API RP 13C - An Explanation & FAQ's

Summary:
API has revised the shale shaker screen testing procedures and numbering convention. By using the new API Screen Number, confusion among screen types is reduced and comparison between screen types can be made fairer. Some screens which may previously have been named "200 mesh" may now have an API Screen Number of only 100 to 140. However, ALL screens which are tested according to RP13C and have the same API Screen Number will remove solids of a similar size.

Note: The change from using D_{50} to D_{100} (50% of a specific particle size removed versus 100%) will change the rating of most screens – the extent of the change being dependent upon screen type/design.

The new number describes the size at which particles will be rejected (removed) under laboratory test conditions. The new API number is NOT intended to describe how the screen (or indeed the shaker) will operate in the field. This will depend upon several other parameters such as fluid type & properties, shaker design, operating parameters, ROP, bit type, etc.

The greatest value of the new numbering system is that ALL conforming screens are measured using the same process which will allow cross-comparison of screen designs/types based on a uniform solids size removal value.

Any manufacturer labeling their screens as "conforming to API RP 13C" must supply the test data for that screen upon request to the end user/purchaser.

Definitions:

Mesh
Mesh, as it relates to a piece of woven wirecloth, is a measure of the number of holes in a linear inch (such as 100 mesh) or in a linear inch in each direction (such as 100 x 60 mesh).

D_{50} Cut Point
The D_{50} cut point of a screen is the particle size at which half of those particles reporting to the screen will pass through the screen and half will be retained.

D_{100} Cut Point
The D_{100} cut point of a screen is the largest particle size which will pass through the screen.

API Screen Number
The API Screen Number is determined using a specific test procedure (as set out in API RP 13C). The test uses a specifically graded sample of Aluminum Oxide which is passed through a stack of sieves – including the test sieve – and mounted on a Tyler Ro-Tap®.

The method determines the D_{100} cut point of the test screen and relates it to the D_{100} of an 'equivalent' standard ASTM test sieve.

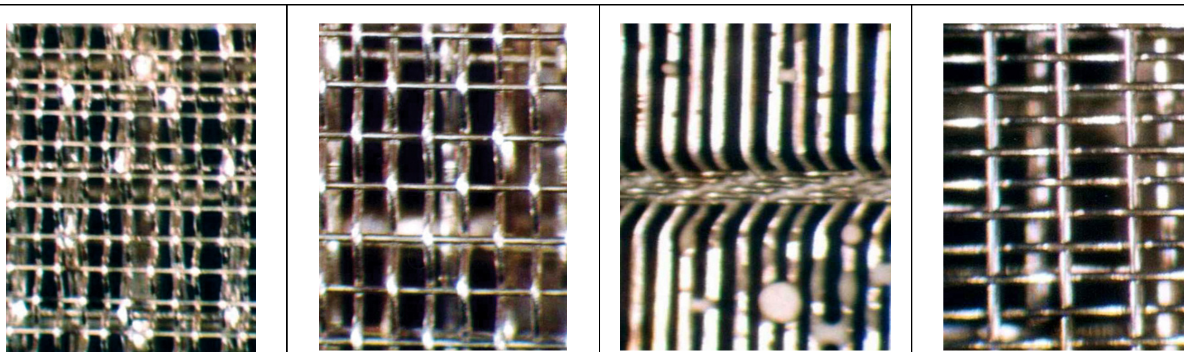
Screen Conductance
Conductance, measured in kilodarcies per millimeter (kD/mm), defines a Newtonian fluid's ability to flow through a unit area of screen in a laminar flow regime under prescribed test conditions. All other factors being equal the screen with the higher conductance number should process more flow.

Non-Blanked Area
The non-blanked area of a screen describes the net unblocked area in square feet (ft^2) or square meters (m^2) available to permit the passage of fluid.

Background

The use of the term "mesh" (when considering the capabilities of shaker screens) was made obsolete by the introduction of oblong mesh and multi-layer screens which resulted in variations in 'aperture sizes'.

The following photomicrographs (60x) show four different screens from four different manufacturers.



Labeled 200 mesh Actual: API 200 (88 microns)	Labeled 175 mesh Actual: API 80 (173 microns)	Labeled 200 mesh Actual: API 60 (234 microns)	Labeled 180 mesh Actual: API 80 (173 microns)

Figure 1: Demonstration of the Confusion Caused by 'Non-Standard' Screen Nomenclature

Rig-based personnel continued to rely on the 'mesh number' indicated by the manufacturer. This may have borne little relationship to the actual separation potential of the screen being used. Hence, comparison of screens from different manufacturers (or even across one manufacturer's series) could be difficult or inaccurate.

In December 2004, the API passed RP13C – titled "Recommended Practice on Drilling Fluids Processing Systems Evaluation". The practice combined and updated two previous separate documents RP13C and RP13E. This document was also passed by ISO as ISO13501.

RP13C covers a number of subjects relating to fluids treatment systems. However this tutorial only addresses screen testing (cut point and conductance), classification and labeling.

API Screen Number Determination

RP13C describes a method to define and compare the absolute (or D_{100}) separation potential of any shale shaker screen to an equivalent standard ASTM test sieve. A representative section of the screen is mounted in a holder (Figure 2) and is placed in the middle of a stack of ASTM test sieves (calibrated according to ASTM E-11). Using a Ro-Tap® (Figure 3) a defined amount of dry Aluminum Oxide is sieved and the results collated and graphed. The test is repeated three times and the results from each test are then averaged to determine the D_{100} cut point.

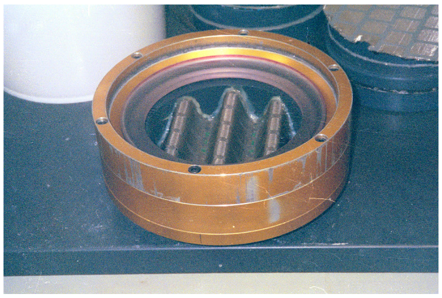


Figure 2: Test Screen Mounted in Holder

Figure 3: Ro-Tap with Test Screen and Sieve Stack

This cut point is the absolute or D_{100} cut point. Any particle larger than this value will not pass through the screen. The cut point is cross-referred to Table 5 in the RP13C document (Table 1 in this article) and compared to standard ASTM sieves of known separation ability.

For example, if the measured D_{100} cut point of the test screen is 114.88 microns (114.88µ), the table indicates that it compares to the ASTM 140 sieve. The test screen would then be classified as an API 140 screen.

D_{100} (µ)	API Screen Number
>462.5 to 550.0	API 35
>390.0 to 462.5	API 40
>327.5 to 390.0	API 45
>275.0 to 327.5	API 50
>231.0 to 275.0	API 60
>196.0 to 231.0	API 70
>165.0 to 196.0	API 80
>137.5 to 165.0	API 100
>116.5 to 137.5	API 120
>98.0 to 116.5	API 140
>82.5 to 98.0	API 170
>69.0 to 82.5	API 200
>58.0 to 69.0	API 230
>49.0 to 58.0	API 270
> 41.5 to 49.0	API 325
>35.0 to 41.5	API 400
> 28.5 to 35.0	API 450

Table 1: D_{100} Cut Point and API Screen Number

Important Note: RP13C states that this test describes the openings of the screen and does not predict the performance of the screen in the field. However, if all other variables are equal, a screen with a higher API Screen Number (smaller holes) should remove more and finer solids.

Comparison with RP13E

The predecessor to the new RP13C was called RP13E. This (now obsolete) procedure used a light source, a microscope and a computer system to measure the size and distribution of apertures within a screen. Values for D_{16}, D_{50}, and D_{84} were calculated from the results.

The D_{50} was called the 'mean' value and was generally considered the primary cut point used to 'name' the screen. Figure 4 illustrates how screens classified by their D_{50} (75 µ) could have very different D_{100} values. The graph also shows a comparison with the standard ASTM 200 sieve.

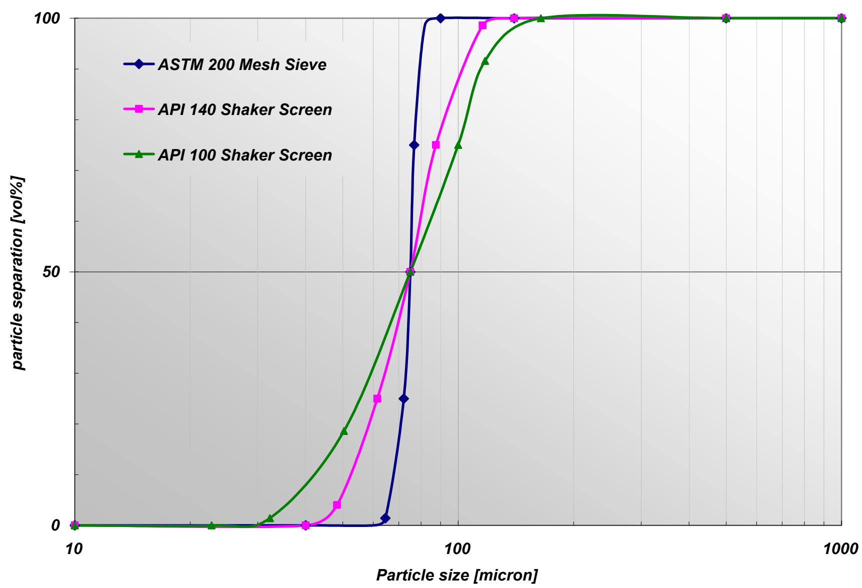


Figure 4: Impact of API RP 13C on Screen Nomenclature

Figure 5 shows a significant difference between the D_{50} (RP13E) and the D_{100} used in the new procedure.

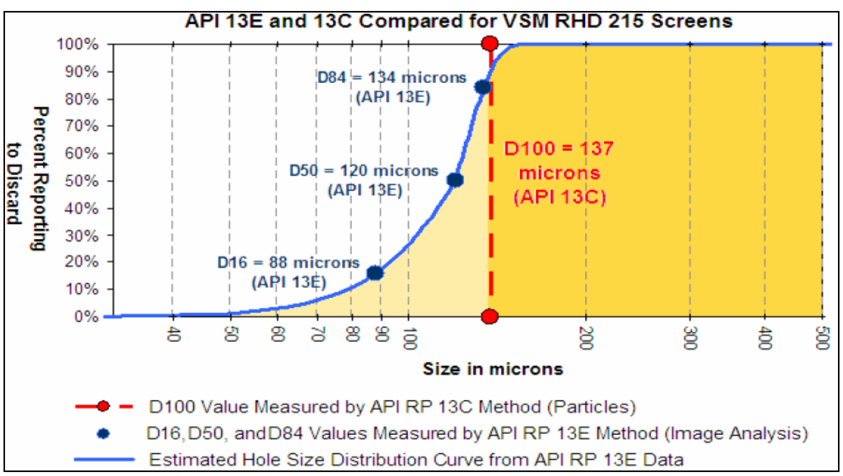


Figure 5: Comparison of API RP13E (old) and API RP 13C (new) (courtesy of Brandt NOV)

The change from RP13E to RP13C is a positive step because the new procedure moves away from measuring openings in the screen to an actual physical test using real solids.

One further advantage of RP13C is that any screen with any aperture shape can be tested using the same procedures.

Rig Site Performance

RP13C does not predict rig site performance given the myriad combinations of screens, shakers, fluids, flow-rates, solids loadings, etc. Performance will depend upon various factors including the properties of the fluid, the operational parameters of the shaker and the particle size distribution of the drilled solids presented to the screens.

Labeling Requirements

RP13C states that the designation system (labeling) will consist of no fewer than the following minimum elements:

1. **API Screen Designation or API number (this must be 2X larger than any other information);**
2. **D_{100} (Equivalent Aperture) in microns (μ);**
3. **Conductance in kilodarcies per millimeter (kD/mm);**
4. **Non-blanked screen area in square meters (m^2) or square feet (ft^2);**
5. **Manufacturer's Designation and/or Part Number** (although not currently required to conform to API 13C, API recommends manufacturers use the API screen designation in the part number)
6. **Conforms to API 13C**

The following information is optional (but recommended):

1. **Manufacturer's name**
2. **Application or description**
3. **Country of origin**
4. **Lot number**
5. **Date of manufacture**
6. **Order number**
7. **Bar code**

The label/tag must be permanently attached to the screen in a visible place. Examples are shown in Figures 7 & 8.

API NUMBER (D_{100} Separation, microns) Conductance, yy kD/mm Non-blanked area: xx m^2 or ft^2 Conforms to API RP 13C	Manufacturer's designation	API 170 (92 microns) Conductance: 1,4 kD/mm Non-blanked area: 0,67 m^2 Conforms to API RP 13C	Polygon Plus 170 Screen, Inc. Shaker XYZ Made in USA Lot 456 / 07.08.2009 Order No. 101112 Polygon Plus 170

Figure 7: Horizontal Labeling Format and Example

API NUMBER	API 170
(D_{100} Separation, microns)	(92 microns)
Conductance, yy kD/mm	Conductance: 1,4 kD/mm
Non-blanked area: xx m^2 or ft^2	Non-blanked area: 0,67 m^2
Conforms to API RP 13C	Conforms to API RP 13C
Manufacturer's designation	Polygon Plus 170 Screen, Inc. Shaker XYZ Made in USA Lot 456 / 07.08.2009 Order No. 101112 Polygon Plus 170

Figure 8: Vertical Labeling Format and Example

<u>Putting the Label to Use</u>

Because screens that conform to RP13C have all been tested using the same procedure, the labels are very helpful when it comes to comparing different screens.

For example, if it is determined that there is a need for the cut point provided by an API 170 screen then a screen labeled API 170 can be selected <u>regardless of the manufacturer of the screen</u>.

All other factors being equal the screen with the higher conductance number should process more flow.

Alternatively, if there is excess shaker capacity but longer screen life is desired, selecting a screen with larger diameter wires and perhaps more bonding material should provide increased screen life.

Using screens conforming to RP13C can help the operator can make a more informed decision.

<u>Conclusion</u>

By specifying screens that conform to RP13C, much of the previous confusion can be eliminated and screen selection/comparison simplified.

FAQs Regarding RP13C

1. ***What is the D_{100}?***
   a. The D_{100} cut point of a screen is the largest particle size which will pass through the screen.
   b. D_{100} is a single number determined from a prescribed laboratory procedure – the results of the procedure should yield the same value for any given screen.
   c. The D_{100} should not be compared in any way to the D_{50} value used in RP13E.
   d. The method used in RP13C provides only the D_{100} value with no provision for D_{16}, D_{50}, or D_{84} values.

2. ***What does the API Screen Number tell us?***
   a. The API Screen Number corresponds to the API defined range of sizes into which the D_{100} value falls.

3. ***What does the API Screen Number NOT tell us?***
   a. The API Screen Number is a single number which defines solids separation potential under specific test conditions. It does NOT define how a screen will operate on a shaker in the field as this will depend upon several other parameters such as fluid type & properties, shaker design, operating parameters, ROP, bit type, etc.

4. ***Will a screen with a D_{100} of 172µ remove solids finer than 172µ?***
   a. By definition, every particle of the D_{100} size or coarser will be discarded.
   b. In practice some portion of solids finer than 172µ may be removed.

5. ***Why is there such a large variance between the old and new labeling values?***
   a. The biggest variation is due to the shift from using D_{50} to D_{100}.
   b. The previous test procedure (RP13E) measured the distribution of the apertures in the screen. RP13C uses a physical and repeatable test using actual solids (dry aluminum oxide) which measures the coarsest particle that can pass through the screen.

6. ***Should I use the old screen number or the new API Screen Number when ordering replacement screens?***
   a. Although some companies are changing their part numbers to reflect their conformance to RP13C, others are not. It is therefore best to specify the RP13C value you want.

7. ***Should I screen with a finer screen now if what used to be called a '200 mesh' screen is now labeled API 120?***
   a. Users are advised to determine the screens that work best in their applications regardless of what the new API Screen Number happens to be.

8. ***What is the practical value of RP13C to the end user?***
   a. RP13C provides an unequivocal procedure and benchmark for comparing different screens.
   b. The primary intent of RP13C is to provide a standard measuring system for screens