SHELF LIFE SCALE

DAY/TEMPERATURE SCALE

Figure 1.—The shelf life prediction slide rule.

INDEX

Slide Rule for Predicting Shelf Life of Cod

## L.J. RONSIVALLI, ROBERT J. LEARSON, and S.E. CHARM

L.J. Ronsivalli is Acting Center Director, NMFS Atlantic Fishery Products Technology Laboratory, Gloucester, MA; R.J. Learson is a Supervisory Research Food Technologist, NMFS Atlantic Fishery Products Technology Center, Gloucester, MA; S.E. Charm is Director, New England Enzyme Center, Tufts University School of Medicine, Boston, MA.

INTRODUCTION

The slide rule described in this article is based on the publication by Charm et al. 1972. According to that publication, the spoilage of cod occurs at a constant rate for any given temperature in the range of 32°F to 46°F. When the spoilage rate constants were plotted versus the temperature, a linear relationship was suggested. This agrees with findings by others (Spencer and Baines, 1964, and James and Olley, 1971). Charm et al. also found that when cod fillets were stored under conditions of varying temperatures, the spoilage rate constants were unaffected when the sequence of storage temperature was varied.

These findings clearly indicated that a device for predicting the shelf life of cod fillets is possible. The slide rule should be useful to anyone concerned with distribution and handling of fresh fish. It emphasizes the advantage of maintaining the product at as low a temperature as possible. The slide rule predicts the quality of fish in terms of "days held in ice."

The slide rule shown in Figure 1 has three parts: 1) the day/temperature (D/T) scale, 2) the shelf life (S) scale, and 3) the index. Note that the temperature lines are horizontals and that the day lines are diagonals. The slide rule should *only* be used when the history of the fish is known or can be estimated fairly accurately.
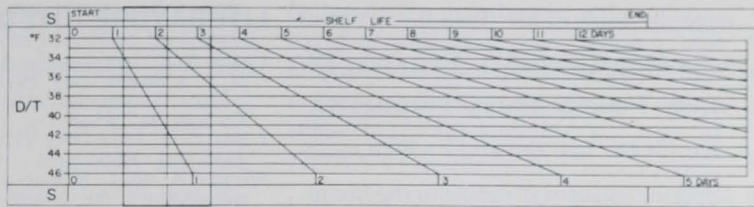
OPERATION

To illustrate its use, the following example is given:

Problem: Suppose fillets were cut from fish that had been held in ice aboard a vessel for two days and then stored in a cool room at 40°F for one day. What would be the shelf life of the fillets in a refrigerated showcase held at 46°F?
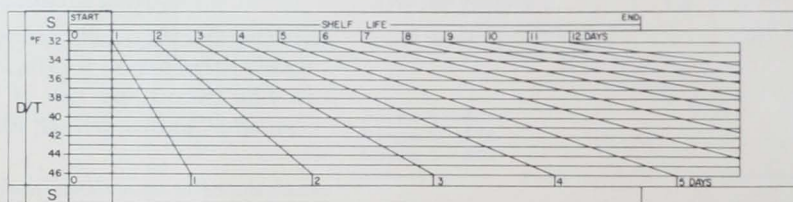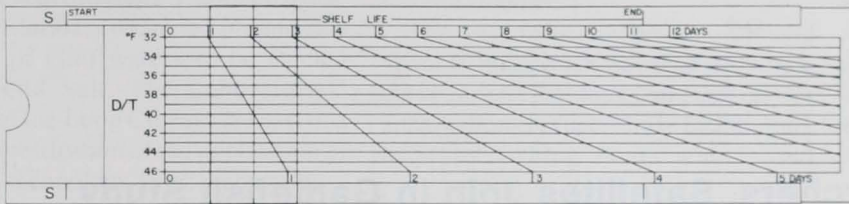
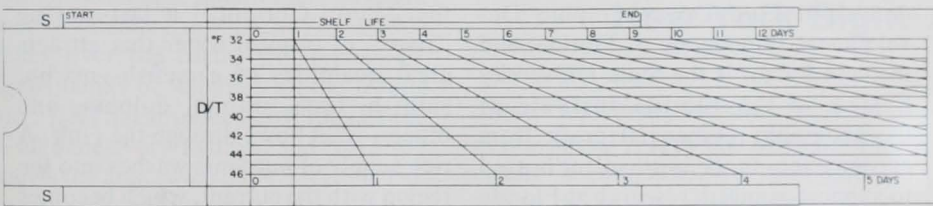Step 1. Set start of S scale and index line over O and D/T scale.

Step 2. Slide index line over point where two-day line crosses 33°F line. (Our data indicated that the temperature of iced fish is about 33°F).
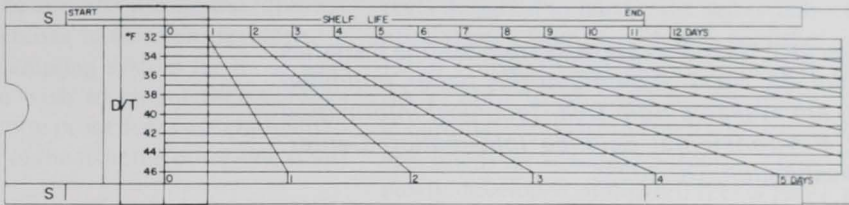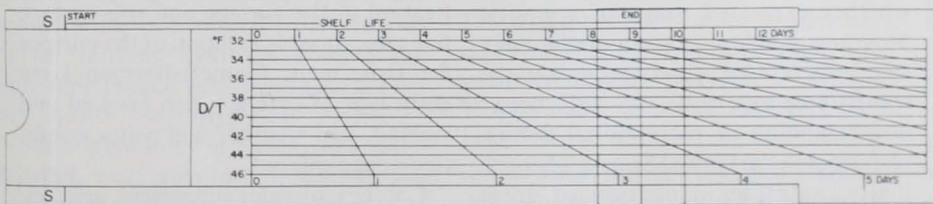
Step 3. Slide D/T scale to right until O on D/T scale is under index line.

Step 4. Slide index line over point where one-day line crosses 40°F line.

Step 5. Repeat step 3.

Step 6. Slide index to right until index line is at end of shelf life on S scale. At point where index line crosses 46°F line on D/T scale, we see that answer to problem is a little more than three days.

Note that when step 6 is reached, the shelf life remaining at any temperature shown can be read under the index line.

It is worthwhile to point out once more the benefit of holding fish at as low a temperature as possible. Note that the fillets cited in the problem above would have about twice the shelf life by holding them at 35°F.

Except by only a slight chance, day lines will not intersect exactly the point where the index scale intersects the 46°F line (or any of the temperature lines); therefore, one has to select the nearest day line or estimate fractions of a day.

Although the slide rule is specifically for cod fillets, our experience indicates it is just as useful for eviscerated whole cod and for eviscerated whole haddock and haddock fillets. In fact, it should be useful for most lean fish since the varia-

bility in spoilage rate constants among lean species should not be significant.

The slide rule was developed with Federal research funds, and there is no restriction as to its use by the public. Anyone having questions or needing assistance in the fabrication of the slide rule is requested to contact the authors at the Atlantic Fishery Products Technology Center, National Marine Fisheries Service, National Oceanic

and Atmospheric Administration, U.S. Department of Commerce, Emerson Avenue, Gloucester, Massachusetts 01930.

ACKNOWLEDGMENT

The authors are pleased to acknowledge the work of Mr. Paul Earl, Visual Information Specialist, Extension Division, National Marine Fisheries Service for the fine drawings which facilitated the job of instructing in the operation of the slide rule.

LITERATURE CITED

Charm, S. E., R. J. Learson, L. J. Ronsivalli, and M. S. Schwartz. 1972. Organoleptic technique *predicts refrigeration shelf life of fish.* Food Technol. 26(7):65-68.

James, D. G., and J. Olley. 1971. Spoilage of shark. Aust. Fish. 30(4):11-13.

Spencer, R., and C. R. Baines. 1964. The effect of temperature on the spoilage of wet white fish. I. Storage at constant temperatures between −1° and 25°C. Food Technol. 18:769-773.

NOAA/NMFS Developments

Sportfishermen, Researchers, Satellites Join in Gamefish Study

A fleet of privately-owned sportfishing craft, several scientific research vessels, two refueling platforms, and two orbiting satellites rendezvoused in and over the northeast Gulf of Mexico in June to collaborate in a unique study of the ecology of ocean gamefish.

Work began June 15, 1973, when about 50 sportfish boats put to sea to take part in the "Old Salt" fishing tournament, about 100 miles off the Florida "Sun Coast" (Crystal River south to Fort Myers).

Participants included many bluewater fishermen, several components of the Commerce Department's NOAA, the National Aeronautics and Space Administration, about a dozen academic institutions, and several business firms.

Dates for the event are June 15-18, July 20-22, August 24-26, and September 14-16. The planners will take advantage of information from NASA's ERTS-1 (Earth Resources Technology Satellite) to define the fishing area. The four-part event is sponsored by the non-profit Gulf Oceanographic Development Foundation of Florida, and the coordinator is the State University System of the Florida Institute of Oceanography. Financial profit from entrance fees in the tournament is used to support gamefish research at Florida universities.

The end result is expected to indicate whether expanded usage of scientific programs employing space technology can help NOAA—and through it the sportfishing fraternity—toward a better understanding of recreational fishing resources in the United States. Theoretically, satellite inspection of great stretches of the ocean may reduce some of the guesswork about where the big fighting fish congregate by directing fishermen to favorable locations. An auxiliary result could be an increase in the efficiency of research vessels engaged in oceanographic surveys at the sea surface.

Marine science is served in a variety of ways during the Old Salt tournament. Fishermen station their boats along the eastern edge of an oceanic feature called the "Loop Current," a fast-moving "river" of tropical water that attracts great quantities of gamefish—marlin, sailfish, tuna, wahoo, dolphin, and others—as it flows through the Gulf. A rich supply of nutrients washes into the region with the current, which becomes a gigantic feeding station for fish of all sizes. Preliminary oceanographic investigation of the surface and sub-surface fixes the variable location of the current for fishermen. Gamefishermen keep daily logs of catches, fish hooked and sighted, and weather and water conditions encountered.

Catches, by prior agreement, are contributed to marine scientists, who seek to understand the relationship between fish populations and oceanographic features. The NOAA research vessel *Oregon II*, under the direction of the National Marine Fisheries Service Southeast Fisheries Center, Miami, Florida, stood at anchor at the fishing site to serve—for the third year—as mothership and floating laboratory for the fleet of anglers.

Aboard the *Oregon II*, the scientific