Attachment 1-1 **WAFER V-CONE CONDITIONS OF APPROVAL**

Wafer V-Cones installed at Federal and Indian points of measurement shall comply with the following requirements. The BLM may add, modify, or delete requirements if additional data for the Wafer V-Cone become available.

1. The nominal pipe size shall not be less than 2" or greater than 4".

2. The Beta Ratio shall not be less than 0.45 or greater than 0.65.

3. a. The Wafer V-Cone shall be installed with the following minimum lengths of straight and uninterrupted pipe, expressed in nominal pipe diameters [upstream/downstream]:

Nominal Size	**Beta Ratios**				
	.45	**.50**	**.55**	**.60**	**.65**
2"	5/1	5/1	5/1	5/1	5/1
3"	5/2	5/1	5/1	5/1	5/1
4"	5/2	5/1	5/1	5/1	5/1

For example, a 4" Wafer V-cone with a 0.45 Beta Ratio needs to have 20" (5 x 4") of straight and uninterrupted pipe upstream of the meter body, and 8" (2 x 4") of straight and uninterrupted pipe downstream of the meter body.

b. Wafer V-Cones with Beta Ratios of 0.45 may be installed with zero diameters upstream if the upstream piping consists of two out-of-plane, close-coupled (less than 2 diameter separation) 90^{o} elbows, with at least 5 diameters of straight piping upstream of the first elbow. The required length of downstream pipe shall be the same as that specified in the table in Part a, above.

c. Required lengths of straight and uninterrupted pipe shall be free of any protrusions and pipe connections including thermowells, gas sampling ports, welds, and gaskets extending into the pipe inside diameter.

d. Thermowells may be placed upstream or downstream, but shall be placed no closer than the minimum upstream or downstream pipe length shown in Part a, above, and no further than 20 nominal pipe diameters from the meter body.

4. The Wafer V-Cone shall be removed and visually inspected at least once every 6 months. The Wafer V-Cone shall be replaced if any perceptible wear is detected without magnification. During the inspection, the operator shall have available to the BLM a Wafer V-Cone in "new" condition for the purpose of comparison.

5. The Beta Ratio and Discharge Coefficient for each Wafer V-Cone shall be maintained onsite and shall be accessible to the BLM without the need for any special equipment.

6. The Discharge Coefficient shall be determined by testing over the appropriate Reynolds Number range given in Condition 9. Reynolds numbers outside of this range shall not be used in the determination of discharge coefficient.

Attachment 1-2

7. If an Electronic Flow Computer (EFC) is used for secondary and tertiary instrumentation, it shall be subject to the requirements of any NTLs or Orders that apply to Electronic Flow Computers for orifice plates or differential types of meters.
8. If a chart recorder is used for secondary instrumentation, requirements III.C.7 and III.C.12-19 of Order No. 5 will be in full force and effect.
9. The meter installation shall operate within the following Reynolds Number limits [low/high]:

Nominal Size	**Beta Ratios**				
	.45	**.50**	**.55**	**.60**	**.65**
2”	26/302	48/302	90/302	90/302	90/302
3”	50/302	48/302	90/302	90/302	90/302
4”	50/530	48/522	90/522	90/522	90/528

Note: values given are Re/1000

10. For meters flowing more than 100 Mcf/day on a monthly basis:
    a. If an EFC is used for secondary and tertiary instrumentation, the meter station (primary, secondary, and tertiary devices) shall be installed, operated, and maintained to achieve an overall meter station uncertainty of ±3% for the majority of the flowing period.
    b. EFCs must be used instead of chart records if the Beta Ratio of the Wafer V-Cone is greater than 0.45.
    c. If chart recorders are used (less than 0.45 Beta Ratio only), then the pens that record differential and static pressure shall record at or above the percentages of chart range shown in the following table, for the majority of the flowing period:

Beta	2”	3”	4”
0.45	35%	50%	50%

    d. The meter installation shall operate at or below the following Differential Pressure to Static Pressure (DP/SP) ratios:

Nominal Size	**Beta Ratios**				
	.45	**.50**	**.55**	**.60**	**.65**
2”	.2682	.1402	.0692	.0546	.0546
3”	.2682	.1402	.0692	.0546	.0546
4”	.2682	.1402	.0692	.0546	.0546

Note: these are dimensionless values