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CONSIDERATIONS AND SPECIFICATIONS FOR UNIVERSAL VISCOSITY CURVE

INTRODUCTION

Turbine flowmeters exhibit a performance which is dependent upon the viscosity of the fluid to be measured. The viscosity effects on turbine flowmeter performance are discussed in Tech Note 19.

A unique form of presenting the calibration characteristic (or K Factor) for a turbine flowmeter targeted for service in varying viscosity fluids is the Universal Viscosity Curve. The Universal Viscosity Curve is a semilog plot of K Factor as a function of the ratio of output frequency (Hz) to kinematic viscosity (cstk). Application of the Universal Viscosity Curve is discussed in Tech Note 4.

When it is desired to use a turbine flowmeter in varying viscosity fluids, it is necessary to properly specify the testing and documentation for the flowmeter in addition to the configuration, flow range and materials of construction.

SPECIFICATION OF DOCUMENTATION FOR A UNIVERSAL VISCOSITY CURVE

In general, any flowmeter size may be supplied with a Universal Viscosity Curve. However, since smaller meter sizes (under one inch) display the largest sensitivity of calibration factor to viscosity, it is this size range which are the most likely to be considered candidates for a Universal Viscosity Curve.

Begin by determining the minimum and maximum viscosity and flow rates to be encountered in the application.

From the required flow rates, choose a suitable meter size based on the linear range chart published for the flowmeter family.

The materials of construction should be compatible with the media to be measured. Ball Bearings are commonly used within turbine flowmeters since their use results in superior performance. However, ball bearings are available only in 440C stainless steel which is the least chemically resistant material of which the flowmeter's components are commonly constructed.

The end fitting configuration should be chosen based on convenience and the operating pressures which will likely occur at the point of measurement.

The choice of pickoff type, either a standard magnetic pickoff or an option modulated carrier pickoff is often dictated by the flowmeter size, flow range and viscosity. It is often necessary to consult with the manufacturer on a decision whether a magnetic pickup may be substituted for the modulated carrier pickoff type usually required for small turbine flowmeters in service on varying viscosity fluids.

The specification of the viscosity conditions at which the flowmeter will be calibrated are chosen to represent the expected viscosity range required by the application from among those viscosities available from the testing laboratory.

Conventionally, 1, 5, 25, and 100 centistokes are used to generate a Universal Viscosity Curve. However, only those viscosities need be tested which represent those the flowmeter will see in actual service. For example, if the media has a viscosity of from 3 to 20 centistokes, a cost savings is realized by not specifying viscosity testing at 100 centistokes.

Observe that testing on water (1 cstk) is usually provided in the base price of the flowmeter and should be requested since it does not result in additional cost to the user.

The choice of test viscosities of 1, 5, 25, etc., centistokes results in an overlap of 20% on the individual test segments of a Universal Viscosity Curve. See Figure 1. While this overlap is adequate for most requirements, some users prefer to specify additional testing.

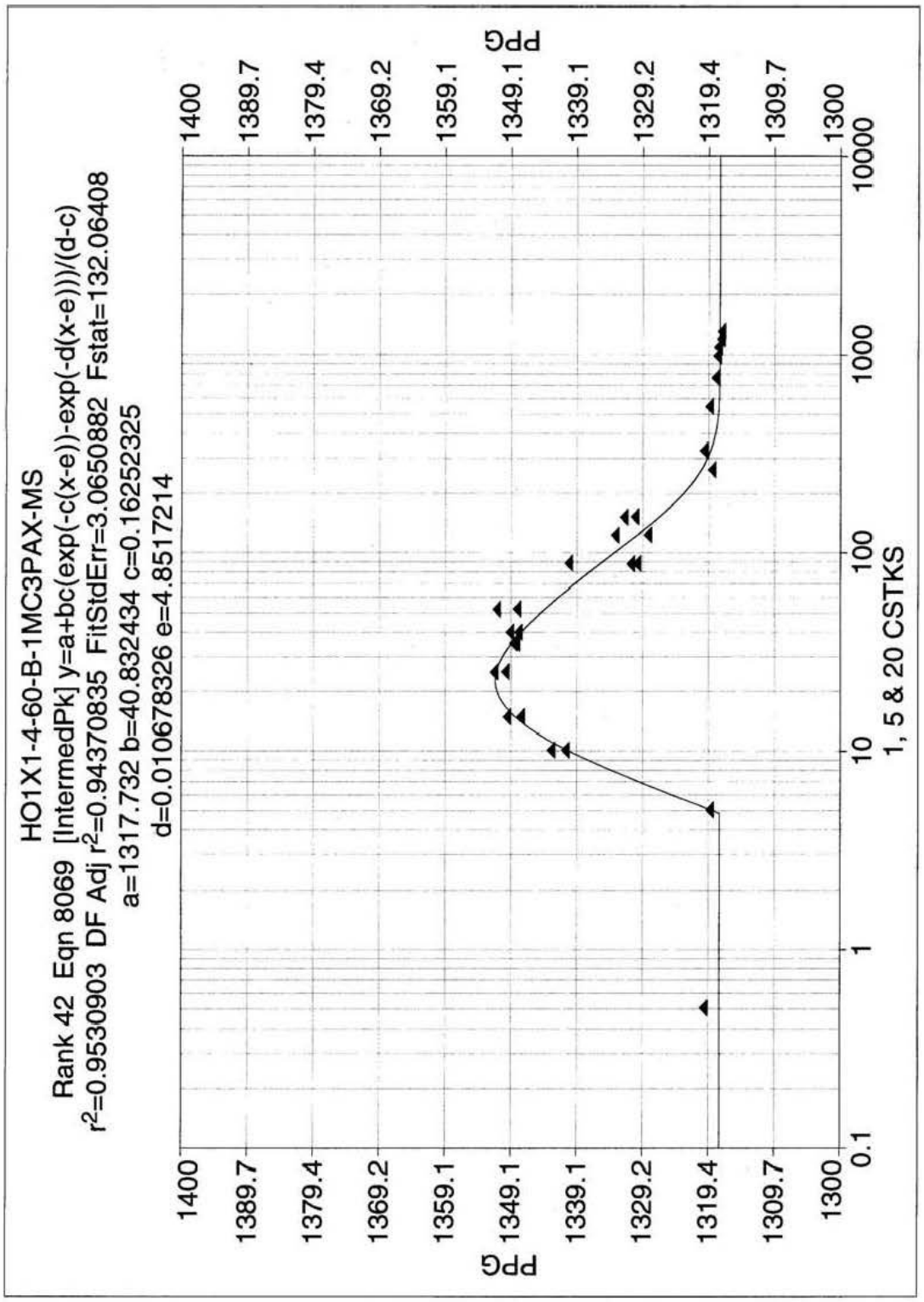
In order to minimize setup time between tests, turbine flowmeters calibrated at Hoffer Flow Controls are performed in groups which are to undergo similar testing. Commonly tested viscosities are 1, 5, 10, 15, 20, 25 and 50 centistokes. Figure 2 shows the product flow diagram during the testing sequence. Two individuals are involved, the test technician and the test engineer.

The test engineer specifies the viscosities and flow range, as well as, the output frequencies on the test log. Data taken by the test technician is reduced by a computer program and reviewed by the test engineer prior to completing the Universal Viscosity Curve. At the discretion of the test engineer, additional data points may be taken at no expense to the end user, to clarify certain regions of the Universal Viscosity Curve.

SUMMARY

With a properly specified test program a Universal Viscosity Curve similar to that shown on Figure 1, results where the individual viscosity tests form over lapping segments on the Universal Viscosity Curve.

The range of application of both the flow rate and viscosity is listed on each Universal Viscosity Curve.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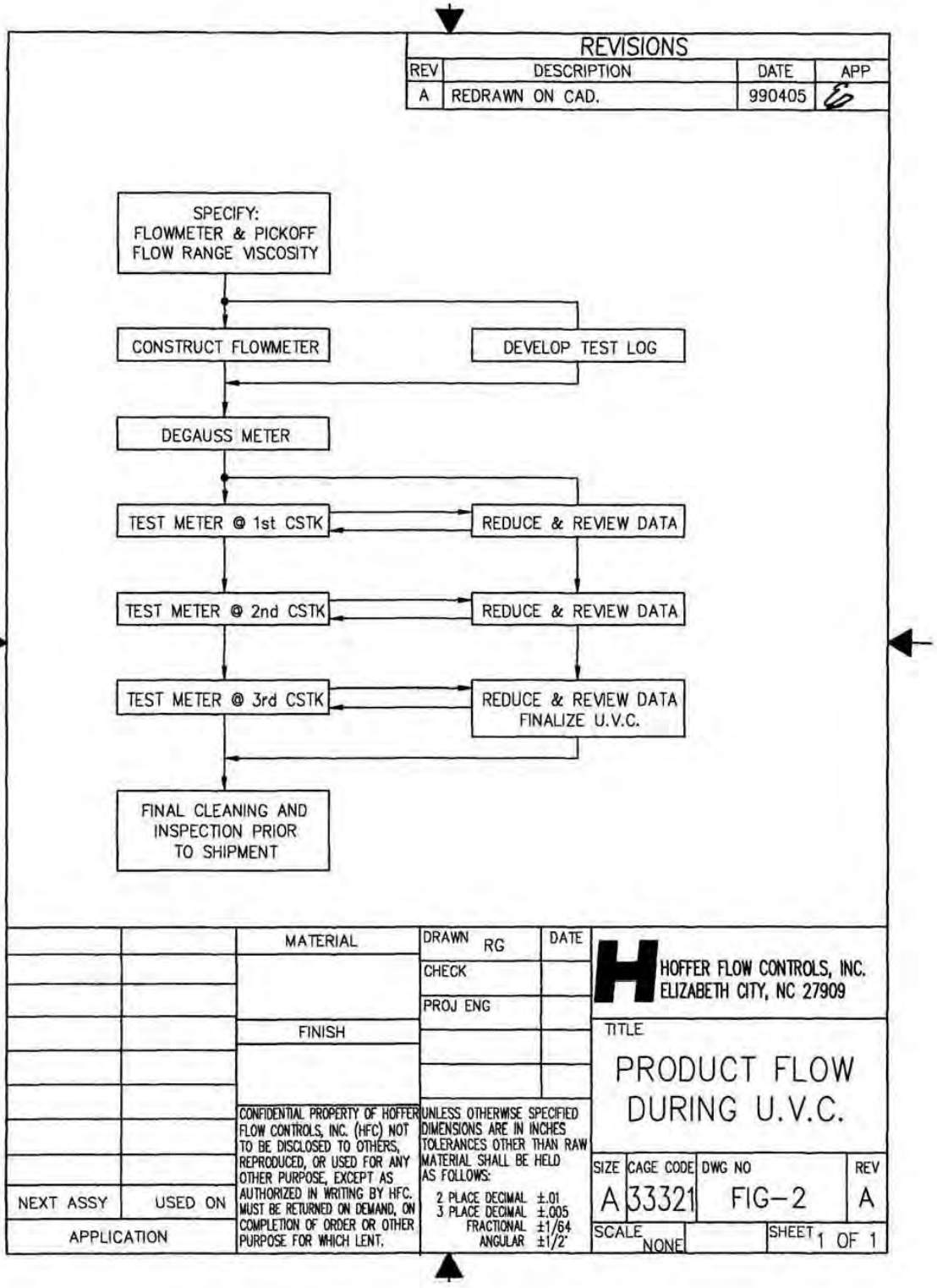
Rank 42 Eqn 8069 [IntermedPk] y=a+bc(exp(-c(x-e))-exp(-d(x-e)))/(d-c)
r²=0.9530903 DF Adj r²=0.94370835 FitStdErr=3.0650882 Fstat=132.06408
a=1317.732 b=40.832434 c=0.16252325
d=0.010678326 e=4.8517214
PPG
1400
1389.7
1379.4
1369.2
1359.1
1349.1
1339.1
1329.2
1319.4
1309.7
1300
0.1
1
10
100
1000
10000
1, 5 & 20 CSTKS


REVISIONS
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A
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990405
SPECIFY:
FLOWMETER & PICKOFF
FLOW RANGE VISCOSITY
CONSTRUCT FLOWMETER
DEVELOP TEST LOG
DEGAUSS METER
TEST METER @ 1st CSTK
REDUCE & REVIEW DATA
TEST METER @ 2nd CSTK
REDUCE & REVIEW DATA
TEST METER @ 3rd CSTK
REDUCE & REVIEW DATA
FINALIZE U.V.C.
FINAL CLEANING AND
INSPECTION PRIOR
TO SHIPMENT
MATERIAL
FINISH
NEXT ASSY
USED ON
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PROJ ENG
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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES OTHER THAN RAW MATERIAL SHALL BE HELD AS FOLLOWS:
2 PLACE DECIMAL ±.01
3 PLACE DECIMAL ±.005
FRACTIONAL ±1/64
ANGULAR ±1/2°
HOFFER FLOW CONTROLS, INC.
ELIZABETH CITY, NC 27909
TITLE
PRODUCT FLOW
DURING U.V.C.
SIZE
A
CAGE CODE
33321
DWG NO
FIG-2
REV
A
SCALE
NONE
SHEET
1 OF 1