

EXPERIMENT 3 Critical Heat Flux of Oxidized Sample*Safety Precautions:*

Please make sure all the equipment is in safe condition before and after conducting the experiment.

Objectives:

1. To determine the critical heat flux of oxidized sample

Introduction:

As per discuss and describe in Experiment 2, the CHF is a key approach to maximize the efficiency and safety of a nuclear reactor power plant. For a large safety margin and high performance of the nuclear reactor core, investigations on the enhancement of the CHF have been performed and reported extensively using nanofluids and surface modification.

CHF is an important criterion in nuclear reactor safety and the efficiency of boiling heat transfer. This parameter is known to be dependent of the surface roughness and the wettability of a material that is in contact with boiling fluid. Generally, CHF enhances with increasing surface roughness and wettability. However, the uncombine effect of each dependency is not yet well understood. Hence, to better understand this is by analyze the dynamic wetting behavior. Thus, this study reports the effect of dynamic wetting behavior on CHF using oxidized steel sample to modify roughness and wettability.

The oxidized specimen used in this experiment is prepared by sanding down the sample with sandpaper, which in this case 320 ultrafine grade sandpaper. After sanding, the sample is put inside furnace until achieve 300°C, with heating rate of 2-2.5°C/min. the sample then maintain its temperature for 10 minutes before cooled down to 30°C with rate of 2-3°C/min.

Direct Joule heating method is used. This method easily supplies steady state heat flux and exhibits fast thermal response. Applied heat flux can be calculated using the Joule's heat flux equation, Equation 2.1

$$q'' = \frac{\text{Power}}{\text{Heated area}} = \frac{VI}{WL} \quad (2.1)$$

where, V is the measured voltage drop across the test material, I is the measured current, W is the width of the heat transfer area, and L is the heated length. Uncertainty of the measured heat flux is estimated 5.2% based on the propagation of error method.

Equipment and materials:

1. Pool boiling chamber:
 - Size: 300 mm × 300 mm × 300 mm
 - Material: Polycarbonate 8 mm thick
2. Immersion heaters:
 - Type: U type cartridge water heater continuously adjustable.
 - Material: S.S304
 - Capacity: 500 watts
 - Capacity: 1000 watts
3. Test section:
 - Copper blocks
 - Copper cover
 - Polyether ether ketone PEEK block
 - Test specimen:
 - Material: Stainless steel grade 304L
 - Size: L-25 mm × W-10 mm × T-2 mm
4. DC power supply:
 - Type: Switched mode power supply
 - Output: 0-10 volts & 1200A DC
 - Regulation: 0.5% to 1% at full load
 - Efficiency: 85%-95% at full load
 - Cooling: Forces air cooled

- Remote control: Digital voltmeter & ammeter with 3 m flexible connection cable from main power supply unit.
5. Data acquisition device:
- Make: National instruments
 - Model: NI USB 6001
 - Inputs: 8 analog input
 - Output: 2 analog output

Procedure:

1. Insert oxidized specimen in the test specimen block. Secure the bolt and nut
2. Fill distilled water into pool boiling chamber up to heater levels.
3. Give single phase electric supply to trainer and switch on Mains.
4. Give three phase electric supply to DC power supply and switch on Mains.
5. Secure connection from pool boiling to computer.
6. Turn on heater and heat the water until achieve saturated temperature. (start boiling)
7. After reaching saturation temperature, turn on DC power supply for power pass through the specimen.
8. Open SCITECH DAQ application to collect real time data.
9. From software, pass initially 1 volt to DC power supply.
10. Increase gradually voltage and current from DC power supply.
11. Observe the bubbles formation at the test specimen.
12. Record data.
13. Now after supplying current and voltage, the specimen will reach at its critical point of heat transfer and it will break at maximum capacity which is its CHF. Thus, CHF can be calculated as per data collected and formula given in introduction section (Equation 2.1)
14. After completion of the experiment, let the specimen cool down at room temperature with distilled water and switch of mains.

Data Analysis:

1. Plot a graph between Time versus Voltage for non-treated sample
2. Determine and calculate the critical heat flux of the specimen
3. How does the sample preparation affect the CHF of the material?

T1 : Temperature sensor mounted on left side cooper block

T2 : Temperature sensor mounted below PEEK block

T3 : Temperature sensor mounted on right side cooper block

TC : Temperature sensor mounted below test specimen

Treated Sample (320 sandpaper 300°C)

| Date | Time | Observation | T1 (C) | T2 (C) | T3 (C) | TC (C) | Voltage (V) |
|------------|-------------|-------------|---------|---------|---------|---------|-------------|
| 09/09/2020 | 12:38:28 PM | 354 | 106.189 | 109.037 | 109.576 | 106.331 | -1.043 |
| 09/09/2020 | 12:38:29 PM | 355 | 106.252 | 109.172 | 109.778 | 106.383 | -1.01 |
| 09/09/2020 | 12:38:29 PM | 356 | 106.189 | 109.037 | 109.711 | 106.331 | -1.02 |
| 09/09/2020 | 12:38:30 PM | 357 | 106.316 | 109.172 | 109.711 | 106.383 | -1.032 |
| 09/09/2020 | 12:38:30 PM | 358 | 106.189 | 109.172 | 109.846 | 106.435 | -1.042 |
| 09/09/2020 | 12:38:31 PM | 359 | 106.379 | 109.105 | 109.98 | 106.383 | -1.017 |
| 09/09/2020 | 12:38:31 PM | 360 | 106.252 | 109.172 | 109.778 | 106.331 | -1.008 |
| 09/09/2020 | 12:38:32 PM | 361 | 106.442 | 109.172 | 109.711 | 106.279 | -1.185 |
| 09/09/2020 | 12:38:32 PM | 362 | 106.126 | 109.172 | 109.644 | 106.435 | -1.17 |
| 09/09/2020 | 12:38:33 PM | 363 | 106.252 | 109.307 | 109.98 | 106.331 | -1.167 |
| 09/09/2020 | 12:38:33 PM | 364 | 106.379 | 109.172 | 110.25 | 106.487 | -1.198 |
| 09/09/2020 | 12:38:34 PM | 365 | 106.379 | 109.307 | 110.048 | 106.331 | -1.149 |
| 09/09/2020 | 12:38:34 PM | 366 | 106.505 | 109.374 | 109.711 | 106.227 | -1.132 |
| 09/09/2020 | 12:38:35 PM | 367 | 106.252 | 109.239 | 110.048 | 106.279 | -1.149 |
| 09/09/2020 | 12:38:35 PM | 368 | 106.379 | 109.239 | 109.846 | 106.331 | -1.148 |
| 09/09/2020 | 12:38:36 PM | 369 | 106.379 | 109.239 | 109.846 | 106.435 | -1.183 |
| 09/09/2020 | 12:38:36 PM | 370 | 106.442 | 109.374 | 109.711 | 106.435 | -1.192 |
| 09/09/2020 | 12:38:37 PM | 371 | 106.442 | 109.239 | 109.913 | 106.435 | -1.196 |
| 09/09/2020 | 12:38:38 PM | 372 | 106.379 | 109.172 | 109.846 | 106.435 | -1.205 |
| 09/09/2020 | 12:38:38 PM | 373 | 106.505 | 109.239 | 109.644 | 106.383 | -1.202 |
| 09/09/2020 | 12:38:39 PM | 374 | 106.568 | 109.105 | 109.711 | 106.435 | -1.187 |

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|------------|-------------|-----|---------|---------|---------|---------|--------|
| 09/09/2020 | 12:38:39 PM | 375 | 106.505 | 109.172 | 109.509 | 106.435 | -1.18 |
| 09/09/2020 | 12:38:40 PM | 376 | 106.442 | 109.172 | 109.846 | 106.435 | -1.173 |
| 09/09/2020 | 12:38:40 PM | 377 | 106.568 | 109.105 | 109.778 | 106.435 | -1.165 |
| 09/09/2020 | 12:38:41 PM | 378 | 106.568 | 108.97 | 110.048 | 106.435 | -1.192 |
| 09/09/2020 | 12:38:41 PM | 379 | 106.505 | 109.172 | 110.048 | 106.279 | -1.164 |
| 09/09/2020 | 12:38:42 PM | 380 | 106.631 | 109.037 | 109.711 | 106.383 | -1.17 |
| 09/09/2020 | 12:38:42 PM | 381 | 106.631 | 109.172 | 109.778 | 106.383 | -1.16 |
| 09/09/2020 | 12:38:43 PM | 382 | 106.695 | 109.172 | 109.913 | 106.435 | -1.154 |
| 09/09/2020 | 12:38:43 PM | 383 | 106.758 | 109.037 | 109.98 | 106.331 | -1.157 |
| 09/09/2020 | 12:38:44 PM | 384 | 106.758 | 109.239 | 109.913 | 106.279 | -1.151 |
| 09/09/2020 | 12:38:44 PM | 385 | 106.758 | 109.037 | 109.576 | 106.435 | -1.161 |
| 09/09/2020 | 12:38:45 PM | 386 | 106.695 | 109.239 | 109.711 | 106.331 | -1.153 |
| 09/09/2020 | 12:38:45 PM | 387 | 106.631 | 109.441 | 109.846 | 106.383 | -1.192 |
| 09/09/2020 | 12:38:46 PM | 388 | 106.695 | 109.239 | 109.913 | 106.279 | -1.154 |
| 09/09/2020 | 12:38:46 PM | 389 | 106.758 | 109.172 | 109.913 | 106.383 | -1.09 |
| 09/09/2020 | 12:38:47 PM | 390 | 106.758 | 109.105 | 109.846 | 106.279 | -1.157 |
| 09/09/2020 | 12:38:47 PM | 391 | 106.631 | 109.172 | 109.98 | 106.279 | -1.182 |
| 09/09/2020 | 12:38:48 PM | 392 | 106.695 | 109.172 | 109.711 | 106.279 | -1.18 |
| 09/09/2020 | 12:38:48 PM | 393 | 106.568 | 109.037 | 109.846 | 106.383 | -1.161 |
| 09/09/2020 | 12:38:49 PM | 394 | 106.758 | 109.172 | 110.048 | 106.279 | -1.179 |
| 09/09/2020 | 12:38:49 PM | 395 | 106.568 | 109.239 | 109.913 | 106.383 | -1.166 |
| 09/09/2020 | 12:38:50 PM | 396 | 106.631 | 109.037 | 109.846 | 106.435 | -1.183 |
| 09/09/2020 | 12:38:50 PM | 397 | 106.758 | 108.97 | 109.98 | 106.227 | -1.188 |
| 09/09/2020 | 12:38:51 PM | 398 | 106.695 | 109.105 | 109.913 | 106.227 | -1.164 |
| 09/09/2020 | 12:38:52 PM | 399 | 106.758 | 108.97 | 109.778 | 106.279 | -1.185 |
| 09/09/2020 | 12:38:52 PM | 400 | 106.695 | 109.037 | 109.913 | 106.383 | -1.188 |
| 09/09/2020 | 12:38:53 PM | 401 | 106.821 | 109.037 | 109.711 | 106.331 | -1.176 |
| 09/09/2020 | 12:38:53 PM | 402 | 106.695 | 108.97 | 110.115 | 106.383 | -1.182 |
| 09/09/2020 | 12:38:54 PM | 403 | 106.631 | 108.7 | 109.644 | 106.279 | -1.179 |
| 09/09/2020 | 12:38:54 PM | 404 | 106.695 | 109.172 | 109.711 | 106.435 | -1.18 |
| 09/09/2020 | 12:38:55 PM | 405 | 106.695 | 109.307 | 109.576 | 106.279 | -1.107 |
| 09/09/2020 | 12:38:55 PM | 406 | 106.695 | 109.239 | 109.644 | 106.279 | -1.185 |
| 09/09/2020 | 12:38:56 PM | 407 | 106.884 | 109.105 | 109.778 | 106.279 | -1.205 |
| 09/09/2020 | 12:38:56 PM | 408 | 106.821 | 109.105 | 109.711 | 106.279 | -1.173 |
| 09/09/2020 | 12:38:57 PM | 409 | 106.631 | 109.105 | 110.115 | 106.227 | -1.191 |
| 09/09/2020 | 12:38:57 PM | 410 | 106.821 | 108.902 | 109.98 | 106.279 | -1.2 |
| 09/09/2020 | 12:38:58 PM | 411 | 106.695 | 108.97 | 109.98 | 106.279 | -1.2 |
| 09/09/2020 | 12:38:58 PM | 412 | 106.821 | 108.902 | 109.913 | 106.279 | -1.187 |
| 09/09/2020 | 12:38:59 PM | 413 | 106.758 | 109.239 | 109.778 | 106.383 | -1.197 |
| 09/09/2020 | 12:38:59 PM | 414 | 106.821 | 109.239 | 109.441 | 106.279 | -1.184 |
| 09/09/2020 | 12:39:00 PM | 415 | 106.695 | 109.172 | 109.846 | 106.383 | -1.187 |
| 09/09/2020 | 12:39:00 PM | 416 | 106.695 | 109.307 | 109.98 | 106.279 | -1.187 |
| 09/09/2020 | 12:39:01 PM | 417 | 106.758 | 108.97 | 109.778 | 106.279 | -1.183 |
| 09/09/2020 | 12:39:01 PM | 418 | 106.631 | 109.307 | 109.778 | 106.331 | -1.184 |
| 09/09/2020 | 12:39:02 PM | 419 | 106.758 | 108.97 | 110.048 | 106.435 | -1.195 |
| 09/09/2020 | 12:39:02 PM | 420 | 106.568 | 109.172 | 109.846 | 106.279 | -1.185 |

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|------------|-------------|-----|---------|---------|---------|---------|--------|
| 09/09/2020 | 12:39:03 PM | 421 | 106.821 | 109.239 | 109.913 | 106.487 | -1.227 |
| 09/09/2020 | 12:39:03 PM | 422 | 106.821 | 109.105 | 109.846 | 106.487 | -1.205 |
| 09/09/2020 | 12:39:04 PM | 423 | 106.695 | 109.172 | 109.711 | 106.435 | -1.192 |
| 09/09/2020 | 12:39:04 PM | 424 | 106.695 | 109.172 | 110.183 | 106.383 | -1.213 |
| 09/09/2020 | 12:39:05 PM | 425 | 106.695 | 109.105 | 110.115 | 106.435 | -1.12 |
| 09/09/2020 | 12:39:06 PM | 426 | 106.695 | 109.037 | 110.048 | 106.279 | -1.187 |
| 09/09/2020 | 12:39:06 PM | 427 | 106.631 | 109.172 | 109.913 | 106.279 | -1.2 |
| 09/09/2020 | 12:39:07 PM | 428 | 106.695 | 109.172 | 109.846 | 106.383 | -1.213 |
| 09/09/2020 | 12:39:07 PM | 429 | 106.821 | 109.172 | 109.778 | 106.435 | -1.197 |
| 09/09/2020 | 12:39:08 PM | 430 | 106.758 | 109.172 | 109.913 | 106.331 | -1.206 |
| 09/09/2020 | 12:39:08 PM | 431 | 106.758 | 109.105 | 109.913 | 106.279 | -1.201 |
| 09/09/2020 | 12:39:09 PM | 432 | 106.695 | 109.037 | 109.778 | 106.279 | -1.196 |
| 09/09/2020 | 12:39:09 PM | 433 | 106.758 | 109.037 | 109.913 | 106.331 | -1.206 |
| 09/09/2020 | 12:39:10 PM | 434 | 106.758 | 109.172 | 109.644 | 106.435 | -1.201 |
| 09/09/2020 | 12:39:10 PM | 435 | 106.821 | 109.172 | 109.846 | 106.279 | -1.191 |
| 09/09/2020 | 12:39:11 PM | 436 | 106.695 | 109.239 | 109.913 | 106.383 | -1.196 |
| 09/09/2020 | 12:39:37 PM | 479 | 106.631 | 109.037 | 109.846 | 106.383 | -1.196 |
| 09/09/2020 | 12:39:38 PM | 480 | 106.695 | 109.105 | 109.913 | 106.227 | -1.213 |
| 09/09/2020 | 12:39:38 PM | 481 | 106.758 | 108.97 | 109.711 | 106.383 | -1.2 |
| 09/09/2020 | 12:39:39 PM | 482 | 106.821 | 109.172 | 109.846 | 106.331 | -1.214 |
| 09/09/2020 | 12:39:39 PM | 483 | 106.884 | 109.239 | 109.576 | 106.331 | -1.202 |
| 09/09/2020 | 12:39:40 PM | 484 | 106.695 | 109.307 | 109.778 | 106.331 | -1.204 |
| 09/09/2020 | 12:39:40 PM | 485 | 106.568 | 109.037 | 109.846 | 106.331 | -1.228 |
| 09/09/2020 | 12:39:41 PM | 486 | 106.695 | 109.239 | 109.913 | 106.383 | -1.21 |
| 09/09/2020 | 12:39:41 PM | 487 | 106.758 | 108.97 | 109.846 | 106.331 | -1.202 |
| 09/09/2020 | 12:39:42 PM | 488 | 106.821 | 109.239 | 109.778 | 106.227 | -1.21 |
| 09/09/2020 | 12:39:42 PM | 489 | 106.631 | 109.037 | 109.98 | 106.331 | -1.21 |
| 09/09/2020 | 12:39:43 PM | 490 | 106.758 | 109.105 | 109.913 | 106.383 | -1.156 |
| 09/09/2020 | 12:39:43 PM | 491 | 106.758 | 109.172 | 109.913 | 106.383 | -1.214 |
| 09/09/2020 | 12:39:44 PM | 492 | 106.695 | 109.239 | 109.711 | 106.279 | -1.218 |
| 09/09/2020 | 12:39:44 PM | 493 | 106.758 | 109.037 | 109.846 | 106.279 | -1.195 |
| 09/09/2020 | 12:39:45 PM | 494 | 106.758 | 108.97 | 109.846 | 106.383 | -1.223 |
| 09/09/2020 | 12:39:45 PM | 495 | 106.695 | 109.105 | 109.913 | 106.227 | -1.219 |
| 09/09/2020 | 12:39:46 PM | 496 | 106.758 | 109.172 | 109.846 | 106.435 | -1.107 |
| 09/09/2020 | 12:39:47 PM | 497 | 106.821 | 109.105 | 109.846 | 106.435 | -1.188 |
| 09/09/2020 | 12:39:47 PM | 498 | 106.758 | 109.105 | 109.778 | 106.331 | -1.329 |
| 09/09/2020 | 12:39:48 PM | 499 | 107.137 | 109.037 | 109.98 | 106.331 | -1.345 |
| 09/09/2020 | 12:39:48 PM | 500 | 106.821 | 109.037 | 109.913 | 106.383 | -1.388 |
| 09/09/2020 | 12:39:49 PM | 501 | 106.695 | 109.172 | 110.048 | 106.331 | -1.391 |
| 09/09/2020 | 12:39:49 PM | 502 | 106.821 | 108.97 | 109.644 | 106.227 | -1.404 |
| 09/09/2020 | 12:39:50 PM | 503 | 106.821 | 109.105 | 109.913 | 106.383 | -1.396 |
| 09/09/2020 | 12:39:50 PM | 504 | 106.821 | 108.97 | 109.913 | 106.331 | -1.356 |
| 09/09/2020 | 12:39:51 PM | 505 | 106.884 | 108.902 | 110.115 | 106.175 | -1.376 |
| 09/09/2020 | 12:39:51 PM | 506 | 106.947 | 109.172 | 109.913 | 106.279 | -1.388 |
| 09/09/2020 | 12:39:52 PM | 507 | 106.821 | 109.105 | 109.846 | 106.383 | -1.357 |
| 09/09/2020 | 12:39:52 PM | 508 | 106.884 | 109.172 | 109.778 | 106.435 | -1.394 |

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|------------|-------------|-----|---------|---------|---------|---------|--------|
| 09/09/2020 | 12:39:53 PM | 509 | 106.821 | 109.105 | 109.846 | 106.279 | -1.348 |
| 09/09/2020 | 12:39:53 PM | 510 | 106.947 | 108.97 | 110.048 | 106.383 | -1.392 |
| 09/09/2020 | 12:39:54 PM | 511 | 106.884 | 109.172 | 109.778 | 106.383 | -1.354 |
| 09/09/2020 | 12:39:54 PM | 512 | 106.884 | 109.105 | 109.913 | 106.331 | -1.403 |
| 09/09/2020 | 12:39:55 PM | 513 | 106.821 | 109.307 | 110.115 | 106.331 | -1.425 |
| 09/09/2020 | 12:39:55 PM | 514 | 106.884 | 109.105 | 109.913 | 106.331 | -1.436 |
| 09/09/2020 | 12:39:56 PM | 515 | 106.947 | 109.105 | 110.048 | 106.383 | -1.438 |
| 09/09/2020 | 12:39:56 PM | 516 | 106.884 | 109.172 | 109.98 | 106.383 | -1.454 |
| 09/09/2020 | 12:39:57 PM | 517 | 106.884 | 109.307 | 109.576 | 106.383 | -1.453 |
| 09/09/2020 | 12:39:57 PM | 518 | 106.947 | 109.105 | 110.048 | 106.435 | -1.479 |
| 09/09/2020 | 12:39:58 PM | 519 | 106.884 | 109.037 | 109.846 | 106.383 | -1.472 |
| 09/09/2020 | 12:39:58 PM | 520 | 106.947 | 108.97 | 109.711 | 106.331 | -1.465 |
| 09/09/2020 | 12:39:59 PM | 521 | 106.821 | 109.037 | 109.846 | 106.279 | -1.488 |
| 09/09/2020 | 12:40:00 PM | 522 | 107.01 | 109.105 | 110.115 | 106.279 | -1.523 |
| 09/09/2020 | 12:40:00 PM | 523 | 107.074 | 109.172 | 109.778 | 106.331 | -1.582 |
| 09/09/2020 | 12:40:01 PM | 524 | 107.01 | 108.97 | 110.317 | 106.331 | -1.582 |
| 09/09/2020 | 12:40:01 PM | 525 | 107.074 | 109.172 | 110.183 | 106.435 | -1.575 |
| 09/09/2020 | 12:40:02 PM | 526 | 106.947 | 109.105 | 109.913 | 106.383 | -1.607 |
| 09/09/2020 | 12:40:02 PM | 527 | 107.01 | 108.97 | 110.25 | 106.279 | -1.528 |
| 09/09/2020 | 12:40:03 PM | 528 | 107.074 | 109.172 | 109.98 | 106.435 | -1.597 |
| 09/09/2020 | 12:40:03 PM | 529 | 107.137 | 109.172 | 110.048 | 106.487 | -1.613 |
| 09/09/2020 | 12:40:04 PM | 530 | 106.947 | 109.239 | 109.98 | 106.539 | -1.573 |
| 09/09/2020 | 12:40:04 PM | 531 | 107.137 | 108.97 | 110.048 | 106.383 | -1.58 |
| 09/09/2020 | 12:40:05 PM | 532 | 107.137 | 109.105 | 109.913 | 106.435 | -1.584 |
| 09/09/2020 | 12:40:05 PM | 533 | 107.137 | 109.172 | 110.183 | 106.539 | -1.628 |
| 09/09/2020 | 12:40:06 PM | 534 | 107.074 | 108.97 | 110.115 | 106.539 | -1.586 |
| 09/09/2020 | 12:40:06 PM | 535 | 107.074 | 109.037 | 109.913 | 106.435 | -1.597 |
| 09/09/2020 | 12:40:07 PM | 536 | 107.01 | 109.239 | 110.25 | 106.591 | -1.643 |
| 09/09/2020 | 12:40:07 PM | 537 | 107.074 | 109.307 | 109.913 | 106.643 | -1.619 |
| 09/09/2020 | 12:40:08 PM | 538 | 107.074 | 109.374 | 110.048 | 106.695 | -1.679 |
| 09/09/2020 | 12:40:08 PM | 539 | 107.137 | 109.172 | 109.913 | 106.851 | -1.686 |
| 09/09/2020 | 12:40:09 PM | 540 | 107.074 | 109.239 | 109.846 | 107.111 | -1.699 |
| 09/09/2020 | 12:40:09 PM | 541 | 107.01 | 109.374 | 109.711 | 107.475 | -1.725 |
| 09/09/2020 | 12:40:10 PM | 542 | 107.137 | 109.307 | 110.115 | 108.047 | -1.796 |
| 09/09/2020 | 12:40:10 PM | 543 | 107.263 | 109.172 | 109.778 | 108.826 | -1.885 |
| 09/09/2020 | 12:40:11 PM | 544 | 107.137 | 109.172 | 109.913 | 109.866 | -1.999 |
| 09/09/2020 | 12:40:11 PM | 545 | 107.2 | 109.307 | 109.846 | 111.477 | -2.267 |
| 09/09/2020 | 12:40:12 PM | 546 | 107.137 | 109.105 | 110.115 | 113.089 | -2.063 |
| 09/09/2020 | 12:40:12 PM | 547 | 107.263 | 109.307 | 109.846 | 115.22 | -2.059 |
| 09/09/2020 | 12:40:13 PM | 548 | 107.2 | 109.239 | 109.98 | 117.559 | -2.05 |
| 09/09/2020 | 12:40:14 PM | 549 | 107.137 | 109.239 | 109.711 | 120.21 | -2.071 |
| 09/09/2020 | 12:40:14 PM | 550 | 107.2 | 109.239 | 109.98 | 123.173 | -2.092 |
| 09/09/2020 | 12:40:15 PM | 551 | 107.074 | 109.105 | 109.846 | 126.448 | -2.103 |
| 09/09/2020 | 12:40:15 PM | 552 | 107.074 | 109.105 | 109.846 | 129.93 | 0.001 |
| 09/09/2020 | 12:40:16 PM | 553 | 107.01 | 109.239 | 110.048 | 133.465 | 0.001 |
| 09/09/2020 | 12:40:16 PM | 554 | 106.947 | 109.172 | 110.25 | 137.207 | 0 |

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|------------|-------------|-----|---------|---------|---------|---------|--------|
| 09/09/2020 | 12:40:17 PM | 555 | 106.884 | 109.239 | 110.115 | 141.158 | 0 |
| 09/09/2020 | 12:40:17 PM | 556 | 106.821 | 109.105 | 109.913 | 145.004 | 0 |
| 09/09/2020 | 12:40:18 PM | 557 | 106.695 | 109.307 | 109.913 | 149.163 | 0 |
| 09/09/2020 | 12:40:18 PM | 558 | 106.631 | 109.374 | 109.778 | 153.269 | 0 |
| 09/09/2020 | 12:40:19 PM | 559 | 106.631 | 109.239 | 109.846 | 157.479 | 0.001 |
| 09/09/2020 | 12:40:19 PM | 560 | 106.568 | 109.172 | 109.913 | 161.638 | 0 |
| 09/09/2020 | 12:40:20 PM | 561 | 106.695 | 109.172 | 109.711 | 165.796 | 0.001 |
| 09/09/2020 | 12:40:20 PM | 562 | 106.505 | 109.239 | 109.778 | 169.539 | 0 |
| 09/09/2020 | 12:40:21 PM | 563 | 106.505 | 109.239 | 110.048 | 173.281 | 0.001 |
| 09/09/2020 | 12:40:21 PM | 564 | 106.505 | 109.307 | 109.778 | 176.764 | 0.001 |
| 09/09/2020 | 12:40:22 PM | 565 | 106.442 | 109.239 | 109.711 | 180.246 | 0.002 |
| 09/09/2020 | 12:40:22 PM | 566 | 106.505 | 109.441 | 109.644 | 183.365 | 0.002 |
| 09/09/2020 | 12:40:23 PM | 567 | 106.316 | 109.374 | 109.778 | 186.38 | 0.001 |
| 09/09/2020 | 12:40:23 PM | 568 | 106.252 | 109.307 | 109.778 | 189.135 | 0.001 |
| 09/09/2020 | 12:40:24 PM | 569 | 106.316 | 109.172 | 109.913 | 191.474 | 0.001 |
| 09/09/2020 | 12:40:24 PM | 570 | 106.252 | 109.172 | 109.98 | 193.241 | 0.001 |
| 09/09/2020 | 12:40:25 PM | 571 | 106.252 | 109.172 | 109.711 | 194.489 | 0.001 |
| 09/09/2020 | 12:40:25 PM | 572 | 106.126 | 109.239 | 109.846 | 195.113 | 0.001 |
| 09/09/2020 | 12:40:26 PM | 573 | 106.063 | 109.307 | 109.778 | 195.165 | 0.001 |
| 09/09/2020 | 12:40:26 PM | 574 | 106.126 | 109.239 | 109.644 | 194.801 | 0.001 |
| 09/09/2020 | 12:40:27 PM | 575 | 106.126 | 109.239 | 109.711 | 194.021 | 0.002 |
| 09/09/2020 | 12:40:27 PM | 576 | 106.063 | 109.105 | 109.644 | 192.825 | 0.002 |
| 09/09/2020 | 12:40:28 PM | 577 | 106.063 | 109.239 | 109.778 | 191.578 | 0.001 |
| 09/09/2020 | 12:40:29 PM | 578 | 106.063 | 109.307 | 109.778 | 190.019 | 0 |
| 09/09/2020 | 12:40:29 PM | 579 | 106 | 109.307 | 109.778 | 188.251 | 0 |
| 09/09/2020 | 12:40:30 PM | 580 | 106 | 109.172 | 109.778 | 186.588 | 0.002 |
| 09/09/2020 | 12:40:30 PM | 581 | 105.937 | 109.307 | 109.711 | 184.821 | 0.001 |
| 09/09/2020 | 12:40:31 PM | 582 | 105.937 | 109.239 | 109.711 | 182.949 | 0.001 |
| 09/09/2020 | 12:40:31 PM | 583 | 105.937 | 109.307 | 109.711 | 180.974 | 0.002 |
| 09/09/2020 | 12:40:32 PM | 584 | 105.937 | 109.307 | 109.711 | 179.051 | 0.001 |
| 09/09/2020 | 12:40:32 PM | 585 | 106 | 109.307 | 109.711 | 177.18 | 0.002 |
| 09/09/2020 | 12:40:33 PM | 586 | 105.874 | 109.374 | 109.441 | 175.256 | 0.001 |
| 09/09/2020 | 12:40:33 PM | 587 | 105.747 | 109.441 | 109.711 | 173.437 | 0.001 |
| 09/09/2020 | 12:40:34 PM | 588 | 105.937 | 109.307 | 109.644 | 171.618 | 0.001 |
| 09/09/2020 | 12:40:34 PM | 589 | 105.874 | 109.307 | 109.778 | 169.747 | 0.002 |
| 09/09/2020 | 12:40:35 PM | 590 | 105.81 | 109.374 | 109.509 | 168.187 | -0.071 |
| 09/09/2020 | 12:40:35 PM | 591 | 105.747 | 109.846 | 109.711 | 166.316 | -0.321 |
| 09/09/2020 | 12:40:36 PM | 592 | 105.874 | 109.307 | 109.711 | 164.653 | -0.515 |
| 09/09/2020 | 12:40:36 PM | 593 | 105.81 | 109.239 | 109.778 | 163.093 | -0.655 |
| 09/09/2020 | 12:40:37 PM | 594 | 105.81 | 109.307 | 109.509 | 161.482 | -0.798 |
| 09/09/2020 | 12:40:37 PM | 595 | 105.874 | 109.441 | 109.711 | 160.078 | -0.933 |
| 09/09/2020 | 12:40:38 PM | 596 | 105.81 | 109.441 | 109.509 | 158.675 | -1.043 |
| 09/09/2020 | 12:40:38 PM | 597 | 105.874 | 109.239 | 109.509 | 157.115 | -1.152 |
| 09/09/2020 | 12:40:39 PM | 598 | 105.874 | 109.441 | 109.778 | 155.712 | -1.228 |
| 09/09/2020 | 12:40:39 PM | 599 | 105.937 | 109.644 | 109.778 | 154.465 | -1.306 |
| 09/09/2020 | 12:40:40 PM | 600 | 105.937 | 109.239 | 109.778 | 153.165 | -1.341 |

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|------------|-------------|-----|---------|---------|---------|---------|--------|
| 09/09/2020 | 12:40:40 PM | 601 | 106 | 109.441 | 109.846 | 151.969 | -1.413 |
| 09/09/2020 | 12:40:41 PM | 602 | 106.063 | 109.374 | 109.576 | 150.67 | -1.489 |
| 09/09/2020 | 12:40:41 PM | 603 | 106.126 | 109.374 | 109.576 | 149.526 | -1.518 |
| 09/09/2020 | 12:40:42 PM | 604 | 106.252 | 109.307 | 109.644 | 148.331 | -1.54 |
| 09/09/2020 | 12:40:43 PM | 605 | 106.252 | 109.307 | 109.644 | 147.343 | -1.595 |
| 09/09/2020 | 12:40:43 PM | 606 | 106.252 | 109.172 | 109.644 | 146.148 | -1.758 |
| 09/09/2020 | 12:40:44 PM | 607 | 106.189 | 109.239 | 109.778 | 145.108 | -1.672 |
| 09/09/2020 | 12:40:44 PM | 608 | 106.316 | 109.172 | 109.711 | 144.277 | -1.691 |
| 09/09/2020 | 12:40:45 PM | 609 | 106.379 | 109.307 | 109.778 | 143.289 | -1.71 |
| 09/09/2020 | 12:40:45 PM | 610 | 106.505 | 109.374 | 109.509 | 142.249 | -1.748 |
| 09/09/2020 | 12:40:46 PM | 611 | 106.379 | 109.172 | 109.374 | 141.314 | -1.75 |
| 09/09/2020 | 12:40:46 PM | 612 | 106.316 | 109.307 | 109.644 | 140.586 | -1.772 |
| 09/09/2020 | 12:40:47 PM | 613 | 106.379 | 109.441 | 109.98 | 139.754 | -1.789 |
| 09/09/2020 | 12:40:47 PM | 614 | 106.505 | 109.441 | 109.644 | 138.767 | -1.82 |
| 09/09/2020 | 12:40:48 PM | 615 | 106.568 | 109.239 | 109.778 | 138.091 | -1.834 |
| 09/09/2020 | 12:40:48 PM | 616 | 106.568 | 109.307 | 109.913 | 137.259 | -1.841 |
| 09/09/2020 | 12:40:49 PM | 617 | 106.442 | 109.441 | 110.183 | 136.584 | -1.88 |
| 09/09/2020 | 12:40:49 PM | 618 | 106.568 | 109.441 | 109.913 | 135.856 | -1.827 |
| 09/09/2020 | 12:40:50 PM | 619 | 106.505 | 109.374 | 109.846 | 135.128 | -1.858 |
| 09/09/2020 | 12:40:50 PM | 620 | 106.316 | 109.374 | 109.778 | 134.4 | -1.867 |
| 09/09/2020 | 12:40:51 PM | 621 | 106.568 | 109.374 | 109.913 | 133.777 | -1.831 |
| 09/09/2020 | 12:40:51 PM | 622 | 106.631 | 109.441 | 109.846 | 133.205 | -1.889 |
| 09/09/2020 | 12:40:52 PM | 623 | 106.568 | 109.307 | 109.644 | 132.529 | -1.873 |
| 09/09/2020 | 12:40:52 PM | 624 | 106.631 | 109.307 | 109.576 | 131.853 | -1.823 |
| 09/09/2020 | 12:40:53 PM | 625 | 106.568 | 109.307 | 109.913 | 131.23 | -1.906 |
| 09/09/2020 | 12:40:53 PM | 626 | 106.631 | 109.374 | 109.846 | 130.814 | -1.899 |
| 09/09/2020 | 12:40:54 PM | 627 | 106.189 | 109.239 | 109.98 | 130.294 | -1.894 |
| 09/09/2020 | 12:40:54 PM | 628 | 106.695 | 109.307 | 109.98 | 129.722 | -1.915 |
| 09/09/2020 | 12:40:55 PM | 629 | 106.568 | 109.374 | 109.509 | 129.098 | -1.913 |
| 09/09/2020 | 12:40:55 PM | 630 | 106.695 | 109.644 | 109.644 | 128.579 | -1.898 |
| 09/09/2020 | 12:40:56 PM | 631 | 106.695 | 109.307 | 109.509 | 128.215 | -1.884 |
| 09/09/2020 | 12:40:57 PM | 632 | 106.695 | 109.239 | 109.98 | 127.591 | -1.929 |
| 09/09/2020 | 12:40:57 PM | 633 | 106.758 | 109.374 | 109.913 | 127.175 | -1.899 |
| 09/09/2020 | 12:40:58 PM | 634 | 106.695 | 109.307 | 109.98 | 126.811 | -1.912 |
| 09/09/2020 | 12:40:58 PM | 635 | 106.821 | 109.374 | 109.98 | 126.24 | -1.921 |
| 09/09/2020 | 12:40:59 PM | 636 | 106.631 | 109.576 | 109.846 | 125.98 | -1.917 |
| 09/09/2020 | 12:40:59 PM | 637 | 106.758 | 109.576 | 109.778 | 125.46 | -1.938 |
| 09/09/2020 | 12:41:00 PM | 638 | 106.631 | 109.307 | 109.98 | 125.096 | -1.903 |
| 09/09/2020 | 12:41:00 PM | 639 | 106.758 | 109.374 | 109.778 | 124.628 | -1.956 |
| 09/09/2020 | 12:41:01 PM | 640 | 106.695 | 109.307 | 109.778 | 124.368 | -1.917 |
| 09/09/2020 | 12:41:01 PM | 641 | 106.695 | 109.509 | 109.913 | 123.901 | -1.92 |
| 09/09/2020 | 12:41:02 PM | 642 | 106.695 | 109.307 | 110.048 | 123.693 | -1.915 |
| 09/09/2020 | 12:41:02 PM | 643 | 106.758 | 109.307 | 109.913 | 123.277 | -1.951 |
| 09/09/2020 | 12:41:03 PM | 644 | 106.695 | 109.374 | 110.048 | 122.861 | -1.906 |
| 09/09/2020 | 12:41:03 PM | 645 | 106.631 | 109.374 | 109.98 | 122.601 | -1.915 |
| 09/09/2020 | 12:41:04 PM | 646 | 106.695 | 109.441 | 110.048 | 122.393 | -1.935 |

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|------------|-------------|-----|---------|---------|---------|---------|--------|
| 09/09/2020 | 12:41:04 PM | 647 | 106.631 | 109.711 | 109.913 | 121.925 | -1.933 |
| 09/09/2020 | 12:41:05 PM | 648 | 106.758 | 109.374 | 109.711 | 121.665 | -1.918 |
| 09/09/2020 | 12:41:05 PM | 649 | 106.695 | 109.374 | 109.846 | 121.302 | -1.928 |
| 09/09/2020 | 12:41:06 PM | 650 | 106.695 | 109.441 | 109.778 | 121.042 | -1.908 |
| 09/09/2020 | 12:41:06 PM | 651 | 106.631 | 109.441 | 109.913 | 120.73 | -1.947 |
| 09/09/2020 | 12:41:07 PM | 652 | 106.695 | 109.374 | 109.778 | 120.574 | -1.926 |
| 09/09/2020 | 12:41:07 PM | 653 | 106.695 | 109.307 | 109.98 | 120.366 | -1.938 |
| 09/09/2020 | 12:41:08 PM | 654 | 106.695 | 109.441 | 109.98 | 119.95 | -1.917 |
| 09/09/2020 | 12:41:08 PM | 655 | 106.568 | 109.374 | 109.846 | 119.742 | -1.915 |
| 09/09/2020 | 12:41:09 PM | 656 | 106.695 | 109.374 | 109.98 | 119.43 | -1.928 |
| 09/09/2020 | 12:41:09 PM | 657 | 106.631 | 109.374 | 109.98 | 119.378 | -1.942 |
| 09/09/2020 | 12:41:10 PM | 658 | 106.758 | 109.441 | 109.913 | 119.014 | -1.951 |
| 09/09/2020 | 12:41:11 PM | 659 | 106.568 | 109.105 | 109.98 | 118.91 | -1.94 |
| 09/09/2020 | 12:41:11 PM | 660 | 106.758 | 109.307 | 110.048 | 118.547 | -1.955 |
| 09/09/2020 | 12:41:12 PM | 661 | 106.631 | 109.509 | 109.778 | 118.391 | -1.939 |
| 09/09/2020 | 12:41:12 PM | 662 | 106.631 | 109.441 | 109.98 | 118.287 | -1.944 |
| 09/09/2020 | 12:41:13 PM | 663 | 106.631 | 109.441 | 110.115 | 117.975 | -1.924 |
| 09/09/2020 | 12:41:13 PM | 664 | 106.695 | 109.441 | 110.048 | 117.819 | -1.928 |
| 09/09/2020 | 12:41:14 PM | 665 | 106.695 | 109.441 | 109.913 | 117.507 | -1.939 |
| 09/09/2020 | 12:41:14 PM | 666 | 106.695 | 109.307 | 109.98 | 117.299 | -1.922 |
| 09/09/2020 | 12:41:15 PM | 667 | 106.695 | 109.441 | 110.048 | 117.143 | -1.926 |
| 09/09/2020 | 12:41:15 PM | 668 | 106.695 | 109.374 | 109.98 | 116.935 | -1.929 |
| 09/09/2020 | 12:41:16 PM | 669 | 106.758 | 109.441 | 109.778 | 116.987 | -1.944 |
| 09/09/2020 | 12:41:16 PM | 670 | 106.695 | 109.441 | 109.98 | 116.571 | -1.937 |
| 09/09/2020 | 12:41:17 PM | 671 | 106.631 | 109.374 | 110.048 | 116.519 | -1.956 |
| 09/09/2020 | 12:41:17 PM | 672 | 106.631 | 109.711 | 109.98 | 116.363 | -1.921 |
| 09/09/2020 | 12:41:18 PM | 673 | 106.695 | 109.509 | 109.711 | 116.104 | -1.933 |
| 09/09/2020 | 12:41:18 PM | 674 | 106.695 | 109.441 | 110.048 | 116 | -2.015 |
| 09/09/2020 | 12:41:19 PM | 675 | 106.568 | 109.509 | 109.98 | 115.844 | -1.934 |
| 09/09/2020 | 12:41:19 PM | 676 | 106.695 | 109.441 | 109.778 | 115.636 | -1.93 |
| 09/09/2020 | 12:41:20 PM | 677 | 106.695 | 109.644 | 109.913 | 115.636 | -1.955 |
| 09/09/2020 | 12:41:20 PM | 678 | 106.821 | 109.576 | 109.913 | 115.532 | -1.944 |
| 09/09/2020 | 12:41:21 PM | 679 | 106.695 | 109.441 | 109.846 | 115.22 | -1.952 |