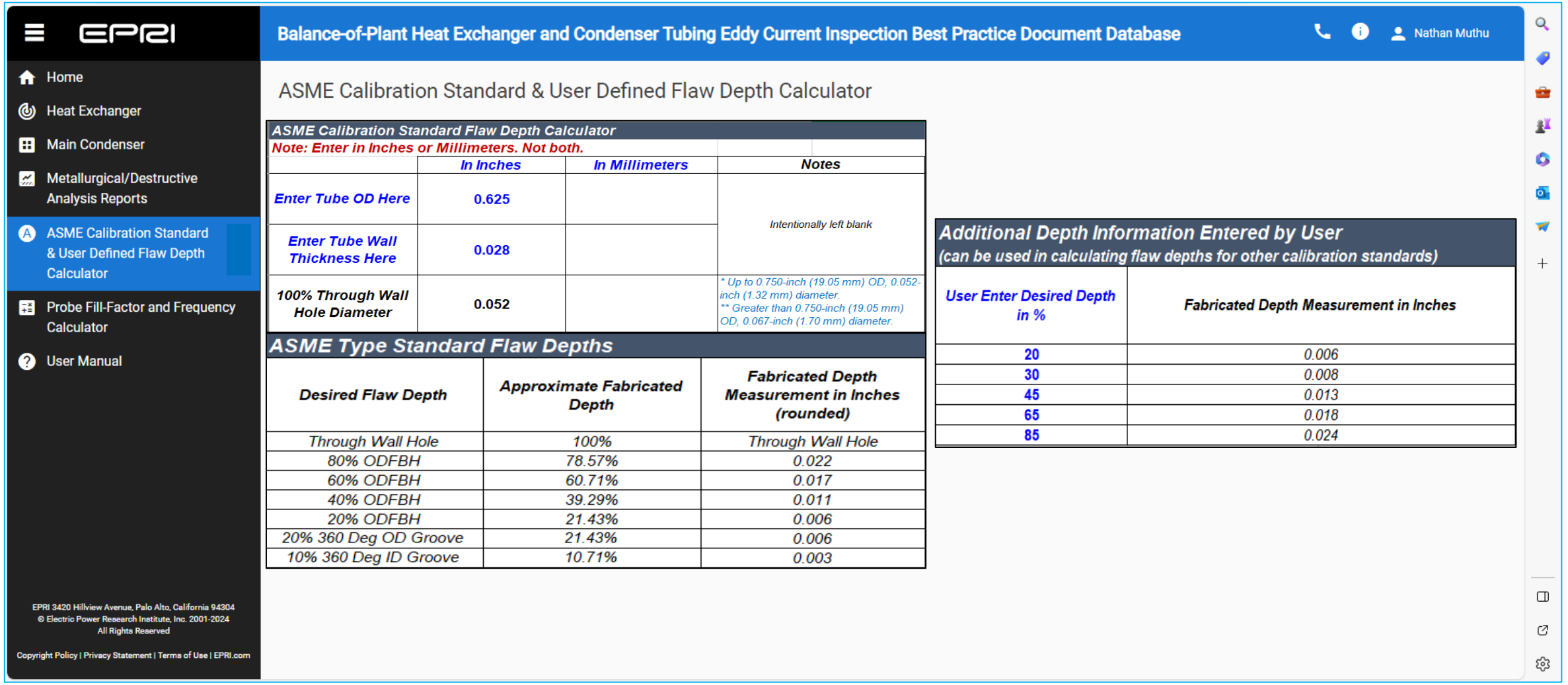
ASME Calibration Standard Flaw Depth Calculator

1) Download Spreadsheet to your Desktop and Use



ASME Calibration Standard & User Defined Flaw Depth Calculator

ASME Calibration Standard Flaw Depth Calculator

Note: Enter in Inches or Millimeters. Not both.

	In Inches	In Millimeters	Notes
Enter Tube OD Here	0.625		Intentionally left blank
Enter Tube Wall Thickness Here	0.028		
100% Through Wall Hole Diameter	0.052		* Up to 0.750-inch (19.05 mm) OD, 0.052-inch (1.32 mm) diameter. ** Greater than 0.750-inch (19.05 mm) OD, 0.067-inch (1.70 mm) diameter.

ASME Type Standard Flaw Depths

Desired Flaw Depth	Approximate Fabricated Depth	Fabricated Depth Measurement in Inches (rounded)
Through Wall Hole	100%	Through Wall Hole
80% ODFBH	78.57%	0.022
60% ODFBH	60.71%	0.017
40% ODFBH	39.29%	0.011
20% ODFBH	21.43%	0.006
20% 360 Deg OD Groove	21.43%	0.006
10% 360 Deg ID Groove	10.71%	0.003

Additional Depth Information Entered by User
(can be used in calculating flaw depths for other calibration standards)

User Enter Desired Depth in %	Fabricated Depth Measurement in Inches
20	0.006
30	0.008
45	0.013
65	0.018
85	0.024

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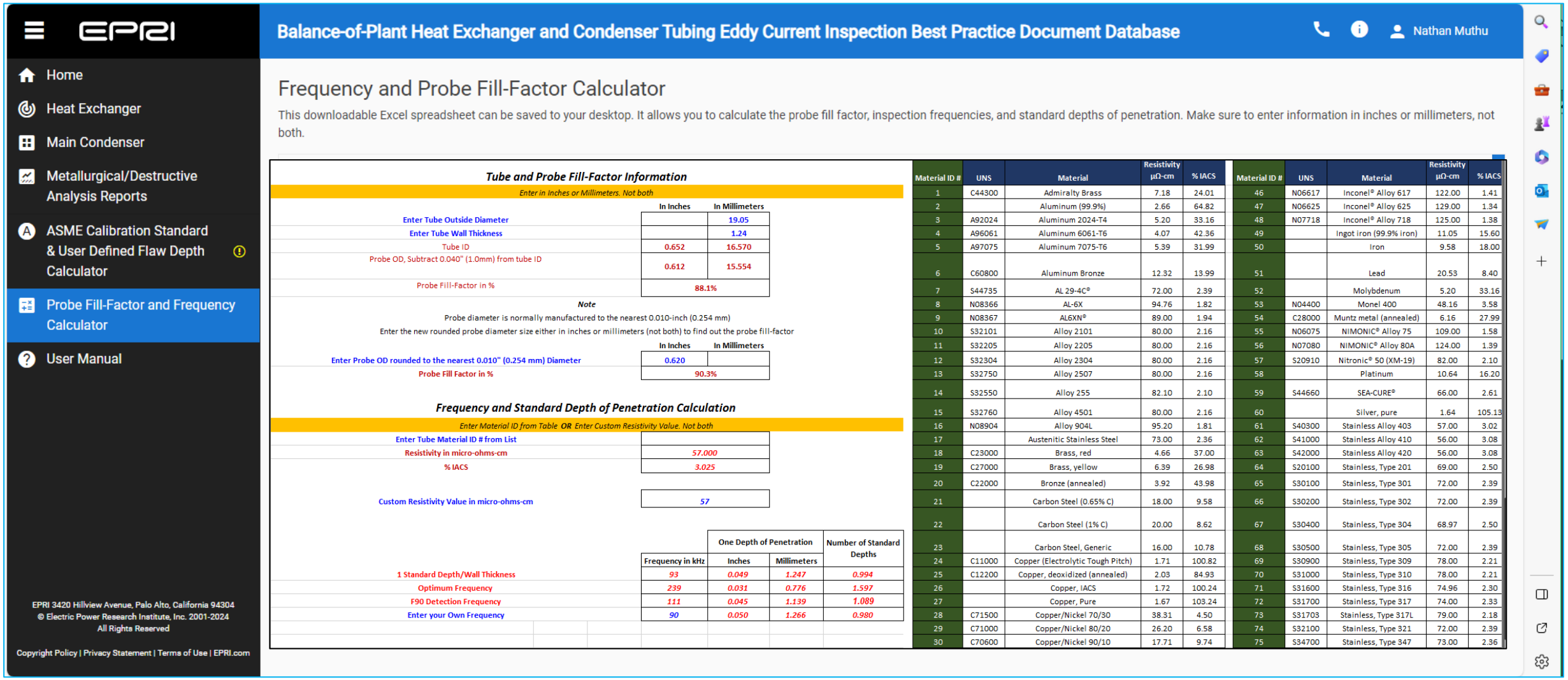
Probe Fill-Factor and Frequency Calculator

1) Download Spreadsheet to your Desktop and Use



Frequency and Probe Fill-Factor Calculator

This downloadable Excel spreadsheet can be saved to your desktop. It allows you to calculate the probe fill factor, inspection frequencies, and standard depths of penetration. Make sure to enter information in inches or millimeters, not both.

Tube and Probe Fill-Factor Information

Enter in Inches or Millimeters. Not both

	In Inches	In Millimeters
Enter Tube Outside Diameter		19.05
Enter Tube Wall Thickness		1.24
Tube ID	0.652	16.570
Probe OD, Subtract 0.040" (1.0mm) from tube ID	0.612	15.554
Probe Fill-Factor in %	88.1%	

Note

Probe diameter is normally manufactured to the nearest 0.010-inch (0.254 mm)

Enter the new rounded probe diameter size either in inches or millimeters (not both) to find out the probe fill-factor

	In Inches	In Millimeters
Enter Probe OD rounded to the nearest 0.010" (0.254 mm) Diameter	0.620	
Probe Fill Factor in %	90.3%	

Frequency and Standard Depth of Penetration Calculation

*Enter Material ID from Table **OR** Enter Custom Resistivity Value. Not both*

Enter Tube Material ID # from List	
Resistivity in micro-ohms-cm	57.000
% IACS	3.025
Custom Resistivity Value in micro-ohms-cm	57

	Frequency in kHz	One Depth of Penetration: Inches	One Depth of Penetration: Millimeters	Number of Standard Depths
1 Standard Depth/Wall Thickness	93	0.049	1.247	0.994
Optimum Frequency	239	0.031	0.776	1.597
F90 Detection Frequency	111	0.045	1.139	1.089
Enter your Own Frequency	90	0.050	1.266	0.980

Material ID #	UNS	Material	Resistivity µΩ-cm	% IACS	Material ID #	UNS	Material	Resistivity µΩ-cm	% IACS
1	C44300	Admiralty Brass	7.18	24.01	46	N06617	Inconel® Alloy 617	122.00	1.41
2		Aluminum (99.9%)	2.66	64.82	47	N06625	Inconel® Alloy 625	129.00	1.34
3	A92024	Aluminum 2024-T4	5.20	33.16	48	N07718	Inconel® Alloy 718	125.00	1.38
4	A96061	Aluminum 6061-T6	4.07	42.36	49		Ingot iron (99.9% iron)	11.05	15.60
5	A97075	Aluminum 7075-T6	5.39	31.99	50		Iron	9.58	18.00
6	C60800	Aluminum Bronze	12.32	13.99	51		Lead	20.53	8.40
7	S44735	AL 29-4C®	72.00	2.39	52		Molybdenum	5.20	33.16
8	N08366	AL-6X	94.76	1.82	53	N04400	Monel 400	48.16	3.58
9	N08367	AL6XN®	89.00	1.94	54	C28000	Muntz metal (annealed)	6.16	27.99
10	S32101	Alloy 2101	80.00	2.16	55	N06075	NIMONIC® Alloy 75	109.00	1.58
11	S32205	Alloy 2205	80.00	2.16	56	N07080	NIMONIC® Alloy 80A	124.00	1.39
12	S32304	Alloy 2304	80.00	2.16	57	S20910	Nitronic® 50 (XM-19)	82.00	2.10
13	S32750	Alloy 2507	80.00	2.16	58		Platinum	10.64	16.20
14	S32550	Alloy 255	82.10	2.10	59	S44660	SEA-CURE®	66.00	2.61
15	S32760	Alloy 4501	80.00	2.16	60		Silver, pure	1.64	105.13
16	N08904	Alloy 904L	95.20	1.81	61	S40300	Stainless Alloy 403	57.00	3.02
17		Austenitic Stainless Steel	73.00	2.36	62	S41000	Stainless Alloy 410	56.00	3.08
18	C23000	Brass, red	4.66	37.00	63	S42000	Stainless Alloy 420	56.00	3.08
19	C27000	Brass, yellow	6.39	26.98	64	S20100	Stainless, Type 201	69.00	2.50
20	C22000	Bronze (annealed)	3.92	43.98	65	S30100	Stainless, Type 301	72.00	2.39
21		Carbon Steel (0.65% C)	18.00	9.58	66	S30200	Stainless, Type 302	72.00	2.39
22		Carbon Steel (1% C)	20.00	8.62	67	S30400	Stainless, Type 304	68.97	2.50
23		Carbon Steel, Generic	16.00	10.78	68	S30500	Stainless, Type 305	72.00	2.39
24	C11000	Copper (Electrolytic Tough Pitch)	1.71	100.82	69	S30900	Stainless, Type 309	78.00	2.21
25	C12200	Copper, deoxidized (annealed)	2.03	84.93	70	S31000	Stainless, Type 310	78.00	2.21
26		Copper, IACS	1.72	100.24	71	S31600	Stainless, Type 316	74.96	2.30
27		Copper, Pure	1.67	103.24	72	S31700	Stainless, Type 317	74.00	2.33
28	C71500	Copper/Nickel 70/30	38.31	4.50	73	S31703	Stainless, Type 317L	79.00	2.18
29	C71000	Copper/Nickel 80/20	26.20	6.58	74	S32100	Stainless, Type 321	72.00	2.39
30	C70600	Copper/Nickel 90/10	17.71	9.74	75	S34700	Stainless, Type 347	73.00	2.36

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User Manual

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Continued Reach Out Will be Done to Build This Database

- This is a living database.
  - Updated documents that can supersede present documents (Improvements to existing techniques).
  - If an error with the present documents are identified.

Next Update to Database

  - Tentative plan is to reach out to the industry in 18 months (September 2025) and release version 2 in September 2026 (~2 ½ year update cycle).

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