Maclaurin Series for Functions with Removable Singularities

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When is a Maclaurin series not a Maclaurin series? As silly as this questions sounds, it is often confusing to students (and instructors) when a function *f*(*x*) does not satisfy the assumptions of continuity and differentiability necessary for generating a Maclaurin series using the standard formula

$$f(x) = f(0) + xf'(0) + \frac{x^2}{2!}f''(0) + \frac{x^3}{3!}f'''(0) + \ldots + \frac{x^n}{n!}f^{(n)}(0) + \ldots$$

$$= \sum_{k=0}^{\infty} \frac{x^k}{k!} f^{(k)}(0) \qquad (1)$$

Yet, by a sleight of hand (substitution, arithmetic operation of both sides of an equation, etc.) we produce a new series from an existing one and claim that it is the Maclaurin series for the given function.