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INTEGRAL EXPERIMENTS III

COMPARISON OF U AND WC FOR TAMPERS

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ABSTRACT [redacted]

The distribution of neutron in solid WC and U surrounding the D-D source (2.5-Mev neutrons) has been measured with 25 and 28 detectors in an attempt to distinguish which would be a better tamper material. The difference between the two is very small and probably spectrum-dependent.

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INTEGRAL EXPERIMENTS III

COMPARISON OF U AND WC FOR TAMPERS

The two tampers which have been most favorably considered for metal gadgets are WC and U. As reported in LA-304, the comparison of these two tampers in an integral form was made using shells of material and measuring fission-count multiplication. Sinse the WC geometry was irregular and unlike the U, the experiments were difficult to interpret. After consideration of the fabrication difficulties of WC it was decided that a solid block of material surrounding the source was the easiest geometry to obtain in duplicate for U and WC. The measurements reported here were made in such geometries using the d-d source.

The interiors of the two tampers were identical. A cross section through the mid plane of the WC is shown in Fig. 1. The outer surfaces of each were approximate spheres of radius 24 cm. The tampers were hung around the target of the d-d source as described in LA-304. The holes for the detectors were plugged except for the 1" of length occupied by the chamber itself. The detectors were 28 and 25 fission chambers of the spiral type, housed in cylindrical shells 1" in diameter and 1" long. The 25 chamber was Cd covered. Using the standardization of the chambers and the 28 data, the data from the 25 chamber have in all cases been reduced to pure 25.

Figs. 2 and 3 show M, the multiplication due to the tamper, i.e., the counting rate in the presence of the tamper divided by the rate for the bare source, as a function of radius. The asymmetry of the d-d source has been averaged as discussed in LA-304. The abscissa r is the distance between the center of the source and the center of the detector.

The goal of these experiments was to measure a distribution which could be used to check the use of differential constants introduced into an integral theory.

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It is immediately evident that the 28-detector data make very little distinction between U and WC; in fact, the difference is even less than anticipated from the differential data. Before the integral and differential data can be correlated it is therefore necessary to take account of the perturbations due to the source cavity and the detector cavity and the contribution from fission in the 25 present in normal alloy. This latter correction can be made by using the measured 25 distribution. The corrections are being treated by Group T-3 and will be discussed in a report by them.

The 25 distributions are not subject to such large corrections due to holes. However, the contribution to the 25 distribution from the fissions in 28 due to the primary neutrons is very appreciable, of the order of 20% and space-dependent to some degree. A simple point-source theory will consequently be in error for U. For a point source alone, the maximum height of the 25 distribution is inversely proportional to the scattering mean free path λ_s, for the spectrum present. Hence we may compare the 25 distribution in WC roughly with U reduced by 20%. Since the maximum heights are about equal before correction of U, the WC is 20% higher after correction. Consequently λ_s for WC is shorter than for U. It is not possible to draw conclusions about the spectra in the two tampers because for almost all energies λ_s for WC is less than λ_s for U. Quantitative analysis of the data is necessary for this purpose.

This analysis is in progress and the results applied to these data will be summarized in a future report. However, even a complete analysis will probably not definitely reveal whether U- or WC-tamped 25 will give the lower critical mass. These measurements suggest that the two materials are nearly identical in effectiveness. The effect of fissions in U is so sensitive to the core spectrum that this gain may or may not compensate the shorter mean free path in WC.

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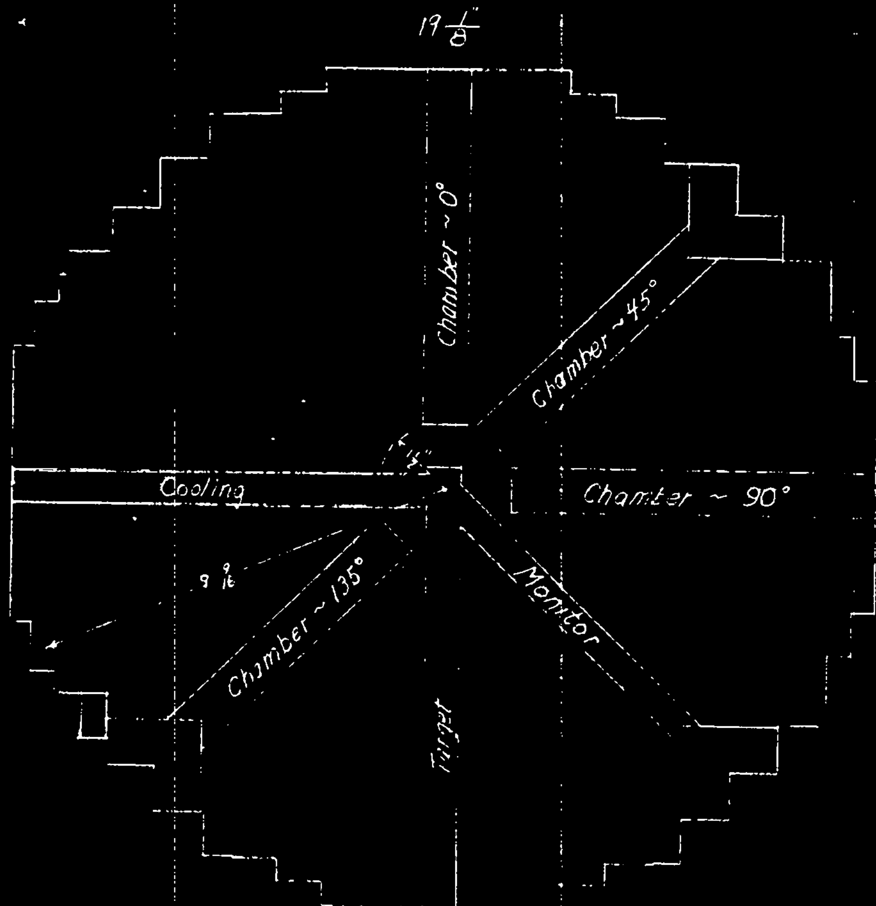
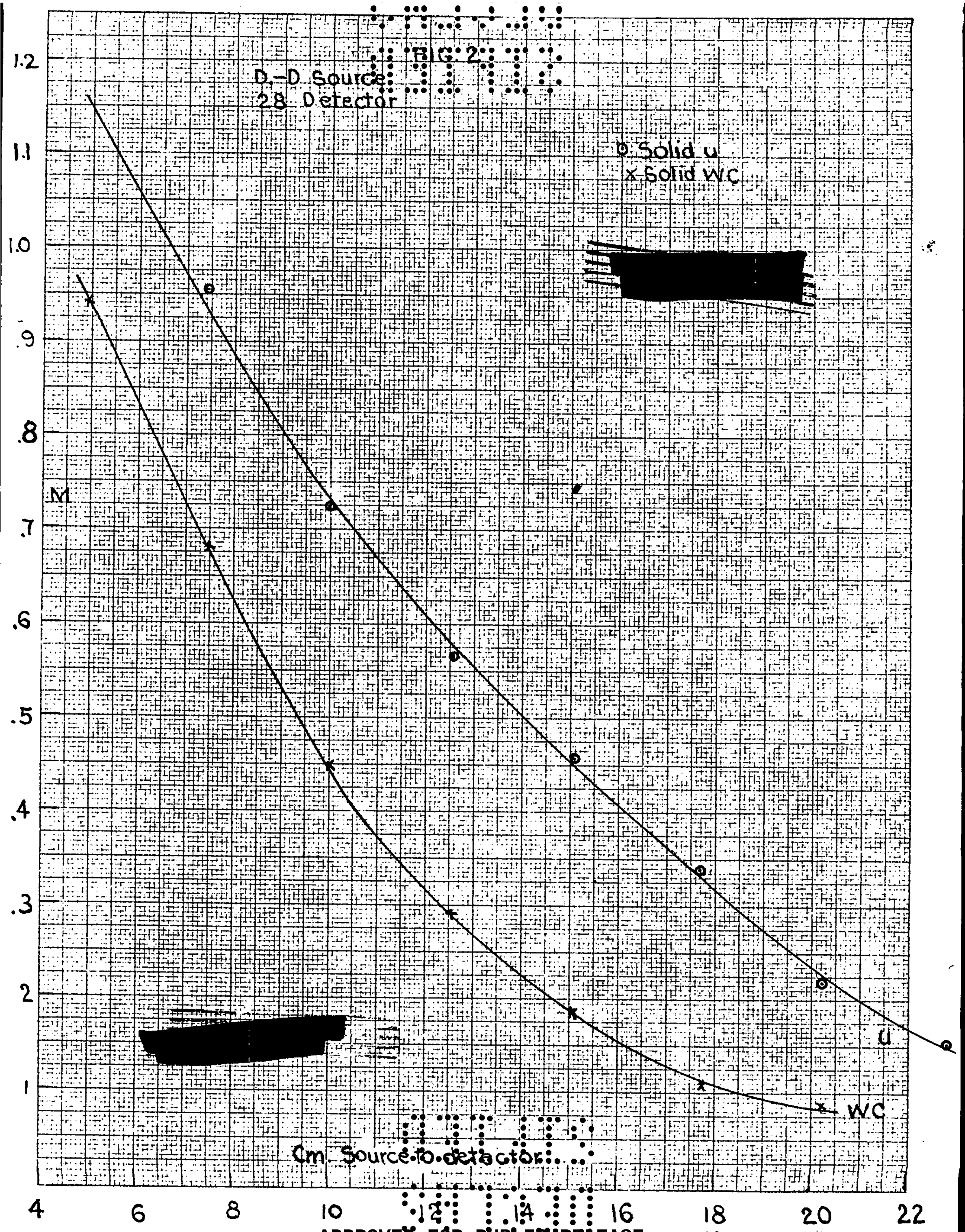


FIG. 1

LEGEND
Cooling Slot ~ 3/4" x 3/4"
Target Slot ~ 3/4 x 3/4"
Monitor Slot ~ 5/8 x 5/8"
Chamber Slot ~ [illegible] x 1 1/32"
Scale ~ 1/2



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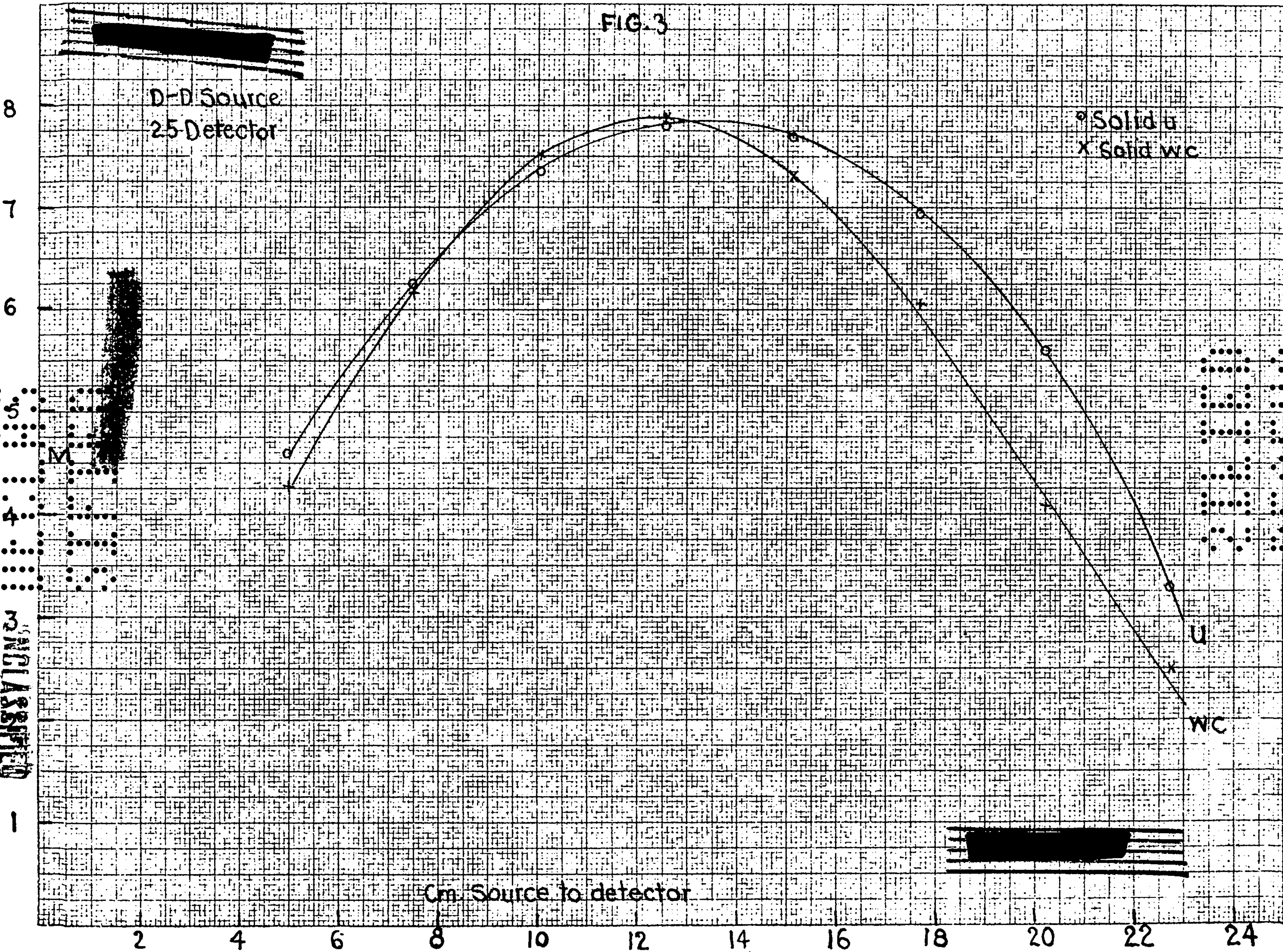
FIG. 3
[redacted]
D-D Source
2.5 Detector
o Solid U
x Solid WC
U
WC
[redacted]
Cm. Source to detector
8
7
6
5
4
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