Technical Note for Tuning Input Coupler

at the RF Test Stand

When a new input coupler is installed at the rf test stand it will need to be adjusted for the best match so most of the applied power will enter the cavity and not be reflected back to the driving amplifier.

Persons working in the test stand room must have locks on both closed shutters and safety shoes and glasses.

When the mechanical/vacuum personnel install the new coupler it must be positioned with the loop close to vertical at about one o'clock. If a tuning mark is not visible on the outer retaining ring along the degree placard then install one with a marker. The coupler must be left loose enough to be rotated and an "N" type transition installed as shown in fig.1. Also shown in fig.1 is the coaxial connection to the network analyzer.

With the analyzer connected,(S11), adjust frequency of the cavity manually by rotating the mechanical tuner to be at 351.927 Mhz. After adjusting this and the analyzer display(you will need about 30-40 dB dynamic range) you can perform a calibration on the analyzer. Now you are ready for tuning.

Make a note of the coupler position from the alignment placard using the mark previously scribed with the marker(fig.1). When the analyzer reads a return loss of 20dB or better preliminary tightening can begin. The coupler must be rotated clockwise in increments of about 5-10 degrees,and you need to keep track of tuning progress by writing down loss versus rotation degrees as you go. When the next adjustment or two produces worse return losses,you can back up to the last best setting and ask the mechanical/vacuum personnel to begin tightening the flange bolts to what they describe as "if we make it any tighter we will have to replace the gasket if we need to loosen the bolts and rotate the coupler more".

At this point you must decide if the return loss is good enough after preliminary tightening to continue to make the flange vacuum tight. It is a good idea to make a plot of the preliminary return loss to compare to the vacuum tight results. If the return loss degrades to less than 20db after vacuum tightening then the system must be dis-assembled,a new gasket installed,and tuning performed again. Make a plot of the final measurement for future use.

The "N" transition can now be removed and the waveguide connected to the rf system.

In reality this process is more difficult due to two factors. First the loose coupler causes intermittent readings on the network analyzer,meaning that your chart of losses versus degrees of rotation may have to be made at preliminary tightening level. Second

the return loss always changes when the coupler is tightened to vacuum tight,which means that you really don't know if you have failed or not until then.

Figure 1-Tuning set-up for test stand coupler.

RF Cavity Input Coupler Replacement (Mechanical)

1). Perform proper LOTO procedures.

2). Have the RF cavity vented by qualified vacuum technicians.

3). Valve out the ¾" rigid water lines that supply the coupler, drain the ¾" lines.
Optional LOTO of the isolation valves is recommended for protection of vacuum surfaces from water contamination.

4). Remove water hoses, blower hoses, infrared temperature sensors, and thermocouples from the coupler and waveguide transition.
Coupler body water hoses may sometimes be removed after waveguide transition removal, if no interference exists between the water fittings and the coupler/waveguide inside flange screws.

5). Remove the ¼-20 socket head screws from the coupler/waveguide contact ring.

6). Remove the ½-13 waveguide flange bolts from the top flange of the waveguide transition. Using the waveguide alignment tool attached to the ceiling of the tunnel, raise the section of waveguide above the transition evenly on all four corners, approximately 1/8".
After loosening the jam-nuts on the waveguide tool turnbuckles, the turnbuckles should turn freely by hand.
If they don't, do not force them or use a wrench to turn them. This indicates a "hang-up" of the waveguide or some other problem that will need to be investigated before proceeding.

7). Remove the ¼-20 socket head screws from the coupler/waveguide inside flange.

8). Carefully remove the waveguide transition by sliding it out away from the coupler on the transition support.

9). The coupler can now be removed by qualified vacuum technicians.
Vacuum technicians should note the approximate radial position of the e-probe (e.g. 11 O'clock) before removal.

10). Vacuum technicians can now install the new coupler and copper gasket on the cavity, aligning the e-probe as noted in step 9. All vacuum flange bolts should be installed "snug" at this point.

11). Install the waveguide transition onto the transition support, and carefully slide it over the coupler. Some alignment of the retaining ring (located on the inside of the transition) to the counterbored recesses on the coupler/waveguide inside flange may be necessary to insure proper contact.

12). Inspect the position of the coupler relative to the waveguide transition. There should be an equal gap radially between the coupler center conductor head and the waveguide transition. There should be no visible gap between the coupler/waveguide inside flange and the waveguide transition.

13). Install and fully tighten the ¼-20 socket head screws on the coupler/waveguide inside flange.

14). Lower the section of waveguide above the transition using the waveguide alignment tool. **DO NOT LOWER THE WAVEGUIDE WITH THE WAVEGUIDE FLANGE BOLTS IN PLACE.** Be careful not to apply too much downward pressure to the transition. Once the alignment turnbuckles go loose (contact with the transition), turn them slightly, (approx. 1/4 turn), in the opposite direction. Check each waveguide flange bolt hole with a ½-13 flange bolt. If some bolts do not line up, lateral alignment of the waveguide tool will be necessary. Raise the waveguide slightly and use the lateral adjustment turnbuckles to reposition the waveguide in the desired direction. **DO NOT ADJUST THE WAVEGUIDE IN ANY DIRECTION WITH THE WAVEGUIDE FLANGE BOLTS IN PLACE.** Lower the section of waveguide above the transition and check the waveguide flange bolt holes again. Several iterations may be necessary before all bolt holes line up. Once all holes line up, install and fully tighten bolts in the 4 corners, and center of waveguide positions. Tighten the jam-nuts on the waveguide tool turnbuckles.

15). Loosen the ¼-20 socket head screws on the coupler/waveguide inside flange.

16). Slightly tighten 8 evenly spaced coupler vacuum flange bolts.

17). The coupler is now ready to be measured by qualified RF Group personnel. If measurements are acceptable, the remaining vacuum flange bolts may be slightly tightened, and the remaining coupler/waveguide inside flange screws may be fully tightened. The coupler is now ready to be measured again.

18). If measurements performed in step 17 are unacceptable, loosen all coupler vacuum flange bolts, all coupler/waveguide contact ring screws, and all coupler/waveguide inside flange screws. Using a strap wrench(fig. 2) around the coupler body, turn the coupler in the desired direction as directed by RF Group personnel (more coupling = loop/e-probe toward 3 or 9 O'Clock; less coupling = loop/e-probe toward 12 or 6 O'Clock).

19). Repeat step 17.

20). After vacuum flange bolts are fully tightened, RF Group personnel may want to take another measurement before pumpdown of the system begins. The remaining waveguide flange bolts should be installed and fully tightened before this measurement is made.

21). Reconnect water lines, thermocouples, and blower hoses. Reinstall and reconnect infrared temperature sensors and lead shielding. Open ¾" isolation valves and check for water leaks. Check the RF screens for thermocouple and infrared readbacks.

Input coupler being rotated with strap wrench.