

CLEANING LABORATORY EVALUATION SUMMARY

SCL #: 2006
 DateRun: 06/28/2006
 Experimenters: Jason Marshall
 ClientType: Consultant
 ProjectNumber: Project #1
 Substrates: Wood
 PartType: Coupon
 Contaminants: Coatings
 Cleaning Methods:
 Analytical Methods: Performance Test
 Purpose: To determine the coefficient of friction for various floor finishes.

Experimental Procedure: Control of Moisture Content and Temperature
 The moisture content at the time of testing will influence results due to the hygroscopic nature of the base materials. Therefore, efforts must be taken to ensure that the moisture content and temperature remain constant during the evaluation period. Ideally, the sample floor should be kept at 65+/-1% relative humidity and 68+/-6 F. During laboratory testing, conditions were 64% relative humidity and the temperature was ~74 F.

Sample Preparation
 The flooring material supplied was Hardwood flooring made from Red Oak. The boards were 3/4" thick, 2 1/4" wide and cut into 8" sections.

Three coupons were coated with a supplied floor finish according to the manufacturers' specifications. The finish was applied using a 1" Pure Bristle 1500 paint brush. To ensure proper coating application rates, the coatings were applied via pipettes to surface. Three coats were used for each floor finish as this was common number of coating layers suggested by the various manufacturers.

The first two coatings were allowed to dry for 2 hours prior to the application of the next coat. The second coat for the current process was allowed to dry overnight before the application of final coat. The Completed coupons were allowed to sit for a minimum period of 24 hours before performance evaluations were conducted.

Coefficient of Friction
 The ASTM specified apparatus was replaced with an IMASS, Inc SP-102B-3M90 Slip/Peel Tester (Figure 1). Two types of friction coefficients were measured using this instrument. The first, Static CoF, was determined by obtaining the force required to move the specimen from a stationary position. The second, Sliding CoF (or Kinetic), was found by measuring the average force required to maintain movement at a certain rate. Measured forces will have peaks and valleys in the amount of force needed to keep moving. Average these values results and dividing by the weight of the object will result in the desired coefficient. Figure 1. IMASS Slip/Peel Tester

The Slip/Peel tester was first adjusted to ensure that the device was properly calibrated for the sled weight being used. A coupon was then placed and clamped onto the bed of the device. The speed of the bed was set to 45"/min. The instrument records two values, the peak, the valley and calculates the average. The device was run three times per coupon for measuring the Static CoF and three times to measure the Kinetic CoF. Each coupon's value was averaged and then the values for each finish (three coupon averages) were averaged to get one value for the Static Coefficient of Friction and one value for the Kinetic Coefficient of Friction. These values for coated samples were compared to the CoF for the same uncoated coupons.

Coefficient of Friction = Ratio of tractive (pulling) force to the normal force (sled weight): $CoF = F/N = (Tractive\ force)/(Normal\ Force) = (meter\ reading)/(sled\ weight)$

Results: Uncoated CoF Readings

| Product | Initial CoF Coupon # | Static | | | Kinetic | | |
|---------|-------------------------|--------|--------|---------|---------|--------|---------|
| | | Peak | Valley | Average | Peak | Valley | Average |
| CP | 1 | 590 | 482 | 503 | 550 | 492 | 511 |
| | | 659 | 493 | 513 | 511 | 484 | 497 |
| | | 606 | 487 | 504 | 524 | 491 | 501 |
| | 2 | 578 | 468 | 483 | 496 | 415 | 441 |
| | | 694 | 463 | 477 | 535 | 483 | 497 |
| | | 692 | 461 | 476 | 518 | 468 | 481 |
| | 3 | 691 | 483 | 497 | 523 | 480 | 493 |
| | | 689 | 480 | 491 | 507 | 479 | 492 |

CLEANING LABORATORY EVALUATION SUMMARY

| | | | | | | | |
|-------|----|-----|-----|-----|-----|-----|-----|
| | | 647 | 482 | 494 | 521 | 474 | 486 |
| MCP | 4 | 638 | 486 | 498 | 509 | 439 | 465 |
| | | 671 | 474 | 489 | 489 | 421 | 434 |
| | | 641 | 476 | 489 | 503 | 450 | 461 |
| | 5 | 667 | 431 | 445 | 512 | 468 | 480 |
| | | 643 | 437 | 451 | 516 | 470 | 483 |
| | | 686 | 431 | 443 | 521 | 458 | 477 |
| | 6 | 588 | 440 | 451 | 477 | 436 | 447 |
| | | 614 | 446 | 456 | 475 | 441 | 452 |
| | | 549 | 452 | 464 | 489 | 435 | 445 |
| BO | 7 | 779 | 549 | 564 | 578 | 505 | 518 |
| | | 763 | 560 | 574 | 602 | 559 | 572 |
| | | 799 | 517 | 530 | 568 | 507 | 522 |
| | 8 | 625 | 472 | 486 | 530 | 455 | 466 |
| | | 579 | 476 | 486 | 508 | 435 | 450 |
| | | 610 | 449 | 463 | 534 | 469 | 473 |
| | 9 | 561 | 448 | 473 | 496 | 450 | 467 |
| | | 667 | 504 | 468 | 501 | 455 | 475 |
| | | 579 | 447 | 468 | 500 | 448 | 468 |
| BW | 10 | 417 | 439 | 439 | 474 | 424 | 429 |
| | | 472 | 419 | 432 | 468 | 423 | 430 |
| | | 595 | 403 | 426 | 466 | 427 | 430 |
| | 11 | 522 | 456 | 461 | 471 | 439 | 448 |
| | | 666 | 436 | 451 | 469 | 435 | 451 |
| | | 555 | 440 | 453 | 474 | 451 | 454 |
| | 12 | 799 | 447 | 462 | 468 | 413 | 433 |
| | | 760 | 421 | 434 | 448 | 415 | 431 |
| | | 669 | 415 | 432 | 466 | 404 | 434 |
| Blank | 13 | 687 | 422 | 452 | 474 | 426 | 433 |
| | | 592 | 414 | 437 | 469 | 419 | 430 |
| | | 631 | 424 | 436 | 469 | 420 | 432 |
| | 14 | 542 | 425 | 453 | 457 | 397 | 425 |
| | | 570 | 425 | 453 | 449 | 391 | 414 |
| | | 730 | 404 | 429 | 452 | 385 | 420 |
| | 15 | 600 | 452 | 468 | 447 | 422 | 432 |
| | | 531 | 432 | 445 | 448 | 416 | 428 |
| | | 650 | 418 | 436 | 437 | 414 | 425 |

| CP | Static | | | Kinetic | | |
|-------------|--------|--------|---------|---------|--------|---------|
| | Peak | Valley | Average | Peak | Valley | Average |
| | 618 | 487 | 507 | 528 | 489 | 503 |
| | 655 | 464 | 479 | 516 | 455 | 473 |
| | 676 | 482 | 494 | 517 | 478 | 490 |
| Product Ave | 650 | 478 | 493 | 521 | 474 | 489 |
| MCP | 650 | 479 | 492 | 500 | 437 | 453 |
| | 665 | 433 | 446 | 516 | 465 | 480 |
| | 584 | 446 | 457 | 480 | 437 | 448 |
| Product Ave | 633 | 453 | 465 | 499 | 446 | 460 |
| BO | 780 | 542 | 556 | 583 | 524 | 537 |
| | 605 | 466 | 478 | 524 | 453 | 463 |
| | 602 | 466 | 470 | 499 | 451 | 470 |
| Product Ave | 662 | 491 | 501 | 535 | 476 | 490 |
| BW | 495 | 420 | 432 | 469 | 425 | 430 |
| | 581 | 444 | 455 | 471 | 442 | 451 |
| | 743 | 428 | 443 | 461 | 411 | 433 |

CLEANING LABORATORY EVALUATION SUMMARY

| | | | | | | |
|-------------|-----|-----|-----|-----|-----|-----|
| Product Ave | 606 | 431 | 443 | 467 | 426 | 438 |
| Blank | 637 | 420 | 442 | 471 | 422 | 432 |
| | 614 | 418 | 445 | 453 | 391 | 420 |
| | 594 | 434 | 450 | 444 | 417 | 428 |
| Product Ave | 615 | 424 | 445 | 456 | 410 | 427 |

Coated CoF Readings

| Final CoF | Static | | | Kinetic | | | |
|-----------|----------|------|--------|---------|------|--------|---------|
| Product | Coupon # | Peak | Valley | Average | Peak | Valley | Average |
| CP | 1 | 883 | 835 | 858 | 866 | 809 | 843 |
| | | 1190 | 814 | 843 | 887 | 789 | 855 |
| | | 1048 | 818 | 845 | 882 | 802 | 859 |
| | 2 | 1117 | 799 | 876 | 918 | 803 | 873 |
| | | 1104 | 805 | 865 | 936 | 836 | 888 |
| | | 1292 | 811 | 870 | 925 | 862 | 890 |
| | 3 | 1063 | 905 | 840 | 920 | 899 | 914 |
| | | 939 | 884 | 909 | 928 | 893 | 914 |
| | | 1114 | 870 | 906 | 928 | 907 | 919 |
| MCP | 4 | 824 | 720 | 742 | 720 | 670 | 704 |
| | | 825 | 698 | 727 | 709 | 644 | 706 |
| | | 802 | 657 | 712 | 739 | 682 | 713 |
| | 5 | 946 | 733 | 738 | 737 | 687 | 720 |
| | | 983 | 731 | 726 | 729 | 717 | 722 |
| | | 902 | 696 | 721 | 736 | 716 | 719 |
| | 6 | 887 | 761 | 769 | 744 | 626 | 729 |
| | | 985 | 733 | 741 | 761 | 746 | 750 |
| | | 854 | 736 | 741 | 740 | 734 | 738 |
| BO | 7 | 600 | 398 | 429 | 521 | 443 | 492 |
| | | 529 | 430 | 473 | 516 | 440 | 484 |
| | | 560 | 450 | 490 | 522 | 445 | 482 |
| | 8 | 482 | 437 | 448 | 472 | 450 | 456 |
| | | 686 | 453 | 461 | 460 | 450 | 451 |
| | | 633 | 450 | 458 | 459 | 444 | 431 |
| | 9 | 590 | 484 | 547 | 610 | 512 | 587 |
| | | 688 | 417 | 541 | 578 | 490 | 554 |
| | | 701 | 497 | 581 | 657 | 507 | 605 |
| BW | 10 | 628 | 452 | 494 | 550 | 514 | 526 |
| | | 663 | 486 | 526 | 580 | 509 | 521 |
| | | 805 | 472 | 513 | 541 | 483 | 495 |
| | 11 | 789 | 522 | 604 | 696 | 485 | 585 |
| | | 689 | 519 | 587 | 693 | 492 | 577 |
| | | 672 | 513 | 583 | 656 | 486 | 566 |
| | 12 | 532 | 437 | 440 | 445 | 403 | 422 |
| | | 615 | 430 | 446 | 446 | 402 | 418 |
| | | 467 | 416 | 436 | 520 | 383 | 429 |
| Blank | 13 | 586 | 489 | 506 | 533 | 474 | 497 |
| | | 566 | 436 | 469 | 511 | 432 | 466 |
| | | 616 | 460 | 482 | 505 | 443 | 469 |
| | 14 | 562 | 416 | 433 | 462 | 408 | 432 |
| | | 654 | 404 | 433 | 461 | 409 | 430 |
| | | 638 | 406 | 432 | 459 | 401 | 422 |
| | 15 | 663 | 436 | 455 | 461 | 450 | 457 |
| | | 569 | 435 | 450 | 465 | 434 | 446 |
| | | 574 | 435 | 447 | 462 | 436 | 448 |

| | | |
|--|--------|---------|
| | Static | Kinetic |
|--|--------|---------|

CLEANING LABORATORY EVALUATION SUMMARY

| | Peak | Valley | Average | Peak | Valley | Average |
|-------------|------|--------|---------|------|--------|---------|
| CP | 1040 | 822 | 849 | 878 | 800 | 852 |
| | 1171 | 805 | 870 | 926 | 834 | 884 |
| | 1039 | 886 | 885 | 925 | 900 | 916 |
| Product Ave | 1083 | 838 | 868 | 910 | 844 | 884 |
| MCP | 817 | 692 | 727 | 723 | 665 | 708 |
| | 944 | 720 | 728 | 734 | 707 | 720 |
| | 909 | 743 | 750 | 748 | 702 | 739 |
| Product Ave | 890 | 718 | 735 | 735 | 691 | 722 |
| BO | 563 | 426 | 464 | 520 | 443 | 486 |
| | 600 | 447 | 456 | 464 | 448 | 446 |
| | 660 | 466 | 556 | 615 | 503 | 582 |
| Product Ave | 608 | 446 | 492 | 533 | 465 | 505 |
| BW | 699 | 470 | 511 | 557 | 502 | 514 |
| | 717 | 518 | 591 | 682 | 488 | 576 |
| | 538 | 428 | 441 | 470 | 396 | 423 |
| Product Ave | 651 | 472 | 514 | 570 | 462 | 504 |
| Blank | 589 | 462 | 486 | 516 | 450 | 477 |
| | 618 | 409 | 433 | 461 | 406 | 428 |
| | 602 | 435 | 451 | 463 | 440 | 450 |
| Product Ave | 603 | 435 | 456 | 480 | 432 | 452 |

Cof F Difference

| Product | Static | | | Kinetic | | |
|---------|--------|--------|---------|---------|--------|---------|
| | Peak | Valley | Average | Peak | Valley | Average |
| CP | 434 | 360 | 375 | 389 | 370 | 395 |
| MCP | 257 | 266 | 270 | 236 | 245 | 262 |
| BO | -55 | -45 | -9 | -2 | -11 | 15 |
| BW | 45 | 41 | 71 | 103 | 36 | 67 |
| Blank | -12 | 11 | 11 | 24 | 22 | 25 |

Summary:

Conclusion:

The current practice coating matrix had the greatest increase in both static and kinetic coefficient of friction followed by the modified current practice. The increase represents more traction on the floor.

The Bona Oil mix was the only product that had lower coefficient of friction after application of the coating. This would result in a more slick surface.