



Division of SLICKBAR PRODUCTS CORPORATION

MAXIMUM DAILY RECOVERY CAPACITY

FOR A DIP OIL RECOVERY SYSTEM

Unlike containment booms, not all oil skimmers operate on the same physical principles for recovering spilled oil. Naturally, the maximum daily oil recovery capacity of any skimmer is influenced by numerous factors such as basic design, and its sensitivity to different oil types, viscosities, debris, slick thickness, currents and wave conditions. The primary design objective of any skimmer is to recover as much oil and as little water as possible under wide variations of oil types and prevailing hydrographic conditions.

In order to create a realistic and conservative method for determining the maximum effective daily recovery capacity for oil skimmers, the US Coast Guard "OPA 90" staff has developed a list of standards and formulas for derating skimmers. A copy of the final rules and regulations pertaining to skimmer derating can be found in CFR Part 154 Appendix C.

A DIP skimmer utilizes a method for collecting oil under water using a moving conveyor type belt system. The concept minimizes the effects of hydrodynamic forces and allows for the separation of oil and water prior to pumping the accumulated oil to storage. This process greatly reduces the amount of "free" or non emulsified water in the recovered oil, and more importantly, pumping from the recovered oil layer occurs independent of skimming different from other skimmers that utilize over flow weirs, adhesive belts, absorbent belts, absorbent ropes, rotating drums and discs, or Archimedes screws.

A DIP skimmer by design will recover oil at the rate which it is presented to the belt assembly or the encounter rate. The maximum recovery rate of any DIP skimmer can therefore be calculated by multiplying the width of the belt times the thickness of oil on the belt times the velocity of the oil as it moves down the belt. Utilizing test data and actual spill experience gained with these skimmers, we use a throughput efficiency factor of 80% for derating the skimmer. Because the oil recovery process occurs independent of pumping the recovered oil, DIP units are engineered to utilize various types and sizes of pumps, depending upon the desired pumping rate.

Referring to CFR Part 154 and specifically OPA 90 rules and regulations concerning effective daily recovery capacity, we base our calculations on section 6.2.4 through section 6.3.2. The formula used to obtain the calculations is as follows:

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**JBF DIP OIL RECOVERY RATE
CALCULATION FORMULAS**

$$\text{BBLs/hr} = \frac{\text{BW} \times 12 \text{ T} \times 12400 \times 12}{231 \times 42}$$

- BW = Belt width in feet
- 12 = Inches/foot
- T= Oil thickness in inches on belt
- 12400= 2 knots (2 x 6200 feet/nautical mile) belt speed
- 12= Hours/skimming operations
- 231= Cubic inches/US gallon
- 42= US gallons/barrel

For the purpose of these calculations, we have used the following various oil thicknesses for each size of skimmer belt based upon what tests and actual spill experience has indicated as practical thicknesses.

Belt size	1 ft.	1.5 ft.	2 ft.	3 ft.	4 ft.	6 ft.
Oil thickness On belt	1.5 in	2 in	2 in	2.5 in	2.5 in	3 in



JBF DYNAMIC INCLINE PLANE (DIP) OIL RECOVERY PERFORMANCE DATA IN BBLs/HR ~USG/m ~m³/HR

Belt Size	1 ft (0.3m) Belt	1 ½ ft (0.45m) Belt	2 ft (0.60m) Belt	3 ft (0.90m) Belt	4 ft (1.2m) Belt	One (1) 6 ft (1.8m) Belt	Two (2) 6 ft. (1.8m) Belts
JBF DIP Model	DIP 400 VOSS	DIP 2200 OSRV	DIP 402 VOSS	DIP 500 VOSS DIP 3001 OSRV	DIP 600 VOSS DIP 3003 OSRV DIP 4500 OSRV	DIP 5000 OSRV	DIP 6000 OSRV
Calculated Recovery Rates Groups 1 through 4 oils as defined by 33 CFR 154.1020	276 BBLs/HR 193USG/m 44 m ³ /hr	552 BBLs/HR 386 USG/m 88 m ³ /hr	736 BBLs/HR 515 USG/m 117 m ³ /hr	1380 BBLs/HR 966 USG/m 220 m ³ /hr	1840 BBLs/HR 1288 USG/m 292 m ³ /hr	3312 BBLs/HR 2318 USG/m 526 m ³ /hr	6625 BBLs/HR 4636 USG/m 1052 m ³ /hr
*EDRC Calm (No Waves + 1 knot current) 94%	260 BBLs/HR 180 USG/m 41 m ³ /hr	520 BBLs/HR 360 USG/m 82 m ³ /hr	692 BBLs/HR 484 USG/m 110 m ³ /hr	1300 BBLs/HR 910 USG/m 207 m ³ /hr	1730 BBLs/HR 1210 USG/m 275 m ³ /hr	3110 BBLs/HR 2180 USG/m 495 m ³ /hr	6220 BBLs/HR 4360 USG/m 990 m ³ /hr
*EDRC Calm (No Waves + 2.5 knot current) 80%	220 BBLs/HR 155 USG/m 35 m ³ /hr	440 BBLs/HR 310 USG/m 70 m ³ /hr	590 BBLs/HR 412 USG/m 94 m ³ /hr	1104 BBLs/HR 770 USG/m 176 m ³ /hr	1470 BBLs/HR 1030 USG/m 233 m ³ /hr	2650 BBLs/HR 1855 USG/m 420 m ³ /hr	5300 BBLs/HR 3710 USG/m 840 m ³ /hr
*EDRC Choppy (Waves up to 1m + 1 knot current) 84%	230 BBLs/HR 162USG/m 37 m ³ /hr	460 BBLs/HR 324 USG/m 74 m ³ /hr	620 BBLs/HR 433 USG/m 98 m ³ /hr	1160 BBLs/HR 810 USG/m 185 m ³ /hr	1545 BBLs/HR 1080 USG/m 245 m ³ /hr	2780 BBLs/HR 1950 USG/m 440 m ³ /hr	5560 BBLs/HR 3900 USG/m 880 m ³ /hr
*EDRC Choppy (Waves up to 1m + 2 knot current) 74%	204 BBLs/HR 143 USG/m 32 m ³ /hr	408 BBLs/HR 286 USG/m 64 m ³ /hr	545 BBLs/HR 380 USG/m 87 m ³ /hr	1020 BBLs/HR 715 USG/m 163 m ³ /hr	1360 BBLs/HR 950 USG/m 215 m ³ /hr	2450 BBLs/HR 1715 USG/m 390 m ³ /hr	4900 BBLs/HR 3530 USG/m 780 m ³ /hr

The JBF oil recovery rates for advancing skimmers are based on independent controlled tests by the USN, Environmental Canada and the American Petroleum Institute, and on actual oil spill data logged by the USCG, EPA and the USN. These tests and data include all oils in group 1 through 4 as defined by the US Coast Guard 33CFR 154.1020 the engineering calculations and test data includes throughput and collection efficiency results derived through the American Society for Testing Materials (ASTM) F-631 or ASTM F-808.

Based upon calculation, the maximum daily recovery capacity of each JBF DIP skimmer model is presented in the above table. The owner or operator may be constrained by oil transfer rates or temporary oil storage capacity. JBF can provide various pumping options and temporary storage recommendations to assist in contingency plan compliance.

*EDRC ~ Effective daily recovery capacity ~ Based on USCG authorization letter to JBF of 27 December 1994 and the letter referred US Navy report entitled "USN DIP 3001 Performance Test Program" in June 1976 from extensive tests at Ohmsett Facility in Leonardo, New Jersey. USCG stated in the letter that all JBF "Customers may use these alternative ratings to calculate EDRC for response conditions similar to the test conditions."