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Universal Multiple Octet Coded Character Set  
International Organization for Standardization  
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Международная организация по стандартизации

**Doc Type:** Working Group Document  
**Title:** Mathematical Arrows in FPDAM3  
**Source:** Asmus Freytag, Barbara Beeton, Murray Sargent  
**Status:** Expert comment on the ballot document  
**Action:** For consideration by JTC1/SC2/WG2 and UTC  
**Related:**

### Summary

In reviewing the FPDAM3 ballot document one of the authors noted a potential issue with the set of arrows encoded in that document. After further review and discussions, the authors arrived at a possible solution to prevent an issue. This solution is proposed here.

### Issue

In FPDAM3 a set of arrows is encoded to provide mirrored equivalents of certain embellished arrows for mathematical use. All but two of these arrows have embellishments that are mirror-symmetric. In other words, the embellishment on the arrow doesn't change, when an arrow is mirrored in bidirectional context, only the direction of the arrow does.

There are two arrows

U+2B41 REVERSE TILDE OPERATOR ABOVE LEFTWARDS ARROW  
U+2B42 LEFTWARDS ARROW ABOVE REVERSE ALMOST EQUAL TO

where the embellishment changes when being mirrored, for example from TILDE to REVERSE TILDE.

This means that unlike the other arrows these two can *only* be used for mirroring, and not also for indicating a reverse direction. This issue should be remedied as soon as possible, preferably in the context of AMD3, so as to remove possible confusion among the users when presented with a partial solution.

### **Proposed Remedy**

This problem can be remedied by adding the following four characters to the amendment, with code points and names as proposed here and glyphs to match their names in the obvious way.

U+2B47 REVERSE TILDE OPERATOR ABOVE RIGHTWARDS ARROW  
U+2B48 RIGHTWARDS ARROW ABOVE REVERSE ALMOST EQUAL TO  
U+2B49 TILDE OPERATOR ABOVE LEFTWARDS ARROW  
U+2B4A LEFTWARDS ARROW ABOVE ALMOST EQUAL TO

With these proposed additions, there are only two remaining arrows with asymmetric embellishments that are already encoded in the Standard and for which there are no proper mirror images. These arrows are:

U+2973 LEFTWARDS ARROW ABOVE TILDE OPERATOR  
U+2974 RIGHTWARDS ARROW ABOVE TILDE OPERATOR

This existing pair encodes the forward / backwards distinction, but does not provide the mirror images needed for mirroring. For mirror imaging the following pair of arrows would need to be added to the amendment:

U+2B4A LEFTWARDS ARROW ABOVE REVERSE TILDE OPERATOR  
U+2B4A RIGHTWARDS ARROW ABOVE REVERSE TILDE OPERATOR

with the character names and codes as proposed here, and glyphs to match their names in the obvious way.

### **Further Background**

In the Standard, arrows are not mirrored automatically by using a mirrored glyph, but require the use of a different character code for left-to-right and right-to-left direction. That's the reason why for arrows, mirror images must be encoded, whereas the same is not true for integrals, for example.

### **Requested additions**

- 2B47 REVERSE TILDE OPERATOR ABOVE RIGHTWARDS ARROW
- 2B48 RIGHTWARDS ARROW ABOVE REVERSE ALMOST EQUAL TO
- 2B49 TILDE OPERATOR ABOVE LEFTWARDS ARROW
- 2B4A LEFTWARDS ARROW ABOVE ALMOST EQUAL TO
- 2B4B LEFTWARDS ARROW ABOVE REVERSE TILDE OPERATOR
  - \* mirror image of 2973
- 2B4C RIGHTWARDS ARROW ABOVE REVERSE TILDE OPERATOR
  - \* mirror image of 2974