In this work, we study the behaviour of linear kernel operators on rearrangement-invariant (r.i.) spaces. In particular we focus on the boundedness of such operators between various function spaces. Given an operator and a domain r.i. space Y, our goal is to find an r.i. space Z such that the operator is bounded from Y into Z, and, whenever possible, to show that the target space is optimal (that is, the smallest such space). We concentrate on a particular class of kernel operators denoted by S_a, which have important applications and whose pivotal instance is the Laplace transform. In order to deal properly with these fairly general operators we use advanced techniques from the theory of rearrangement-invariant spaces and theory of interpolation. It turns out that the problem of finding the optimal space for S_a can, to a certain degree, be translated into the problem of finding a "sufficiently small" space X such that a, the kernel of S_a, lies in X.