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Modul:Val

This module implements **Vorlage:TI**.

The following modules are developed:

- **Module:Val** • Main module.
- **Module:Val/units** • Definitions for units built-in to val.

Use **Vorlage:TI** for testing, for example:

- `{{val/sandbox|1234.5678|(23)|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|(23)|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=cm}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=cm|end=$|+errend=U$|-errend=L$}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|(23)|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|(23)|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=deg}}` → **Vorlage:Val/sandbox**
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=deg|end=$|+errend=U$|-errend=L$}}` → **Vorlage:Val/sandbox**

```
-- For Template:Val, output a number and optional unit.
-- Format options include scientific and uncertainty notations.

local data_module = 'Module:Val/units'
local convert_module = 'Module:Convert'

local function valerror(msg, nocat, iswarning)
    -- Return formatted message text for an error or warning.
    -- Can append "#FormattingError" to URL of a page with a problem to find
    local anchor = '<span id="FormattingError"></span>'
    local body, category
    if nocat or mw.title.getCurrentTitle():inNamespaces(1, 2, 3, 5) then
        -- No category in Talk, User, User_talk, or Wikipedia_talk.
        category = ''
    else
        category = '[[Category:Pages with incorrect formatting templates
    end
    iswarning = false -- problems are infrequent so try showing large error
    if iswarning then
```

```
        body = '<sup class="noprint Inline-Template" style="white-space:
                '[[Template:Val|<span title="" ..
                msg:gsub("'", '&quot;') ..
                "'>warning</span>]]</sup>'
    else
        body = '<strong class="error">' ..
                'Error in &#123;&#123;[[Template:val|val]]&#125;&#125;:
                msg ..
                '</strong>'
    end
    return anchor .. body .. category
end

local range_types = {
    -- No need for '&nbsp;-' because nowrap applies to all output.
    [","] = ", ",
    ["by"] = " by ",
    ["-"] = "- ",
    ["-"] = "- ",
    ["and"] = " and ",
    ["or"] = " or ",
    ["to"] = " to ",
    ["x"] = " x ",
    ["x"] = " x ",
    ["/"] = "/ ",
}
local range_repeat_unit = {
    -- WP:UNIT wants unit repeated when a "multiply" range is used.
    ["x"] = true,
    ["x"] = true,
}

local function extract_item(index, numbers, arg)
    -- Extract an item from arg and store the result in numbers[index].
    -- If no argument or if argument is valid, return nil (no error);
    -- otherwise, return an error message.
    -- The stored result is:
    -- * a table for a number (empty if there was no specified number); or
    -- * a string for range text
    -- Input like 1e3 is regarded as invalid for all except argument 1
    -- which accepts e notation as an alternative to the 'e' argument.
    -- Input commas are removed so 1,234 is the same as 1234.
    local which = index
    local function fail(msg)
        local description
        if which == 'e' then
            description = 'exponent parameter (<b>e</b>)'
        else
            description = 'parameter ' .. which
        end
        return description .. ' ' .. (msg or 'is not a valid number') ..
    end
    local result = {}
    local range = range_types[arg]
    if range then
        if type(index) == 'number' and (index % 2 == 0) then
            if index == 2 then
                if numbers[1] and numbers[1].exp then
                    return fail('cannot use a range if the f
                end
                numbers.has_ranges = true
            else
                if not numbers.has_ranges then
                    return fail('needs a range in parameter 2
```

```

        end
        end
        numbers[index] = range
        if range_repeat_unit[arg] then
            -- Any "repeat" range forces unit (if any) to be
            numbers.isrepeat = true
        end
        return nil
    end
    return fail('does not accept a range')
end
if numbers.has_ranges and type(index) == 'number' and (index % 2 == 0) then
    return fail('should be a range')
end
if index == 'e' then
    local e = numbers[1] and numbers[1].exp
    if e then
        if arg then
            return fail('cannot be used if the first parameter is e')
        end
        arg = e
        which = 1
    end
end
if arg and arg ~= '' then
    arg = arg:gsub(',', '')
    if arg:sub(1, 1) == '(' and arg:sub(-1) == ')' then
        result.parens = true
        arg = arg:sub(2, -2)
    end
    local a, b = arg:match('^(.+)[Ee](.+)')
    if a then
        if index == 1 then
            arg = a
        else
            result.exp = b
        end
        return fail('cannot use e notation')
    end
end
local isnegative, propersign, prefix
local minus = '-'
prefix, arg = arg:match('^(-)([d.]+)')
local value = tonumber(arg)
if not value then
    return fail()
end
if arg:sub(1, 1) == '.' then
    arg = '0' .. arg
end
if prefix == '' then
    -- Ignore.
elseif prefix == '±' then
    -- Display for first number, ignore for others.
    if index == 1 then
        propersign = '±'
    end
elseif prefix == '+' then
    propersign = '+'
elseif prefix == '-' or prefix == minus then
    propersign = minus
    isnegative = true
else
    return fail()
end
```

```
        result.clean = arg
        result.sign = propersign or ''
        result.value = isnegative and -value or value
    end
    numbers[index] = result
    return nil -- no error
end

local function get_args(numbers, args)
    -- Extract arguments and store the results in numbers.
    -- Return nothing (no error) if ok; otherwise, return an error message.
    for index = 1, 99 do
        local which = index
        local arg = args[which] -- has been trimmed
        if not arg then
            which = 'e'
            arg = args[which]
        end
        local msg = extract_item(which, numbers, arg)
        if msg then
            return msg
        end
        if which == 'e' then
            break
        end
        if index > 19 then
            return 'too many parameters'
        end
    end
    if numbers.has_ranges and (#numbers % 2 == 0) then
        return 'need a number after the last parameter because it is a range'
    end
end

local function get_scale(text, ucode)
    -- Return the value of text as a number, or throw an error.
    -- This supports extremely basic expressions of the form:
    --   a / b
    --   a ^ b
    -- where a and b are numbers or 'pi'.
    local n = tonumber(text)
    if n then
        return n
    end
    n = text:gsub('pi', math.pi)
    for _, op in ipairs({'/', '^'}) do
        local a, b = n:match('^(-?)' .. op .. '(.*)$')
        if a then
            a = tonumber(a)
            b = tonumber(b)
            if a and b then
                if op == '/' then
                    return a / b
                elseif op == '^' then
                    return a ^ b
                end
            end
            break
        end
    end
    error('Unit "' .. ucode .. '" has invalid scale "' .. text .. "'")
end

local function get_builtin_unit(ucode, definitions)
```

```

-- Return table of information for the specified built-in unit, or nil if
-- Each defined unit code must be followed by two spaces (not tab charact
local _, pos = definitions:find('\n' .. ucode .. ' ', 1, true)
if pos then
    local endline = definitions:find('%s*\n', pos)
    if endline then
        local result = {}
        local n = 0
        local text = definitions:sub(pos + 1, endline - 1):gsub(
        for item in (text .. '\t'):gmatch('(%.S.-)\t') do
            if item == 'ALIAS' then
                result.alias = true
            elseif item == 'ANGLE' then
                result.isangle = true
                result.nospace = true
            elseif item == 'NOSPACE' then
                result.nospace = true
            elseif item == 'SI' then
                result.si = true
            else
                n = n + 1
                if n == 1 then
                    local link, symbol = item:match(
                    if link then
                        result.symbol = symbol
                        result.link = link
                        n = 2
                    else
                        result.symbol = item
                    end
                elseif n == 2 then
                    result.link = item
                elseif n == 3 then
                    result.scale_text = item
                    result.scale = get_scale(item, uc
                else
                    result.more_ignored = item
                    break
                end
            end
        end
        if result.si then
            local s = result.symbol
            if ucode == 'mc' .. s or ucode == 'mu' .. s then
                result.unicode = 'μ' .. s -- unit code for
            end
        end
        if n >= 2 or (n >= 1 and result.alias) then
            return result
        end
        -- Ignore invalid definition, treating it as a comment.
    end
end
end

local function convert_lookup(unicode, value, scaled_top, want_link, si, options)
    local lookup = require(convert_module)._unit
    return lookup(unicode, {
        value = value,
        scaled_top = scaled_top,
        link = want_link,
        si = si,
        sort = options.sortable,
    })
}

```

```
end

local function get_unit(ucode, value, scaled_top, options)
    local want_link = options.want_link
    if scaled_top then
        want_link = options.want_per_link
    end
    local data = mw.loadData(data_module)
    local result = options.want_longscale and
        get_builtin_unit(ucode, data.builtin_units_long_scale) or
        get_builtin_unit(ucode, data.builtin_units)
    local si, use_convert
    if result then
        if result.alias then
            ucode = result.symbol
            use_convert = true
        end
        if result.scale then
            -- Setting si means convert will use the unit as given, a
            -- will be calculated from the value without any extra se
            -- occur if convert found the unit code. For example, if
            -- unit 'year' with a scale and if si were not set, conve
            -- its own scale because convert knows that a year is 31
            si = { result.symbol, result.link }
            value = value * result.scale
        end
        if result.si then
            ucode = result.ucode or ucode
            si = { result.symbol, result.link }
            use_convert = true
        end
    end
    else
        result = {}
        use_convert = true
    end
    local convert_unit = convert_lookup(ucode, value, scaled_top, want_link,
    result.sortkey = convert_unit.sortspan
    if use_convert then
        result.text = convert_unit.text
        result.scaled_top = convert_unit.scaled_value
    else
        if want_link then
            result.text = '[' .. result.link .. ']' .. result.symbol
        else
            result.text = result.symbol
        end
        result.scaled_top = value
    end
    return result
end

local function makeunit(value, options)
    -- Return table of information for the requested unit and options, or
    -- return nil if no unit.
    options = options or {}
    local unit
    local ucode = options.u
    local percode = options.per
    if ucode then
        unit = get_unit(ucode, value, nil, options)
    elseif percode then
        unit = { nospace = true, scaled_top = value }
    else
        return nil
    end
end
```

```
end
local text = unit.text or ''
local sortkey = unit.sortkey
if percode then
    local function bracketed(code, text)
        return code:find('[*./]') and '(' .. text .. ')' or text
    end
    local perunit = get_unit(percode, 1, unit.scaled_top, options)
    text = (ucode and bracketed(ucode, text) or '') ..
        '/' .. bracketed(percode, perunit.text)
    sortkey = perunit.sortkey
end
if not (unit.nospace or options.nospace) then
    text = '&nbsp;' .. text
end
return { text = text, isangle = unit.isangle, sortkey = sortkey }
end

local function list_units(mode)
    -- Return wikitext to list the built-in units.
    -- A unit code should not contain wikimarkup so don't bother escaping.
    local data = mw.loadData(data_module)
    local definitions = data.builtin_units .. data.builtin_units_long_scale
    local last_was_blank = true
    local n = 0
    local result = {}
    local function add(line)
        if line == '' then
            last_was_blank = true
        else
            if last_was_blank and n > 0 then
                n = n + 1
                result[n] = ''
            end
            last_was_blank = false
            n = n + 1
            result[n] = line
        end
    end
end

local si_prefixes = {
    -- These are the prefixes recognized by convert; u is accepted for
    y = 'y',
    z = 'z',
    a = 'a',
    f = 'f',
    p = 'p',
    n = 'n',
    u = 'μ',
    ['μ'] = 'μ',
    m = 'm',
    c = 'c',
    d = 'd',
    da = 'da',
    h = 'h',
    k = 'k',
    M = 'M',
    G = 'G',
    T = 'T',
    P = 'P',
    E = 'E',
    Z = 'Z',
    Y = 'Y',
}
local function is_valid(ucode, unit)
```

```
        if unit and not unit.more_ignored then
            assert(type(unit.symbol) == 'string' and unit.symbol ~=
                if unit.alias then
                    if unit.link or unit.scale_text or unit.si then
                        return false
                    end
                end
            end
            if unit.si then
                if unit.scale_text then
                    return false
                end
                ucode = unit.ucode or ucode
                local base = unit.symbol
                if ucode == base then
                    unit.display = base
                    return true
                end
                local plen = #ucode - #base
                if plen > 0 then
                    local prefix = si_prefixes[ucode:sub(1, plen)]
                    if prefix and ucode:sub(plen + 1) == base then
                        unit.display = prefix .. base
                        return true
                    end
                end
            end
            else
                unit.display = unit.symbol
                return true
            end
        end
    end
    return false
end
local lookup = require(convert_module)._unit
local function show_convert(ucode, unit)
    -- If a built-in unit defines a scale or sets the SI flag, any unit
    -- convert is not used (the scale or SI prefix's scale is used for
    -- If there is no scale or SI flag, and the unit is not defined in
    -- the sort key may not be correct; this allows such units to be
    if not (unit.si or unit.scale_text) then
        if mode == 'convert' then
            unit.show = not lookup(unit.alias and unit.symbol)
            unit.show_text = 'CONVERT'
        elseif mode == 'unknown' then
            unit.show = lookup(unit.alias and unit.symbol or
                unit.show_text = 'UNKNOWN'
        elseif not unit.alias then
            -- Show convert's scale in square brackets ('[1]')
            -- Don't show scale for an alias because it's misleading
            -- and an alias is probably not useful for anything
            local scale = lookup(ucode, {value=1, sort='on'})
            if type(scale) == 'number' then
                scale = string.format('%.5g', scale):gsub(' ', '')
            else
                scale = '?'
            end
            unit.show = true
            unit.show_text = '[' .. scale .. ']'
        end
    end
end
end
for line in definitions:gmatch('([^\n]*)\n') do
    local pos, _ = line:find(' ', 1, true)
    if pos then
        local ucode = line:sub(1, pos - 1)
    end
end
```

```

        local unit = get_builtin_unit(ucode, '\n' .. line .. '\n')
        if is_valid(ucode, unit) then
            show_convert(ucode, unit)
            local flags, text
            if unit.alias then
                text = unit.symbol
            else
                text = '[' .. unit.link .. '|' .. unit.g
            end
            if unit.isangle then
                unit.nospace = nil -- don't show redundant
            end
            for _, f in ipairs({
                { 'alias', 'ALIAS' },
                { 'isangle', 'ANGLE' },
                { 'nospace', 'NOSPACE' },
                { 'si', 'SI' },
                { 'scale_text', unit.scale_text },
                { 'show', unit.show_text },
            }) do
                if unit[f[1]] then
                    local t = f[2]
                    if t:match('^%u+$') then
                        t = '<small>' .. t .. '</small>'
                    end
                    if flags then
                        flags = flags .. ' ' .. t
                    else
                        flags = t
                    end
                end
            end
            if flags then
                text = text .. ' • ' .. flags
            end
            add(ucode .. ' = ' .. text .. '<br />')
        else
            add(line .. ' ♦ <b>invalid definition</b><br />')
        end
    end
    add(line)
end
end
return table.concat(result, '\n')
end

local delimit_groups = require('Module:Gapnum').groups
local function delimit(sign, numstr, fmt)
    -- Return sign and numstr (unsigned digits or '.' only) after formatting
    -- Four-digit integers are not formatted with gaps.
    fmt = (fmt or ''):lower()
    if fmt == 'none' or (fmt == '' and #numstr == 4 and numstr:match('^%d+$'))
        return sign .. numstr
    end
    -- Group number by integer and decimal parts.
    -- If there is no decimal part, delimit_groups returns only one table.
    local ipart, dpart = delimit_groups(numstr)
    local result
    if fmt == 'commas' then
        result = sign .. table.concat(ipart, ',')
        if dpart then
            result = result .. '.' .. table.concat(dpart)
        end
    end
end
else
end

```

```
-- Delimit with a small gap by default.
local groups = {}
groups[1] = table.remove(ipart, 1)
for _, v in ipairs(ipart) do
    table.insert(groups, '<span style="margin-left:.25em;">'
end
if dpart then
    table.insert(groups, '.' .. (table.remove(dpart, 1) or ''
    for _, v in ipairs(dpart) do
        table.insert(groups, '<span style="margin-left:.25em;">'
    end
end
result = sign .. table.concat(groups)
end
return result
end

local function sup_sub(sup, sub, align)
-- Return the same result as Module:Su except val defaults to align=right
if align == 'l' or align == 'left' then
    align = 'left'
elseif align == 'c' or align == 'center' then
    align = 'center'
else
    align = 'right'
end
return '<span style="display:inline-block;margin-bottom:-0.3em;vertical-align .. ';">' .. sup .. '<br />' .. sub .. '</span>'
end

local function range_text(items, unit_table, options)
    local fmt = options.fmt
    local nend = items.nend or ''
    if items.isrepeat or unit_table.isangle then
        nend = nend .. unit_table.text
    end
    local text = ''
    for i = 1, #items do
        if i % 2 == 0 then
            text = text .. items[i]
        else
            text = text .. delimit(items[i].sign, items[i].clean, fmt)
        end
    end
    return text
end

local function uncertainty_text(uncertainty, unit_table, options)
    local angle, text, need_parens
    if unit_table.isangle then
        angle = unit_table.text
    end
    local upper = uncertainty.upper or {}
    local lower = uncertainty.lower or {}
    local uncl = upper.clean
    if uncl then
        local fmt = options.fmt
        local uncl = lower.clean
        if uncl then
            uncl = delimit('+', uncl, fmt) .. (upper.errend or '')
            uncl = delimit('-', uncl, fmt) .. (lower.errend or '')
            if angle then
                uncl = uncl .. angle
            end
        end
    end
end
```

```
        end
        text = (angle or '') ..
            '<span style="margin-left:0.3em;">' ..
            sup_sub(uncU, uncl, options.align) ..
            '</span>'
    else
        if upper.parens then
            text = '(' .. uncU .. ')' -- old template did not
        else
            text = (angle or '') ..
                '<span style="margin-left:0.3em;margin-right:0.3em;">' ..
                delimiter(' ', uncU, fmt) ..
                need_parens = true
        end
        if uncertainty.errend then
            text = text .. uncertainty.errend
        end
        if angle then
            text = text .. angle
        end
    end
end
else
    if angle then
        text = angle
    end
end
return text, need_parens
end

local function _main(values, unit_spec, options)
    if options.sandbox then
        data_module = data_module .. '/sandbox'
        convert_module = convert_module .. '/sandbox'
    end
    local action = options.action
    if action then
        if action == 'list' then
            -- Kludge: am using the align parameter (a=xxx) for type
            return list_units(options.align)
        end
        return valerror('invalid action "' .. action .. '".', options.no)
    end
    local number = values.number or (values.numbers and values.numbers[1]) or {}
    local e_10 = options.e or {}
    local novalue = (number.value == nil and e_10.clean == nil)
    local fmt = options.fmt
    local want_sort = true
    local sortable = options.sortable
    if sortable == 'off' or (sortable == nil and novalue) then
        want_sort = false
    elseif sortable == 'debug' then
        -- Same as sortable = 'on' but the sort key is displayed.
    else
        sortable = 'on'
    end
    local sort_value = 1
    if want_sort then
        sort_value = number.value or 1
        if e_10.value and sort_value ~= 0 then
            -- The 'if' avoids {{val|0|e=1234}} giving an invalid sort
            sort_value = sort_value * 10^e_10.value
        end
    end
    local unit_table = makeunit(sort_value, {
```

```

        u = unit_spec.u,
        want_link = unit_spec.want_link,
        per = unit_spec.per,
        want_per_link = unit_spec.want_per_link,
        nospace = novalue,
        want_longscale = unit_spec.want_longscale,
        sortable = sortable,
    })

    local sortkey
    if unit_table then
        if want_sort then
            sortkey = unit_table.sortkey
        end
    else
        unit_table = { text = '' }
        if want_sort then
            sortkey = convert_lookup('dummy', sort_value, nil, nil, nil)
        end
    end
    local final_unit = unit_table.isangle and '' or unit_table.text
    local e_text, n_text, need_parens
    local uncertainty = values.uncertainty
    if uncertainty then
        if number.clean then
            n_text = delimit(number.sign, number.clean, fmt) .. (number.clean)
            local text
            text, need_parens = uncertainty_text(uncertainty, unit_table)
            if text then
                n_text = n_text .. text
            end
        else
            n_text = ''
        end
    end
    else
        if values.numbers.isrepeat then
            final_unit = ''
        end
        n_text = range_text(values.numbers, unit_table, options)
        need_parens = true
    end
    if e_10.clean then
        if need_parens then
            n_text = '(' .. n_text .. ')'
        end
        e_text = '10<sup>' .. delimit(e_10.sign, e_10.clean, fmt) .. '</sup>'
        if number.clean then
            e_text = '<span style="margin-left:0.25em;margin-right:0.25em">' .. e_text .. '</span>'
        end
    else
        e_text = ''
    end
    local result =
        (sortkey or '') ..
        (options.prefix or '') ..
        n_text ..
        e_text ..
        final_unit ..
        (options.suffix or '')
    if result ~= '' then
        result = '<span class="nowrap">' .. result .. '</span>'
    end
    return result .. (options.warning or '')
end
```

```
local function check_parameters(args, has_ranges, nocat)
  -- Return warning text for the first problem parameter found, or nothing
  local whitelist = {
    a = true,
    action = true,
    debug = true,
    e = true,
    ['end'] = true,
    errend = true,
    ['+errend'] = true,
    ['-errend'] = true,
    fmt = true,
    ['long scale'] = true,
    long_scale = true,
    longscale = true,
    nocategory = true,
    p = true,
    s = true,
    sortable = true,
    u = true,
    ul = true,
    up = true,
    upl = true,
  }
  for k, v in pairs(args) do
    if type(k) == 'string' and not whitelist[k] then
      local warning = 'Val parameter "' .. k .. '=' .. v .. '"'
      return valerror(warning, nocat, true)
    end
  end
  if not has_ranges and args[4] then
    return valerror('Val parameter 4 ignored', nocat, true)
  end
end

local function main(frame)
  local getArgs = require('Module:Arguments').getArgs
  local args = getArgs(frame, {wrappers = { 'Template:Val' }})
  local nocat = args.nocategory
  local numbers = {} -- table of number tables, perhaps with range text
  local msg = get_args(numbers, args)
  if msg then
    return valerror(msg, nocat)
  end
  if args.u and args.ul then
    return valerror('unit (<b>u</b>) and unit with link (<b>ul</b>) a
  end
  if args.up and args.upl then
    return valerror('unit per (<b>up</b>) and unit per with link (<b>
  end
  local values
  if numbers.has_ranges then
    -- Multiple values with range separators but no uncertainty.
    numbers.nend = args['end']
    values = {
      numbers = numbers,
    }
  else
    -- A single value with optional uncertainty.
    local function setfield(i, dst, src)
      local v = args[src]
      if v then
        if numbers[i] then
          numbers[i][dst] = v
        end
      end
    end
  end
end
```

```
                else
                    numbers[i] = { [dst] = v }
                end
            end
        end
        setfield(1, 'nend', 'end')
        setfield(2, 'errend', '+errend')
        setfield(3, 'errend', '-errend')
        values = {
            number = numbers[1],
            uncertainty = {
                upper = numbers[2],
                lower = numbers[3],
                errend = args.errend,
            }
        }
    end
    local unit_spec = {
        u = args.ul or args.u,
        want_link = args.ul ~= nil,
        per = args.upl or args.up,
        want_per_link = args.upl ~= nil,
        want_longscale = (args.longscale or args.long_scale or a
    }
    local options = {
        action = args.action,
        align = args.a,
        e = numbers.e,
        fmt = args.fmt,
        nocat = nocat,
        prefix = args.p,
        sandbox = string.find(frame:getTitle(), 'sandbox', 1, true)
        sortable = args.sortable or (args.debug == 'yes' and 'de
        suffix = args.s,
        warning = check_parameters(args, numbers.has_ranges, nocat
    }
    return _main(values, unit_spec, options)
end

return { main = main, _main = _main }
```

Modul:Val/Doku

Dies ist die Dokumentationsseite für Modul:Val

This module implements [Vorlage:TI](#).

The following modules are developed:

- [Module:Val](#) • Main module.
- [Module:Val/units](#) • Definitions for units built-in to val.

Use [Vorlage:TI](#) for testing, for example:

- `{{val/sandbox|1234.5678|(23)|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|4.56|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|e=3|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|(23)|e=3|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|e=3|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=cm}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=cm|end=$|+errend=U$|-errend=L$}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|(23)|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|4.56|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|e=3|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|(23)|e=3|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|e=3|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=deg}}` → [Vorlage:Val/sandbox](#)
- `{{val/sandbox|1234.5678|1.23|4.56|e=3|u=deg|end=$|+errend=U$|-errend=L$}}` → [Vorlage:Val/sandbox](#)

Modul:Val/sandbox

Die Dokumentation für dieses Modul kann unter *Modul:Val/sandbox/Doku* erstellt werden

```
-- For Template:Val, output a number and optional unit.
-- Format options include scientific and uncertainty notations.

local data_module = 'Module:Val/units'
local convert_module = 'Module:Convert'

local function valerror(msg, nocat, iswarning)
    -- Return formatted message text for an error or warning.
    -- Can append "#FormattingError" to URL of a page with a problem to find
    local anchor = '<span id="FormattingError"></span>'
    local body, category
    if nocat or mw.title.getCurrentTitle():inNamespaces(1, 2, 3, 5) then
        -- No category in Talk, User, User_talk, or Wikipedia_talk.
        category = ''
    else
        category = '[[Category:Pages with incorrect formatting templates
    end
    iswarning = false -- problems are infrequent so try showing large error
    if iswarning then
        body = '<sup class="noprint Inline-Template" style="white-space:
            '[[Template:Val|<span title="" ..
            msg:gsub("'", '&quot;') ..
            '>warning</span>]]</sup>'
    else
        body = '<strong class="error">' ..
            'Error in &#123;&#123;[[Template:val|val]]&#125;&#125;:
            msg ..
            '</strong>'
    end
    return anchor .. body .. category
end

local range_types = {
    -- No need for '&nbsp;,' because nowrap applies to all output.
    [","] = ", ",
    ["by"] = " by ",
    ["-"] = "_",
    ["_"] = "-",
    ["and"] = " and ",
    ["or"] = " or ",
    ["to"] = " to ",
    ["x"] = " x ",
    ["x"] = " x ",
    ["/"] = "/",
}
local range_repeat_unit = {
    -- WP:UNIT wants unit repeated when a "multiply" range is used.
    ["x"] = true,
    ["x"] = true,
}

local function extract_item(index, numbers, arg)
    -- Extract an item from arg and store the result in numbers[index].
    -- If no argument or if argument is valid, return nil (no error);
    -- otherwise, return an error message.
    -- The stored result is:
```

```
-- * a table for a number (empty if there was no specified number); or
-- * a string for range text
-- Input like 1e3 is regarded as invalid for all except argument 1
-- which accepts e notation as an alternative to the 'e' argument.
-- Input commas are removed so 1,234 is the same as 1234.
local which = index
local function fail(msg)
    local description
    if which == 'e' then
        description = 'exponent parameter (<b>e</b>)'
    else
        description = 'parameter ' .. which
    end
    return description .. ' ' .. (msg or 'is not a valid number') ..
end
local result = {}
local range = range_types[arg]
if range then
    if type(index) == 'number' and (index % 2 == 0) then
        if index == 2 then
            if numbers[1] and numbers[1].exp then
                return fail('cannot use a range if the first parameter has an exponent')
            end
            numbers.has_ranges = true
        else
            if not numbers.has_ranges then
                return fail('needs a range in parameter 2')
            end
        end
        numbers[index] = range
        if range_repeat_unit[arg] then
            -- Any "repeat" range forces unit (if any) to be
            numbers.isrepeat = true
        end
        return nil
    end
    return fail('does not accept a range')
end
if numbers.has_ranges and type(index) == 'number' and (index % 2 == 0) then
    return fail('should be a range')
end
if index == 'e' then
    local e = numbers[1] and numbers[1].exp
    if e then
        if arg then
            return fail('cannot be used if the first parameter has an exponent')
        end
        arg = e
        which = 1
    end
end
if arg and arg ~= '' then
    arg = arg:gsub(',', '')
    if arg:sub(1, 1) == '(' and arg:sub(-1) == ')' then
        result.parens = true
        arg = arg:sub(2, -2)
    end
    local a, b = arg:match('^(.+)[Ee](.+)$')
    if a then
        if index == 1 then
            arg = a
            result.exp = b
        else
            return fail('cannot use e notation')
        end
    end
end
```

```
        end
    end
    local isnegative, propersign, prefix
    local minus = '-'
    prefix, arg = arg:match('^(.)([%d.]*)$')
    local value = tonumber(arg)
    if not value then
        return fail()
    end
    if arg:sub(1, 1) == '.' then
        arg = '0' .. arg
    end
    if prefix == '' then
        -- Ignore.
    elseif prefix == '±' then
        -- Display for first number, ignore for others.
        if index == 1 then
            propersign = '±'
        end
    elseif prefix == '+' then
        propersign = '+'
    elseif prefix == '-' or prefix == minus then
        propersign = minus
        isnegative = true
    else
        return fail()
    end
    result.clean = arg
    result.sign = propersign or ''
    result.value = isnegative and -value or value
end
numbers[index] = result
return nil -- no error
end

local function get_args(numbers, args)
    -- Extract arguments and store the results in numbers.
    -- Return nothing (no error) if ok; otherwise, return an error message.
    for index = 1, 99 do
        local which = index
        local arg = args[which] -- has been trimmed
        if not arg then
            which = 'e'
            arg = args[which]
        end
        local msg = extract_item(which, numbers, arg)
        if msg then
            return msg
        end
        if which == 'e' then
            break
        end
        if index > 19 then
            return 'too many parameters'
        end
    end
    if numbers.has_ranges and (#numbers % 2 == 0) then
        return 'need a number after the last parameter because it is a range'
    end
end

local function get_scale(text, ucode)
    -- Return the value of text as a number, or throw an error.
    -- This supports extremely basic expressions of the form:
```

```
-- a / b
-- a ^ b
-- where a and b are numbers or 'pi'.
local n = tonumber(text)
if n then
    return n
end
n = text:gsub('pi', math.pi)
for _, op in ipairs({'/', '^'}) do
    local a, b = n:match('^(-)' .. op .. '(.*)$')
    if a then
        a = tonumber(a)
        b = tonumber(b)
        if a and b then
            if op == '/' then
                return a / b
            elseif op == '^' then
                return a ^ b
            end
        end
        break
    end
end
error('Unit "' .. ucode .. '" has invalid scale "' .. text .. "'")
end

local function get_builtin_unit(ucode, definitions)
    -- Return table of information for the specified built-in unit, or nil if
    -- Each defined unit code must be followed by two spaces (not tab character)
    local _, pos = definitions:find('\n' .. ucode .. ' ', 1, true)
    if pos then
        local endline = definitions:find('%s*\n', pos)
        if endline then
            local result = {}
            local n = 0
            local text = definitions:sub(pos + 1, endline - 1):gsub(
                for item in (text .. '\t'):gmatch('%S.-)\t') do
                    if item == 'ALIAS' then
                        result.alias = true
                    elseif item == 'ANGLE' then
                        result.isangle = true
                        result.nospace = true
                    elseif item == 'NOSPACE' then
                        result.nospace = true
                    elseif item == 'SI' then
                        result.si = true
                    else
                        n = n + 1
                        if n == 1 then
                            local link, symbol = item:match(
                                if link then
                                    result.symbol = symbol
                                    result.link = link
                                    n = 2
                                else
                                    result.symbol = item
                                end
                            elseif n == 2 then
                                result.link = item
                            elseif n == 3 then
                                result.scale_text = item
                                result.scale = get_scale(item, ucode)
                            else
                                result.more_ignored = item
                            end
                        end
                    end
                end
            )
        end
    end
end
```

```

                                break
                            end
                        end
                    end
                end
            end
        end
    end
end

local function convert_lookup(ucode, value, scaled_top, want_link, si, options)
    local lookup = require(convert_module)._unit
    return lookup(ucode, {
        value = value,
        scaled_top = scaled_top,
        link = want_link,
        si = si,
        sort = options.sortable,
    })
end

local function get_unit(ucode, value, scaled_top, options)
    local want_link = options.want_link
    if scaled_top then
        want_link = options.want_per_link
    end
    local data = mw.loadData(data_module)
    local result = options.want_longscale and
        get_builtin_unit(ucode, data.builtin_units_long_scale) or
        get_builtin_unit(ucode, data.builtin_units)
    local si, use_convert
    if result then
        if result.alias then
            ucode = result.symbol
            use_convert = true
        end
        if result.scale then
            -- Setting si means convert will use the unit as given, and
            -- will be calculated from the value without any extra scaling
            -- occur if convert found the unit code. For example, if
            -- unit 'year' with a scale and if si were not set, convert
            -- its own scale because convert knows that a year is 31
            si = { result.symbol, result.link }
            value = value * result.scale
        end
        if result.si then
            ucode = result.ucode or ucode
            si = { result.symbol, result.link }
            use_convert = true
        end
    end
    else
        result = {}
        use_convert = true
    end
    local convert_unit = convert_lookup(ucode, value, scaled_top, want_link,
    result.sortkey = convert_unit.sortspan
end
```

```
    if use_convert then
        result.text = convert_unit.text
        result.scaled_top = convert_unit.scaled_value
    else
        if want_link then
            result.text = '[' .. result.link .. '|' .. result.symbol
        else
            result.text = result.symbol
        end
        result.scaled_top = value
    end
    return result
end

local function makeunit(value, options)
    -- Return table of information for the requested unit and options, or
    -- return nil if no unit.
    options = options or {}
    local unit
    local ucode = options.u
    local percode = options.per
    if ucode then
        unit = get_unit(ucode, value, nil, options)
    elseif percode then
        unit = { nospace = true, scaled_top = value }
    else
        return nil
    end
    local text = unit.text or ''
    local sortkey = unit.sortkey
    if percode then
        local function bracketed(code, text)
            return code:find('[*./]') and '(' .. text .. ')' or text
        end
        local perunit = get_unit(percode, 1, unit.scaled_top, options)
        text = (ucode and bracketed(ucode, text) or '') ..
            '/' .. bracketed(percode, perunit.text)
        sortkey = perunit.sortkey
    end
    if not (unit.nospace or options.nospace) then
        text = '&nbsp;' .. text
    end
    return { text = text, isangle = unit.isangle, sortkey = sortkey }
end

local function list_units(mode)
    -- Return wikitext to list the built-in units.
    -- A unit code should not contain wikimarkup so don't bother escaping.
    local data = mw.loadData(data_module)
    local definitions = data.builtin_units .. data.builtin_units_long_scale
    local last_was_blank = true
    local n = 0
    local result = {}
    local function add(line)
        if line == '' then
            last_was_blank = true
        else
            if last_was_blank and n > 0 then
                n = n + 1
                result[n] = ''
            end
            last_was_blank = false
            n = n + 1
            result[n] = line
        end
    end
end
```

```
end
end
local si_prefixes = {
  -- These are the prefixes recognized by convert; u is accepted for
  y = 'y',
  z = 'z',
  a = 'a',
  f = 'f',
  p = 'p',
  n = 'n',
  u = 'μ',
  ['μ'] = 'μ',
  m = 'm',
  c = 'c',
  d = 'd',
  da = 'da',
  h = 'h',
  k = 'k',
  M = 'M',
  G = 'G',
  T = 'T',
  P = 'P',
  E = 'E',
  Z = 'Z',
  Y = 'Y',
}
local function is_valid(ucode, unit)
  if unit and not unit.more_ignored then
    assert(type(unit.symbol) == 'string' and unit.symbol ~= ''
    if unit.alias then
      if unit.link or unit.scale_text or unit.si then
        return false
      end
    end
    if unit.si then
      if unit.scale_text then
        return false
      end
      ucode = unit.ucode or ucode
      local base = unit.symbol
      if ucode == base then
        unit.display = base
        return true
      end
      local plen = #ucode - #base
      if plen > 0 then
        local prefix = si_prefixes[ucode:sub(1, plen)]
        if prefix and ucode:sub(plen + 1) == base then
          unit.display = prefix .. base
          return true
        end
      end
    end
    else
      unit.display = unit.symbol
      return true
    end
  end
  return false
end
local lookup = require(convert_module)._unit
local function show_convert(ucode, unit)
  -- If a built-in unit defines a scale or sets the SI flag, any unit
  -- convert is not used (the scale or SI prefix's scale is used for
  -- If there is no scale or SI flag, and the unit is not defined in
```

```
-- the sort key may not be correct; this allows such units to be
if not (unit.si or unit.scale_text) then
    if mode == 'convert' then
        unit.show = not lookup(unit.alias and unit.symbol)
        unit.show_text = 'CONVERT'
    elseif mode == 'unknown' then
        unit.show = lookup(unit.alias and unit.symbol or
            unit.show_text = 'UNKNOWN'
    elseif not unit.alias then
        -- Show convert's scale in square brackets ('[1]')
        -- Don't show scale for an alias because it's mis
        -- and an alias is probably not useful for anything
        local scale = lookup(ucode, {value=1, sort='on'})
        if type(scale) == 'number' then
            scale = string.format('%0.5g', scale):gsub
        else
            scale = '?'
        end
        unit.show = true
        unit.show_text = '[' .. scale .. ']'
    end
end
end
end
for line in definitions:gmatch('([^\n]*)\n') do
    local pos, _ = line:find(' ', 1, true)
    if pos then
        local ucode = line:sub(1, pos - 1)
        local unit = get_builtin_unit(ucode, '\n' .. line .. '\n')
        if is_valid(ucode, unit) then
            show_convert(ucode, unit)
            local flags, text
            if unit.alias then
                text = unit.symbol
            else
                text = '[' .. unit.link .. '|' .. unit.c
            end
            if unit.isangle then
                unit.nospace = nil -- don't show redundant
            end
            for _, f in ipairs({
                { 'alias', 'ALIAS' },
                { 'isangle', 'ANGLE' },
                { 'nospace', 'NOSPACE' },
                { 'si', 'SI' },
                { 'scale_text', unit.scale_text },
                { 'show', unit.show_text },
            }) do
                if unit[f[1]] then
                    local t = f[2]
                    if t:match('^%u+$') then
                        t = '<small>' .. t .. '</small>'
                    end
                    if flags then
                        flags = flags .. ' ' .. t
                    else
                        flags = t
                    end
                end
            end
            if flags then
                text = text .. ' • ' .. flags
            end
            add(ucode .. ' = ' .. text .. '<br />')
        else
            else
                end
            end
        end
    end
end
```

```

                                add(line .. ' ♦ <b>invalid definition</b><br />')
                                end
                                else
                                    add(line)
                                end
                                end
                                end
                                return table.concat(result, '\n')
end

local delimit_groups = require('Module:Gapnum').groups
local function delimit(sign, numstr, fmt)
    -- Return sign and numstr (unsigned digits or '.' only) after formatting
    -- Four-digit integers are not formatted with gaps.
    fmt = (fmt or ''):lower()
    if fmt == 'none' or (fmt == '' and #numstr == 4 and numstr:match('^%d+$'))
        return sign .. numstr
    end
    -- Group number by integer and decimal parts.
    -- If there is no decimal part, delimit_groups returns only one table.
    local ipart, dpart = delimit_groups(numstr)
    local result
    if fmt == 'commas' then
        result = sign .. table.concat(ipart, ',')
        if dpart then
            result = result .. '.' .. table.concat(dpart)
        end
    else
        -- Delimit with a small gap by default.
        local groups = {}
        groups[1] = table.remove(ipart, 1)
        for _, v in ipairs(ipart) do
            table.insert(groups, '<span style="margin-left:.25em;">' .. v)
        end
        if dpart then
            table.insert(groups, '.' .. (table.remove(dpart, 1) or ''))
            for _, v in ipairs(dpart) do
                table.insert(groups, '<span style="margin-left:.25em;">' .. v)
            end
        end
        result = sign .. table.concat(groups)
    end
    return result
end

local function sup_sub(sup, sub, align)
    -- Return the same result as Module:Su except val defaults to align=right
    if align == 'l' or align == 'left' then
        align = 'left'
    elseif align == 'c' or align == 'center' then
        align = 'center'
    else
        align = 'right'
    end
    return '<span style="display:inline-block;margin-bottom:-0.3em;vertical-align .. ';">' .. sup .. '<br />' .. sub .. '</span>'
end

local function range_text(items, unit_table, options)
    local fmt = options.fmt
    local nend = items.nend or ''
    if items.isrepeat or unit_table.isangle then
        nend = nend .. unit_table.text
    end
    local text = ''
end
```

```
        for i = 1, #items do
            if i % 2 == 0 then
                text = text .. items[i]
            else
                text = text .. delimit(items[i].sign, items[i].clean, fmt)
            end
        end
    end
    return text
end

local function uncertainty_text(uncertainty, unit_table, options)
    local angle, text, need_parens
    if unit_table.isangle then
        angle = unit_table.text
    end
    local upper = uncertainty.upper or {}
    local lower = uncertainty.lower or {}
    local unclU = upper.clean
    if unclU then
        local fmt = options.fmt
        local unclL = lower.clean
        if unclL then
            unclU = delimit('+', unclU, fmt) .. (upper.errend or '')
            unclL = delimit('-', unclL, fmt) .. (lower.errend or '')
            if angle then
                unclU = unclU .. angle
                unclL = unclL .. angle
            end
            text = (angle or '') ..
                '<span style="margin-left:0.3em;">' ..
                sup_sub(unclU, unclL, options.align) ..
                '</span>'
        else
            if upper.parens then
                text = '(' .. unclU .. ')' -- old template did not
            else
                text = (angle or '') ..
                    '<span style="margin-left:0.3em;margin-right:0.3em;">' ..
                    delimit('', unclU, fmt)
                need_parens = true
            end
            if uncertainty.errend then
                text = text .. uncertainty.errend
            end
            if angle then
                text = text .. angle
            end
        end
    end
    else
        if angle then
            text = angle
        end
    end
    return text, need_parens
end

local function _main(values, unit_spec, options)
    if options.sandbox then
        data_module = data_module .. '/sandbox'
        convert_module = convert_module .. '/sandbox'
    end
    local action = options.action
    if action then
        if action == 'list' then
```

```
        -- Kludge: am using the align parameter (a=xxx) for type
        return list_units(options.align)
    end
    return valerror('invalid action "' .. action .. '".', options.no)
end
local number = values.number or (values.numbers and values.numbers[1]) or
local e_10 = options.e or {}
local novalue = (number.value == nil and e_10.clean == nil)
local fmt = options.fmt
local want_sort = true
local sortable = options.sortable
if sortable == 'off' or (sortable == nil and novalue) then
    want_sort = false
elseif sortable == 'debug' then
    -- Same as sortable = 'on' but the sort key is displayed.
else
    sortable = 'on'
end
local sort_value = 1
if want_sort then
    sort_value = number.value or 1
    if e_10.value and sort_value ~= 0 then
        -- The 'if' avoids {{val|0|e=1234}} giving an invalid so
        sort_value = sort_value * 10^e_10.value
    end
end
local unit_table = makeunit(sort_value, {
    u = unit_spec.u,
    want_link = unit_spec.want_link,
    per = unit_spec.per,
    want_per_link = unit_spec.want_per_link,
    nospace = novalue,
    want_longscale = unit_spec.want_longscale,
    sortable = sortable,
})
local sortkey
if unit_table then
    if want_sort then
        sortkey = unit_table.sortkey
    end
else
    unit_table = { text = '' }
    if want_sort then
        sortkey = convert_lookup('dummy', sort_value, nil, nil, r
    end
end
local final_unit = unit_table.isangle and '' or unit_table.text
local e_text, n_text, need_parens
local uncertainty = values.uncertainty
if uncertainty then
    if number.clean then
        n_text = delimit(number.sign, number.clean, fmt) .. (numb
        local text
        text, need_parens = uncertainty_text(uncertainty, unit_ta
        if text then
            n_text = n_text .. text
        end
    else
        n_text = ''
    end
end
else
    if values.numbers.isrepeat then
        final_unit = ''
    end
end
```

```
        n_text = range_text(values.numbers, unit_table, options)
        need_parens = true
    end
    if e_10.clean then
        if need_parens then
            n_text = '(' .. n_text .. ')'
        end
        e_text = '10<sup>' .. delimit(e_10.sign, e_10.clean, fmt) .. '</sup>'
        if number.clean then
            e_text = '<span style="margin-left:0.25em;margin-right:0.25em">' .. e_text .. '</span>'
        end
    else
        e_text = ''
    end
    local result =
        (sortkey or '') ..
        (options.prefix or '') ..
        n_text ..
        e_text ..
        final_unit ..
        (options.suffix or '')
    if result ~= '' then
        result = '<span class="nowrap">' .. result .. '</span>'
    end
    return result .. (options.warning or '')
end

local function check_parameters(args, has_ranges, nocat)
    -- Return warning text for the first problem parameter found, or nothing
    local whitelist = {
        a = true,
        action = true,
        debug = true,
        e = true,
        ['end'] = true,
        errend = true,
        ['+errend'] = true,
        ['-errend'] = true,
        fmt = true,
        ['long scale'] = true,
        long_scale = true,
        longscale = true,
        nocategory = true,
        p = true,
        s = true,
        sortable = true,
        u = true,
        ul = true,
        up = true,
        upl = true,
    }
    for k, v in pairs(args) do
        if type(k) == 'string' and not whitelist[k] then
            local warning = 'Val parameter "' .. k .. '" = ' .. v .. ''
            return valerror(warning, nocat, true)
        end
    end
    if not has_ranges and args[4] then
        return valerror('Val parameter 4 ignored', nocat, true)
    end
end

local function main(frame)
    local getArgs = require('Module:Arguments').getArgs
```

```
local args = getArgs(frame, {wrappers = { 'Template:Val' }})
local nocat = args.nocategory
local numbers = {} -- table of number tables, perhaps with range text
local msg = get_args(numbers, args)
if msg then
    return valerror(msg, nocat)
end
if args.u and args.ul then
    return valerror('unit (<b>u</b>) and unit with link (<b>ul</b>) a
end
if args.up and args.upl then
    return valerror('unit per (<b>up</b>) and unit per with link (<b
end
local values
if numbers.has_ranges then
    -- Multiple values with range separators but no uncertainty.
    numbers.nend = args['end']
    values = {
        numbers = numbers,
    }
else
    -- A single value with optional uncertainty.
    local function setfield(i, dst, src)
        local v = args[src]
        if v then
            if numbers[i] then
                numbers[i][dst] = v
            else
                numbers[i] = { [dst] = v }
            end
        end
    end
    setfield(1, 'nend', 'end')
    setfield(2, 'errend', '+errend')
    setfield(3, 'errend', '-errend')
    values = {
        number = numbers[1],
        uncertainty = {
            upper = numbers[2],
            lower = numbers[3],
            errend = args.errend,
        }
    }
end
local unit_spec = {
    u = args.ul or args.u,
    want_link = args.ul ~= nil,
    per = args.upl or args.up,
    want_per_link = args.upl ~= nil,
    want_longscale = (args.longscale or args.long_scale or a
}
local options = {
    action = args.action,
    align = args.a,
    e = numbers.e,
    fmt = args.fmt,
    nocat = nocat,
    prefix = args.p,
    sandbox = string.find(frame:getTitle(), 'sandbox', 1, true)
    sortable = args.sortable or (args.debug == 'yes' and 'def
    suffix = args.s,
```



```
        warning = check_parameters(args, numbers.has_ranges, nocā
    }
    return _main(values, unit_spec, options)
end
return { main = main, _main = _main }
```

Modul:Val/units

The list of Val units is published at [Template:Val/list](#), and here is the place that produces that report. So preview [Vorlage:TI](#) from the edit box to see your changes before saving them. The file format and syntax are mostly self explanatory.

- The **field separator** is two or more spaces.
- You can enter new units in the "Unsorted units" section if you are not sure where else it might go.
- If the same *unit code* is defined twice on this page, the first one overrides the later one.
- For new entries the style guideline is [Wikipedia:UNITS](#).
- Convert and Val share units. If you have an issue with a unit pagename or a unit symbol, and that unit is not published at Val/list, you may decide to address it at [Template talk:Convert](#). To override entries at Convert, make an entry here.
- If you're not in a hurry, you may notice when editing Val/units that it consists of two Lua string assignments, and Lua comments. Be careful.

Questions or requests related to Val units are welcomed at [Template talk:Val](#). For feedback specifically about the terminology or procedural steps seen on this page, please use the talk page.

Below are the detailed procedures, examples, descriptions of testing and previewing, explanations about sorting Val expressions, and links to helpful pages. There's also further information about Val/Convert relations.

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Introduction

An entry defining a **unit** for Val is a single line under a [section](#) heading.^[1] It starts with the **unit code**, followed by at least two spaces and a [link](#). If you are adding a group of related units, you can enter a blank line around them to group them in the report at Val/list. An entry is ignored if it lacks at least *two adjacent space characters*.

```
codeVorlage:Spaces[[ pagename | symbol ]]
```

unit code

The keyboard typeable name of the symbol that users give Val's [Vorlage:Para](#), [Vorlage:Para](#), [Vorlage:Para](#) or [Vorlage:Para](#) parameters.

- Unit codes will be case sensitive.
- Prefer [Vorlage:Code](#) for the Greek letter μ , if you're not sure.
- Composite units have [dimensions](#) that multiply, divide, and apply powers to component units. Use [Vorlage:Code](#) to multiply, [Vorlage:Code](#) to divide, and a signed digit for powers. For multiplication, [Vorlage:Code](#) is deprecated. When adding a unit that includes division, consider also adding a version with multiplication by the negated power; for example, [Vorlage:Code](#) and [Vorlage:Code](#) (for m/s^2 and ms^2).

unit pagename

Title or section of an article. When linked with ul or upl, the title or one of its [redirects](#) can expand the abbreviation for the unit.^[2]

unit symbol

[Verifiable](#), standard symbol, formatted in accordance with [WP:UNITS](#).

- Templates will not work for producing the unit symbol for input to this module; only [Wikipedia HTML formatting](#) is accepted.
- Composite units use [Vorlage:Code](#) to multiply, [Vorlage:Code](#) to divide, and [Vorlage:Tag](#) for powers. Division is also the unit-inversion form that multiplies a negative numbered power, for example for m/s^2 and ms^2 (from [Vorlage:Code](#) and [Vorlage:Code](#)).
- If the hover-text just shows the abbreviation, it is not a user-friendly unit-symbol. When not linked, the unit's abbreviation can be spelled out with hover-text at the symbol by way of the *title* attribute of either [Vorlage:Tag](#) or [Vorlage:Tag](#).
- For more about HTML tags and HTML symbols such as [Vorlage:Code](#), see [Wikipedia:HTML](#).
- For more information about marking up your unit symbol see [WP:HTML#formatting](#).
- Examples of unit codes, and hover text are at [Template:Val/list](#).

unit code alias

The same unit/pagename/symbol, but by way of a different unit code.

Unit code aliases are commonly applied for

- capitalization, to make the unit code case insensitive.
- per units, for example m/s and ms [Vorlage:Sup](#).
- Greek letters, to allow for both US keyboard and Greek-character-input applications, for example the SI prefix μ

Preview page with this template/module

A feature, similar to a sandbox and testcases, that provides a preview of how the code currently in the edit box (sandbox) will look when applied to any page (testcases).

The preview of main interest is `Template:Val/list`^[3], but previewing other your own page of interest with your newly added unit in a val call and in a sorting table are also part of this procedure. `Template:Val/units/testcases` contains Val calls for all defined Val units.

How to add a unit

To maintain Val units,

1. **Vorlage:Edit** and make your changes.
2. Preview `Vorlage:Space Vorlage:Big Vorlage:Space` .
 - Look for any messages. An "Invalid definition" message is available automatically.
 - **Prove the intended link** from the preview.
 - Hover the mouse over the link, and read the hover-text or URL display somewhere in the browser.
3. Add any unit-code aliases.
4. Add any sorting if needed. Details about sorting are covered below.
5. Preview a test page. It will have template Val calls on it, and it may have a **sortable table** to test sorting. `Template:Val/units/testcases` is a test page containing Val calls for all units.
6. *Show changes* to prove no accidental edits occurred.
7. Save the page. Saving the page activates the changes immediately, and they go live. You're done adding your unit.

If you want a unit to add for practice, add one from **List of common physics notations**, or from **SI units#Units and prefixes**.

Changing or removing existing unit codes is possible by employing `Vorlage:TI` to see how Val unit codes may or may not be in use on the wiki. For example, to see about changing or removing unit code `J.s`, do a

`{{t|usage|val|"J.s"|0}}` → `Vorlage:Tlusage`.

Put any unit code in quotes if it contains dash, dot, or slash `Vorlage:Mdashanything` but a letter or number. See `Template:Val/units/test` for a list of these searches for each Val unit.

Examples

Say you're creating a new page or revamping an old page, and discover the need for a convenient way to make several entries containing c_0 , and link that symbol to the page *Speed of light*. The following entry will define your unit code as `c0`, your unit symbol as `'c'0`, and the unit's article as *Speed of light#Numerical value, notation, and units*.

`c0Vorlage:SpacesVorlage:BigSpeed of light#Numerical value, notation, and unit symbolVorlage:Big'c'0Vorlage:Big`

or as explained below at §Advanced unit entry formats, you can also write

```
c0Vorlage:Spaces' 'c' '<sub>0</sub>Vorlage:SpacesSpeed of light#Numerical value,
notation, and units
```

Then preview with *Template:Val/list*, and check for an error message next to the new unit, and test the link you gave.

After that the page with the (saved) Val calls is used to test the linked and non-linked versions of the normal and the per units:

- `{{val|0.891|u=c0}}` → **Vorlage:Val**
- `{{val|0.891|ul=c0}}` → **Vorlage:Val**
- `{{val|0.891|up=c0}}` → **Vorlage:Val**
- `{{val|0.891|upl=c0}}` → **Vorlage:Val**

For an entire example that uses the other format to make a Val/unit entry.

1. Put this in a sandbox: `{{val|1.23|ul=tins}}` → **Vorlage:Val**
2. Edit **Module:Val/units** and insert a line like the following (do not save yet):

```
tinsVorlage:SpacetinsVorlage:SpacesContins unities
```
3. Under "Preview page with this module" enter *Template:Val/list*, and click *Show preview*. It shows Val/list through the version of Val/units in the edit box. Say there are no errors, the markup and hover-text look good, and the link navigates to the unit's page.
4. Then in the same way of previewing, put the **fullpagename** of the sandbox from step 1, and click *Show preview*.
5. *Save page* to save the edit to Module:Val/units.

If you want a unit to add for practice, add one from *List of common physics notations*, or from *SI units#Units and prefixes*. There are many examples of *composite* units that have their own page, so adding a unit code for one of those should link to its page. There are many articles that could use a new Val unit, such as molarity at **Resveratrol**.

Either of the test pages of these examples could have the sortable test-table shown in the next section.

Testing a new unit

To test a *newly added* unit not used on any page, you will need to run the preview on a sandbox page you have already created. Here are all the test cases you can preview there before saving your changes here; they are the four **Vorlage:Para** parameters:

```
{{Val|9|u =      }}
{{Val|9|ul =     }}
{{Val|9|u=foo|up = }}
{{Val|9|u=foo|upl = }}
```

and the **sortable table**:

```
{| class="wikitable sortable" summary="Sortable table to test Val sorting"
! Val number and unit
|-
| {{val|5|u=    }}
|-
| {{val|3|u=    }}
|-
| {{val|1|u=    }}
|-
| {{val|2|u=    }}
|-
| {{val|4|u=    }}
|}
```

This table falls into place unsorted, so when your unit accepts an **SI prefix** you can test, say, k, m, and G, with your unit, and compare with e notations 1e3, 1e6, and 1e9 in the number. For example, Val sorts these two as equal: 1e3 m (standard **e notation**) and 1 km.

What to look for

- The linked and non-linked markup should look exactly the same.
- Navigate to the new link. It is safe: you can go back in your browser to here.
- The two **Vorlage:Para** versions should have no space in front of them.
- For SI prefixes sorting 2e3 (or 2000) should be greater than k (kilo prefix).

Advanced unit-entry format

In the usual format

```
codeVorlage:Spaces[[pagename|symbol]]
```

the wikilink represents two fields itself, for a total of three fields per entry. But you cannot use a wikilink for composite units that need more than one pagename.

The other record type for adding a unit entry is also three fields. It has the same three fields, but they are in a different order.

```
codeVorlage:SpacessymbolVorlage:Spacespagename
```

This format separates each field with whitespace, and also takes tabs between fields two and three.

For a new composite unit you should probably link the whole composition, or link the largest portion which could have its own page.

- The val user can compose a *divisor* unit on the fly from existing unit codes, and with individually linked numerator and denominator. For example:

`{{val|99|u1=m|u2=d}}` → **Vorlage:Val**

- The val user can compose a *multiplier* unit on the fly by using the **Vorlage:Para** parameter to prepend to the unit, and *these* can also be individually linked. For example (in geology) there is already **Vorlage:Val** to use with **Vorlage:Para**:

`{{val|333|u1=uBP|end= ; [[megaannum|Ma]]}}` → **Vorlage:Val**".

For example **Template:Val/list** says

`m.s-1 Vorlage:BigMetre per second|m⋅s^{−1}Vorlage:Big` linking to an article titled *Metre per second*, not

`m.s-1 Vorlage:BigMetre|mVorlage:Big⋅Vorlage:BigSecond|sVorlage:Big^{−1}` which has separate links to already existing unit codes.

Fourth field flags

The module must be told directly about sorting factors, spacing, and aliasing for a unit code.

There is an optional field that goes at the end after two or more spaces or one or more tabs. It is a flag mainly used to provide for that unit to be sorted in a table. Flags are mainly for sorting, and they work for either record type. Just add two or more spaces, or one or more tabs, and then the flag field. (Optional flags ALIAS and NOSPACE and ANGLE are for even more advanced users. See §Advanced unit flags below.)

Using SI requires that the unit symbol compare precisely to the unit code, and so never allows HTML or other characters in the symbol. Any difference between the unit symbol and unit code must be an SI prefix, such as k, M, or G.

Sorting

Vorlage:Details **Vorlage:Details**

Val's sorting scale factor is for comparison to other Val units that might be sorted with it.

Where **Sorting** is done on the wiki, it is done in **sortable tables**. Val entries in a sortable table will need a fourth field sorting flag. It can be a number, an equation, or an SI, but it flags the same function: a wikitable sorting "scale".

To display the sort key use **Vorlage:Para**. For example

- `{{val|999|u=uV|debug=yes}}` → 6996998999999999999♠999 μV
- `{{val|99|u=V|debug=yes}}` → 7001990000000000000♠99 V



- `{{val|1|u=kV|debug=yes}}` → `7003100000000000000♠`1 kV

Scale

For scaling a unit to sort properly, you need to pick a number for a sorting factor. There are numerous examples at [Template:Val/list](#) and at [Template:Val/sortkey/unit](#). A **system of units** will have its base units, for example 1 bit; then the scale for sorting a kilobyte unit is then 8000 (eight bits per byte, times a kilo, or thousand). Or a year scale is seconds so that all *times* sort by seconds, which is a base unit. In general the scale shows to be "base unit" of the same type times the "SI prefix", and if it's not that simple, then the unit system's number has associated a number to it, such as Avogadro's number.

For example, the following defines a unit with code `billion`, symbol `billion`, link `1,000,000,000`, and scale `1e9` ([Vorlage:Val](#)). After the following entry is saved to the database

<code>billion</code>	<code>billion</code>	<code>1,000,000,000</code>	<code>1e9</code>
----------------------	----------------------	----------------------------	------------------

`{{val|2|u=billion}}` would start sorting after `{{val|98.7|e=3}}`.

SI flag

[Vorlage:Common metric prefixes](#) SI is used because it scales Val expressions automatically, and it is a clean indicator that the unit will sort properly. It correctly scales any SI prefix for sorting, but not other unit codes.

For SI the unit symbol will not accept HTML, but will accept μ . HTML is not accepted at this time because in order to validate the entry, the unit code must differ from the unit symbol by exactly one valid **SI prefix**. If there is no difference, or too much difference, it is an invalid definition for sorting purposes. The exception is for the Greek letter μ : if you used a character input application to "install" the Greek letter μ in your symbol, for your "easy to type" unit code, [Vorlage:Key](#), these two are not a character mismatch.

All unit entries that use SI will have the same base unit as the symbol at Val/units, but they will display properly at Val/list.

For example, kilo is a thousand, but you're defining km² for kilometers squared, and need HTML. You can't use SI with HTML, so use `1000*1000`, or `1000000` in the sorting field. Use `1e-6` or `0.000001` or `1/100000` instead.

If the unit you are maintaining has SI prefixes and they are all likely to be sorted in a table, add up to twelve entries, one for each common SI unit. Some of these, like *Meter* in the example, may have their own article, but usually all go to the base unit's pagename. Here is how *meter* is defined.

<code>m</code>	<code>[[Metre m]]</code>	<code>SI</code>
<code>cm</code>	<code>[[Centimetre m]]</code>	<code>SI</code>
<code>dam</code>	<code>[[Decametre m]]</code>	<code>SI</code>
<code>dm</code>	<code>[[Decimetre m]]</code>	<code>SI</code>
<code>hm</code>	<code>[[Hectometre m]]</code>	<code>SI</code>



km	[[Kilometre m]]	SI
Mm	[[Megametre m]]	SI
mm	[[Millimetre m]]	SI
um	[[Micrometre μm]]	1/1000000
μm	[[Micrometre m]]	SI
nm	[[Nanometre m]]	SI
pm	[[Picometre m]]	SI

The information that was in the unit symbol is now fully specified in, and exhibited at, the unit code. SI specifies that the unit's symbol has been transformed from a symbol to a string for use in string comparison that will finally result in calculating a sorting factor. It conveniently uses the idea that the unit code is often equal to the symbol, especially with SI units. The field definitions are sacrificed for a simplicity in the user presentation, user calculation, and user entry.

In the other format, the following defines three unit codes for volts, V for sorting. V is the base unit with the SI prefix removed. A unit code defined in this manner will have its sort key scaled by the software according to the SI prefix produced by the difference between the unit code and unit symbol.

kV	V	Kilovolt	SI
μV	V	Microvolt	SI
uV	V	Microvolt	SI

Now `{{val|1|u=kV}}` will sort after `{{val|999|u=V}}` without having to resort to using a number, and with the clean representation at Val/list.

The symbol column shows "V" for each, but it is not the symbol—it is the base unit after removing the SI prefix so convert can work out what is intended to be the prefix. The following would give identical results:

kV	kV	Kilovolt	1e3
μV	μV	Microvolt	1e-6
uV	μV	Microvolt	1e-6

As you can see, without "SI", you define both the symbol, and the scale. You define the symbol with HTML or the Greek letter or other symbol, and you define the scale with a number or an equation. When "SI" is used, convert just does the right thing for the symbol and scale.

Alias a Convert unit

If you are here to change the link or markup of a unit, but it is not listed at Val/units, sometimes you can find the unit markup and link that you do want, already existing at [Template:Convert#Units](#). In that case you can change the unit code to whatever you'd prefer, and it will achieve your goal. For example, if `{{Val|1|C}}` is going to Celsius instead of Coulombs, you can define your own unit code, say "degC".

The following defines **degC** to refer to the unit known as °C in convert. There is no link because a link is defined at Convert.

degC	°C	ALIAS
------	----	-------

File format

If you want to reorganize sections here, note that the two lines `local builtin_units` and `local builtin_units_long_scale` require a blank line after them. The section **long scale**, with all the units like "billions" and "trillions", is under the latter, near the bottom of the page. All the rest of the units are in the former.

The file format is two Lua strings and a return statement with them in it: a string in quotes `[=[... builtin_units ...]=]`, and another string in quotes `[=[... builtin_units_long_scale ...]=]`. The first string, `builtin_units`, is short-scale, second string is long scale. The reason there are two strings is because of the difference between British and US terms surrounding "billion", "billionth", etc.

For each string there must be a blank line before the first line of the string and after the last line of the string. In other words the first two and last two characters of each string must be newlines.

There is one record per line, starting in first column, having 2-4 fields. The field separator is two or more spaces. Between first and second fields, use two or more spaces. Between all other fields, use two or more spaces, or one or more tabs. Entries without two spaces in them are ignored.

Advanced unit flags

You can alias Convert or Val units. But these are different things.

- A "unit code alias" is when the same *unit pagename and unit symbol* are defined twice. If a different *unit code* is assigned to the same unit symbol and unit pagename, (say, as a copy of the previous entry) it will work as a Val alias.
- A "unit alias" is when Val alias a Convert unit code. A unit of measurement is *here* denoted ALIAS to mean "they are defined *there*". Val *defaults* to Convert, but it's good to this explicit for certain Val units: the ones tempting to define here, but that you don't want defined here because, says ALIAS, they are *already* defined there.
- If your unit code is not listed at **Vorlage:TI**, you can check for it at **Vorlage:TI**, or at **Vorlage:TI**

For spacing and aliasing:

- ALIAS specifies that the unit's symbol is the code for a unit defined in **Vorlage:Tlf}**.
- NOSPACE prevents the default insertion of a non-breaking space before the unit symbol.
- If you see the ANGLE flag, this identifies those special units that must displayed not only after the main Val number, but also after its **uncertainty#Measurements** numbers.(ANGLE also implies NOSPACE.)

Interaction with Convert

Val and Convert share unit codes, but their units of measurement are different.

- Most of the wiki's unit codes are managed by **Vorlage:TI**.

- Some very few unit codes here, like C and F, mean something different there. Val caters to Coulombs and Farads, while Convert caters to Celsius and Fahrenheit. Convert and Val *unit codes* are mostly identical, like they are for `degC` and for `degF`.
- Val could need *any* unit, while not all units are needed in conversions, so Val needs *all* of Convert's units and some of its own.
- Sorting functionality is handled for Val by [Vorlage:Tlf.](#))
- At Convert the procedure for defining a unit is much more involved than it is here, because there every unit defined must reference associated units, conversion factors, alternate spellings, and many other attributes. [An entry at Convert](#) is defined as a multi-line, multi-attribute Lua table with its attendant syntax, and inside a larger Lua script. Therefore Convert is more conservative about adding units. Val may be more liberal in this respect if only because unit entry is simpler and "wikified". Therefore **WP:Be bold**. Bold customization may be a worthwhile risk at Val/units, or it may get removed. Although units used in *articles* have definite stylistic standards, there remains room for depending on Val for markup (but see [WP:Accessibility](#) about color, link, and text). You may want to customize some Val unit codes that will automate some Val markup for special articles, the *talk page*, etc. See [WP:HTML#formatting](#) for possibilities.

Notes

[Vorlage:Refs](#)

See also

- [Module:Val](#)
- [Template:Val/units/test](#)
- [Template:Val/units/testcases](#)
- [Template:Val/units/loadtest](#)
- [Template:Val/unitsfromconvert](#)

1. [↑](#) Module pages don't have section editing.
2. [↑](#) A redirect page is easy to make; there are tools on the editor toolbars.
3. [↑](#) The special relation between Val/units and Val/list is that the wikitext of Val/list is always generated by Val/units when that page is viewed, *so* when you **preview page with this module**, Val/list is generated using the contents of the edit box of Val/units.

```
-- Definitions for units known to val
-- File format is two strings and a return statement with them in it:
-- string in quotes [= [ ... builtin_units ... ]=].
-- string in quotes [= [ ... builtin_units_long_scale ... ]=].
-- First string, builtin_units, is short-scale, second string is long scale.

-- Entry format:
-- One record per line, starting in first column, having 2-4 fields.
-- Field separator: two or more spaces
-- Between first and second fields: two or more spaces
```



```
-- Between all other fields: two or more spaces, or one or more tabs
-- Entries without two spaces in them are ignored.

-- There must be a blank line before the first entry and after the last.
-- I.e. the first two and last two characters of the string must be newlines.

-- Format of entry. Two record types:
--
-- One record type is a wikilink:
-- Unit-code      [[ pagename | Symbol-accepts-HTML-only ]]
-- Text-field separator is still two spaces. Two spaces not allowed in wikilink
--
-- The other record type is all fields:
-- Unit-code      symbol-accepts-HTML-only      pagename#section-OK
--
-- Plus there is an optional field that goes at the end after two or more spaces
-- Whether it is a number or an equation or the letters SI,
-- any of these three has the same function: a wikipable sorting "scale".
-- It is for sorting, and it works for either record type.
-- Difference is SI can't accept HTML. But SI correctly scales any SI prefix.
-- (Optional fields ALIAS and NOSPAC and ANGLE are for advanced users.)

-- "Invalid unit" error:
-- Using SI requires that the symbol equal unit-code, so never allows HTML.
-- Any difference between SI or symbol must be an SI prefix, such as k, M, or G.
-- A space at the end of an entry is an error. No space at each EOL.

local builtin_units = {[

== Test ==
Foo  [[Hz|<samp>Foo</samp>]]
Baz  [[Hertz|baz<sub>0</sub>]]
Baz  [[Kelvins|baz<sub>0</sub>]]
Bar  [[Foobar|bar<abbr title="super duper">0</abbr>]]
quux [[Foobar|<span title="super duper 2">bar0</span>]]

== Unsorted units ==
c0  [[Speed of light#Numerical value, notation, and units|'c'<sub>0</sub>]]
lbf [[Pound (force)|<span title="pound-force">lb<sub>F</sub></span> ]]
N.s [[Newton-second|N&sdot;s]]
J.K-1 [[Joule per kelvin|J&sdot;K<sup>-1</sup>]]
C.mol-1 [[Faraday constant|C&sdot;mol<sup>-1</sup>]]
C/mol [[Faraday constant|C/mol]]
C.kg-1 [[Roentgen (unit)|C&sdot;kg<sup>-1</sup>]]
C/kg [[Roentgen (unit)|C/kg]]
F.m-1 [[vacuum permittivity|F&sdot;m<sup>-1</sup>]]
F/m [[vacuum permittivity|F/m]]
e [[Elementary charge|'e']]
kB  [[Kilobyte|kB]] 8e3
MB  [[Megabyte|MB]] 8e6
GB  [[Gigabyte|GB]] 8e9
TB  [[Terabyte|TB]] 8e12
lx  [[Lux (unit)|lx]]
nat [[nat (unit)|nat]]

== Time and frequency ==
byte/s [[Data rate units|byte/s]] 8
kB/s  [[Data rate units#Kilobyte per second|<span title="Kilobytes per second">kB</span>]]
MB/s  [[Data rate units#Megabyte per second|<span title="Megabytes per second">MB</span>]]
GB/s  [[Data rate units#Gigabyte per second|<span title="Gigabytes per second">GB</span>]]
TB/s  [[Data rate units#Terabyte per second|<span title="Terabytes per second">TB</span>]]
bit/s [[Bit per second|bit/s]] 1
bps  [[Bit per second|bit/s]] 1
kbit/s [[Kilobit per second|kbit/s]] 1e3
```



```

Mbit/s [[Megabit per second|Mbit/s]] 1e6
Gbit/s [[Gigabit per second|Gbit/s]] 1e9
Tbit/s [[Terabit per second|Tbit/s]] 1e12
kT/s [[Transfer (computing)|<span title="Kilo transfers per second">kT/s</span>]]
MT/s [[Transfer (computing)|<span title="Mega transfers per second">MT/s</span>]]
GT/s [[Transfer (computing)|<span title="Giga transfers per second">GT/s</span>]]
year [[Year|year]] 31557600
years [[Year|years]] 31557600
yr [[Year#Symbols y and yr|yr]] 31557600
y [[Year|y]] 31557600
a [[Annum|a]] 31557600
Ga [[Gigaannum|Ga]] 3155760000000000000
Ma [[Megaannum|Ma]] 3155760000000000000
ka [[Kiloannum|ka]] 315576000000
kyr [[kyr|kyr]] 315576000000
kya [[kyr|kya]] 315576000000
myr [[myr|myr]] 3155760000000000
mya [[Mya (unit)|mya]] 3155760000000000000
byr [[Billion years|byr]] 3155760000000000000000
bya [[Billion years ago|bya]] 315576000000000000000000
Gyr [[billion years|Gyr]] 315576000000000000000000
BP [[Before present|BP]]
uBP [[Radiocarbon dating#Calibration|<sup>14</sup>C yr BP]]
BC [[Before Christ|BC]] -1
AD [[Anno Domini|AD]] 1
BCE [[Before the Common Era|BCE]] -1
CE [[Common Era|CE]] 1
JD [[Julian date|JD]] 1
MJD [[Modified Julian date|MJD]] 1

s-1 [[Second|s<sup>-1</sup>]]
s-2 [[Second|s<sup>-2</sup>]]
s2 [[Second|s<sup>2</sup>]]

s [[Second|s]] SI
as [[Attosecond|s]] SI
cs [[Second|s]] SI
das [[Second|s]] SI
ds [[Second|s]] SI
Es [[Second|s]] SI
fs [[Femtosecond|s]] SI
Gs [[Second|s]] SI
hs [[Second|s]] SI
ks [[Second|s]] SI
ms [[Millisecond|s]] SI
µs [[Microsecond|s]] SI
us [[Microsecond|s]] SI
Ms [[Second|s]] SI
ns [[Nanosecond|s]] SI
ps [[Picosecond|s]] SI
Ps [[Second|s]] SI
Ts [[Second|s]] SI
Ys [[Second|s]] SI
ys [[Yoctosecond|s]] SI
Zs [[Second|s]] SI
zs [[Zeptosecond|s]] SI

Hz [[Hertz|Hz]] SI
aHz [[Hertz|Hz]] SI
cHz [[Hertz|Hz]] SI
daHz [[Hertz|Hz]] SI
dHz [[Hertz|Hz]] SI
EHz [[Hertz|Hz]] SI
fHz [[Hertz|Hz]] SI

```



```

hHz [[Hertz|Hz]] SI
GHz [[Gigahertz|Hz]] SI
kHz [[Kilohertz|Hz]] SI
MHz [[Megahertz|Hz]] SI
mHz [[Hertz|Hz]] SI
uHz [[Hertz|Hz]] SI
µHz [[Hertz|Hz]] SI
nHz [[Hertz|Hz]] SI
pHz [[Hertz|Hz]] SI
PHz [[Hertz|Hz]] SI
THz [[Hertz|Hz]] SI
yHz [[Hertz|Hz]] SI
YHz [[Hertz|Hz]] SI
zHz [[Hertz|Hz]] SI
ZHz [[Hertz|Hz]] SI

```

== Length, area, volume ==

```

Å3 [[Ångström|Å<sup>3</sup>]]
fb-1 [[Barn (unit)|fb<sup>-1</sup>]]
m-1 [[Metre|m<sup>-1</sup>]]
m-2 [[Square metre|m<sup>-2</sup>]]
m-3 [[Cubic metre|m<sup>-3</sup>]]
km2 [[Square kilometre|km<sup>2</sup>]]
km3 [[Cubic kilometre|km<sup>3</sup>]]
µm2 [[Square metre|µm<sup>2</sup>]]
um2 [[Square metre|µm<sup>2</sup>]]
am2 [[Square metre|am<sup>2</sup>]]
cm2 [[Square centimetre|cm<sup>2</sup>]]
dam2 [[Square metre|dam<sup>2</sup>]]
dm2 [[Square metre|dm<sup>2</sup>]]
Em2 [[Square metre|Em<sup>2</sup>]]
fm2 [[Square metre|fm<sup>2</sup>]]
Gm2 [[Square metre|Gm<sup>2</sup>]]
hm2 [[Square metre|hm<sup>2</sup>]]
mm2 [[Square metre|mm<sup>2</sup>]]
Mm2 [[Square metre|Mm<sup>2</sup>]]
nm2 [[Square metre|nm<sup>2</sup>]]
pm2 [[Square metre|pm<sup>2</sup>]]
Pm2 [[Square metre|Pm<sup>2</sup>]]
Tm2 [[Square metre|Tm<sup>2</sup>]]
ym2 [[Square metre|ym<sup>2</sup>]]
Ym2 [[Square metre|Ym<sup>2</sup>]]
zm2 [[Square metre|zm<sup>2</sup>]]
Zm2 [[Square metre|Zm<sup>2</sup>]]
gal [[Gallon|gal]]
Gal [[Gal (unit)|Gal]]
uGal [[Gal (unit)|µGal]]
µGal [[Gal (unit)|µGal]]
mGal [[Gal (unit)|mGal]]

```

```

b [[Barn (unit)|b]] SI
ab [[Barn (unit)|b]] SI
cb [[Barn (unit)|b]] SI
dab [[Barn (unit)|b]] SI
db [[Barn (unit)|b]] SI
Eb [[Barn (unit)|b]] SI
fb [[Barn (unit)|b]] SI
Gb [[Barn (unit)|b]] SI
hb [[Barn (unit)|b]] SI
kb [[Barn (unit)|b]] SI
mb [[Barn (unit)|b]] SI
µb [[Barn (unit)|b]] SI
ub [[Barn (unit)|b]] SI
Mb [[Barn (unit)|b]] SI

```



```
nb [[Barn (unit)|b]] SI
pb [[Barn (unit)|b]] SI
Pb [[Barn (unit)|b]] SI
Tb [[Barn (unit)|b]] SI
Yb [[Barn (unit)|b]] SI
yb [[Barn (unit)|b]] SI
Zb [[Barn (unit)|b]] SI
zb [[Barn (unit)|b]] SI

== Velocity and acceleration ==
m.s-2 [[Metre per second squared|m&sdot;s<sup>-2</sup>]]
m/s2 [[Metre per second squared|m/s<sup>2</sup>]]
m.s-1 [[Metre per second|m&sdot;s<sup>-1</sup>]]
m/s [[Metre per second|m/s]]
km.s-1 [[Metre per second|km&sdot;s<sup>-1</sup>]]
km/s [[Metre per second|km/s]]

== Mass and energy ==
lbm [[Pound (mass)|<span title="pound-mass">lb<sub>m</sub></span>]]
uJ [[Joule|μJ]]
J.s [[Joule-second|J&sdot;s]]
kWh [[Kilowatt hour|kWh]]
kW.h [[Kilowatt hour|kW&sdot;h]]
J/C [[Volt|J/C]]
J/kg [[Joule|J/kg]]

Da [[Dalton (unit)|Da]] SI
EDa [[Dalton (unit)|Da]] SI
PDa [[Dalton (unit)|Da]] SI
TDa [[Dalton (unit)|Da]] SI
GDa [[Dalton (unit)|Da]] SI
MDa [[Dalton (unit)|Da]] SI
kDa [[Dalton (unit)|Da]] SI
mDa [[Dalton (unit)|Da]] SI
uDa [[Dalton (unit)|Da]] SI
μDa [[Dalton (unit)|Da]] SI
nDa [[Dalton (unit)|Da]] SI
pDa [[Dalton (unit)|Da]] SI
fDa [[Dalton (unit)|Da]] SI
aDa [[Dalton (unit)|Da]] SI

g [[Gram|g]] SI
ag [[Attogram|g]] SI
cg [[Centigram|g]] SI
dag [[Gram|g]] SI
dg [[Decigram|g]] SI
Eg [[Exagram|g]] SI
fg [[Femtogram|g]] SI
Gg [[Gigagram|g]] SI
hg [[Kilogram#SI multiples|g]] SI
kg [[Kilogram|g]] SI
mcg [[Microgram|g]] SI
Mg [[Megagram|g]] SI
mg [[Milligram|g]] SI
ug [[Microgram|g]] SI
μg [[Microgram|g]] SI
ng [[Nanogram|g]] SI
Pg [[Petagram|g]] SI
pg [[Picogram|g]] SI
Tg [[Tonne|g]] SI
yg [[Yoctogram|g]] SI
Yg [[Yottagram|g]] SI
zg [[Zeptogram|g]] SI
Zg [[Zettagram|g]] SI
```



```

== Pressure and density ==
psi [[Pounds per square inch|psi]]
g.cm-3 [[Gram per cubic centimetre|g&sdot;cm<sup>-3</sup>]]
g/cm3 [[Gram per cubic centimetre|g/cm<sup>3</sup>]]
kg.m-3 [[Kilogram per cubic metre|kg&sdot;m<sup>-3</sup>]]
kg/m3 [[Kilogram per cubic metre|kg/m<sup>3</sup>]]
kg/cm3 [[Density#Formula and common units|kg/cm<sup>3</sup>]]
g/L [[Gram per litre|g/L]]
g/l [[Gram per litre|g/l]]
mcg/dL [[Gram per litre|µg/dL]]
mcg/dl [[Gram per litre|µg/dl]]
mg/mL [[Gram per litre|mg/mL]]
mg/ml [[Gram per litre|mg/ml]]
ug/dL [[Gram per litre|µg/dL]]
ug/dl [[Gram per litre|µg/dl]]
µg/dL [[Gram per litre|µg/dL]]
µg/dl [[Gram per litre|µg/dl]]
mg.L-1 [[Gram per litre|<abbr title="milligrams per liter">mg/L</abbr>]]
mg/L [[Gram per litre|<abbr title="milligrams per liter">mg/L</abbr>]]
mg.l-1 [[Gram per litre|<abbr title="milligrams per liter">mg/l</abbr>]]
mg/l [[Gram per litre|<abbr title="milligrams per liter">mg/l</abbr>]]

== Fracture toughness ==
MPa.m.5 [[Fracture toughness|MPa&sdot;m<sup>1/2</sup>]]
kPa.m.5 [[Fracture toughness|kPa&sdot;m<sup>1/2</sup>]]
Pa.m.5 [[Fracture toughness|Pa&sdot;m<sup>1/2</sup>]]

== Temperature ==
degC °C ALIAS
degF °F ALIAS
degR °R ALIAS

K [[Kelvin|K]] SI
YK [[Yottakelvin|K]] SI
ZK [[Zettakelvin|K]] SI
EK [[Kelvin|K]] SI
PK [[Petakelvin|K]] SI
TK [[Terakelvin|K]] SI
GK [[Gigakelvin|K]] SI
MK [[Megakelvin|K]] SI
kK [[Kilokelvin|K]] SI
hK [[Hectokelvin|K]] SI
daK [[Decakelvin|K]] SI
dK [[Decikelvin|K]] SI
cK [[Centikelvin|K]] SI
mK [[Millikelvin|K]] SI
µK [[Microkelvin|K]] SI
uK [[Microkelvin|K]] SI
nK [[Nanokelvin|K]] SI
pK [[Picokelvin|K]] SI
fK [[Femtokelvin|K]] SI
aK [[Attokelvin|K]] SI
zK [[Zeptokelvin|K]] SI
yK [[Yoctokelvin|K]] SI

== Electromagnetism ==
Wb [[Weber (unit)|Wb]]
N.A-2 [[Permeability (electromagnetism)|N&sdot;A<sup>-2</sup>]]
H.m-1 [[Permeability (electromagnetism)|H&sdot;m<sup>-1</sup>]]
V.m-1 [[Electric field|V&sdot;m<sup>-1</sup>]]
V/m [[Electric field|V/m]]

C [[Coulomb|C]] SI

```



```
YC [[Coulomb|C]] SI
ZC [[Coulomb|C]] SI
EC [[Coulomb|C]] SI
PC [[Coulomb|C]] SI
TC [[Coulomb|C]] SI
GC [[Coulomb|C]] SI
MC [[Coulomb|C]] SI
kC [[Coulomb|C]] SI
hC [[Coulomb|C]] SI
daC [[Coulomb|C]] SI
dC [[Coulomb|C]] SI
cC [[Coulomb|C]] SI
mC [[Coulomb|C]] SI
µC [[Coulomb|C]] SI
uC [[Coulomb|C]] SI
nC [[Coulomb|C]] SI
pC [[Coulomb|C]] SI
fC [[Coulomb|C]] SI
aC [[Coulomb|C]] SI
zC [[Coulomb|C]] SI
yC [[Coulomb|C]] SI

F [[Farad|F]] SI
YF [[Farad|F]] SI
ZF [[Farad|F]] SI
EF [[Farad|F]] SI
PF [[Farad|F]] SI
TF [[Farad|F]] SI
GF [[Farad|F]] SI
MF [[Farad|F]] SI
kF [[Farad|F]] SI
hF [[Farad|F]] SI
daF [[Farad|F]] SI
dF [[Farad|F]] SI
cF [[Farad|F]] SI
mF [[Farad|F]] SI
µF [[Farad|F]] SI
uF [[Farad|F]] SI
nF [[Farad|F]] SI
pF [[Farad|F]] SI
fF [[Farad|F]] SI
aF [[Farad|F]] SI
zF [[Farad|F]] SI
yF [[Farad|F]] SI

H [[Henry (unit)|H]] SI
YH [[Henry (unit)|H]] SI
ZH [[Henry (unit)|H]] SI
EH [[Henry (unit)|H]] SI
PH [[Henry (unit)|H]] SI
TH [[Henry (unit)|H]] SI
GH [[Henry (unit)|H]] SI
MH [[Henry (unit)|H]] SI
kH [[Henry (unit)|H]] SI
hH [[Henry (unit)|H]] SI
daH [[Henry (unit)|H]] SI
dH [[Henry (unit)|H]] SI
cH [[Henry (unit)|H]] SI
mH [[Henry (unit)|H]] SI
µH [[Henry (unit)|H]] SI
uH [[Henry (unit)|H]] SI
nH [[Henry (unit)|H]] SI
pH [[Henry (unit)|H]] SI
fH [[Henry (unit)|H]] SI
```



```
aH [[Henry (unit)|H]] SI
zH [[Henry (unit)|H]] SI
yH [[Henry (unit)|H]] SI

A [[Ampere|A]] SI
YA [[Ampere|A]] SI
ZA [[Ampere|A]] SI
EA [[Ampere|A]] SI
PA [[Ampere|A]] SI
TA [[Ampere|A]] SI
GA [[Ampere|A]] SI
MA [[Ampere|A]] SI
kA [[Ampere|A]] SI
hA [[Ampere|A]] SI
daA [[Ampere|A]] SI
dA [[Ampere|A]] SI
cA [[Ampere|A]] SI
mA [[Ampere|A]] SI
µA [[Ampere|A]] SI
uA [[Ampere|A]] SI
nA [[Ampere|A]] SI
pA [[Ampere|A]] SI
fA [[Ampere|A]] SI
aA [[Ampere|A]] SI
zA [[Ampere|A]] SI
yA [[Ampere|A]] SI

V [[Volt|V]] SI
YV [[Volt|V]] SI
ZV [[Volt|V]] SI
EV [[Volt|V]] SI
PV [[Volt|V]] SI
TV [[Volt|V]] SI
GV [[Volt|V]] SI
MV [[Volt|V]] SI
kV [[Volt|V]] SI
hV [[Volt|V]] SI
daV [[Volt|V]] SI
dV [[Volt|V]] SI
cV [[Volt|V]] SI
mV [[Volt|V]] SI
µV [[Volt|V]] SI
uV [[Volt|V]] SI
nV [[Volt|V]] SI
pV [[Volt|V]] SI
fV [[Volt|V]] SI
aV [[Volt|V]] SI
zV [[Volt|V]] SI
yV [[Volt|V]] SI

VA [[Volt-ampere|VA]] SI
YVA [[Volt-ampere|VA]] SI
ZVA [[Volt-ampere|VA]] SI
EVA [[Volt-ampere|VA]] SI
PVA [[Volt-ampere|VA]] SI
TVA [[Volt-ampere|VA]] SI
GVA [[Volt-ampere|VA]] SI
MVA [[Volt-ampere|VA]] SI
kVA [[Volt-ampere|VA]] SI
hVA [[Volt-ampere|VA]] SI
daVA [[Volt-ampere|VA]] SI
dVA [[Volt-ampere|VA]] SI
cVA [[Volt-ampere|VA]] SI
mVA [[Volt-ampere|VA]] SI
```



μVA [[Volt-ampere|VA]] SI
 uVA [[Volt-ampere|VA]] SI
 nVA [[Volt-ampere|VA]] SI
 pVA [[Volt-ampere|VA]] SI
 fVA [[Volt-ampere|VA]] SI
 aVA [[Volt-ampere|VA]] SI
 zVA [[Volt-ampere|VA]] SI
 yVA [[Volt-ampere|VA]] SI

Ω [[Ohm|\Omega]] SI

$\text{Y}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|Y\Omega\⋅m]] 1e24
 $\text{Z}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|Z\Omega\⋅m]] 1e21
 $\text{E}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|E\Omega\⋅m]] 1e18
 $\text{P}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|P\Omega\⋅m]] 1e15
 $\text{T}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|T\Omega\⋅m]] 1e12
 $\text{G}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|G\Omega\⋅m]] 1e9
 $\text{M}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|M\Omega\⋅m]] 1e6
 $\text{k}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|k\Omega\⋅m]] 1e3
 $\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|\Omega\⋅m]] 1
 $\text{m}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|m\Omega\⋅m]] 1e-3
 $\mu\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|\mu\Omega\⋅m]] 1e-6
 $\text{u}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|\mu\Omega\⋅m]] 1e-6
 $\text{n}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|n\Omega\⋅m]] 1e-9
 $\text{p}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|p\Omega\⋅m]] 1e-12
 $\text{f}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|f\Omega\⋅m]] 1e-15
 $\text{a}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|a\Omega\⋅m]] 1e-18
 $\text{z}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|z\Omega\⋅m]] 1e-21
 $\text{y}\Omega.\text{m}$ [[Electrical resistivity and conductivity#Definition|y\Omega\⋅m]] 1e-24

R [[Rayleigh (unit)|R]] SI

G [[Gauss (unit)|G]] SI
aG [[Attogauss|G]] SI
cG [[Centigauss|G]] SI
daG [[Decagauss|G]] SI
dG [[Decigauss|G]] SI
EG [[Exagauss|G]] SI
fG [[Femtogauss|G]] SI
GG [[Gigagauss|G]] SI
hG [[Hectogauss|G]] SI
kG [[Kilogauss|G]] SI
MG [[Megagauss|G]] SI
mG [[Milligauss|G]] SI
uG [[Microgauss|G]] SI
 μG [[Microgauss|G]] SI
nG [[Nanogauss|G]] SI
PG [[Petagauss|G]] SI
pG [[Picogauss|G]] SI
TG [[Teragauss|G]] SI
yG [[Yoctogauss|G]] SI
YG [[Yottagauss|G]] SI
zG [[Zeptogauss|G]] SI
ZG [[Zettagauss|G]] SI

T [[Tesla (unit)|T]] SI
aT [[Attotesla|T]] SI
cT [[Centitesla|T]] SI
daT [[Decatesla|T]] SI
dT [[Decitesla|T]] SI
ET [[Exatesla|T]] SI
fT [[Femtotesla|T]] SI
GT [[Gigatesla|T]] SI
hT [[Hectotesla|T]] SI



```

kT [[Kilotesla|T]] SI
MT [[Megatesla|T]] SI
mT [[Millitesla|T]] SI
uT [[Microtesla|T]] SI
µT [[Microtesla|T]] SI
nT [[Nanotesla|T]] SI
PT [[Petatesla|T]] SI
pT [[Picotesla|T]] SI
TT [[Teratesla|T]] SI
yT [[Yoctotesla|T]] SI
YT [[Yottatesla|T]] SI
zT [[Zeptotesla|T]] SI
ZT [[Zettatesla|T]] SI

== Astrophysics ==
au [[Astronomical unit|au]]
c [[Speed of light|'c']]
ly [[Light-year|ly]]
dex [[decimal exponent|dex]]
Earth mass [[Earth mass|'M'<sub></sub>]]
Earth radius [[Earth radius|'R'<sub></sub>]]
M_Earth [[Earth mass|'M'<sub></sub>]]
R_Earth [[Earth radius|'R'<sub></sub>]]
M+ [[Earth mass|'M'<sub></sub>]]
R+ [[Earth radius|'R'<sub></sub>]]
Jupiter mass [[Jupiter mass|'M'<sub>J</sub>]]
Jupiter radius [[Jupiter radius|'R'<sub>J</sub>]]
M_Jupiter [[Jupiter mass|'M'<sub>J</sub>]]
R_Jupiter [[Jupiter radius|'R'<sub>J</sub>]]
Solar mass [[Solar mass|'M'<sub>&#x2609;</sub>]]
solar mass [[Solar mass|'M'<sub>&#x2609;</sub>]]
M_Solar [[Solar mass|'M'<sub>&#x2609;</sub>]]
M_solar [[Solar mass|'M'<sub>&#x2609;</sub>]]
R_Solar [[Solar radius|'R'<sub>&#x2609;</sub>]]
R_solar [[Solar radius|'R'<sub>&#x2609;</sub>]]
Solar radius [[Solar radius|'R'<sub>&#x2609;</sub>]]
solar radius [[Solar radius|'R'<sub>&#x2609;</sub>]]
Solar luminosity [[Solar luminosity|'L'<sub>&#x2609;</sub>]]
solar luminosity [[Solar luminosity|'L'<sub>&#x2609;</sub>]]
L_solar [[Solar luminosity|'L'<sub>&#x2609;</sub>]]
L_Solar [[Solar luminosity|'L'<sub>&#x2609;</sub>]]
Lo [[Solar luminosity|'L'<sub>&#x2609;</sub>]]
pc2 [[Parsec|pc<sup>2</sup>]]
pc3 [[Parsec|pc<sup>3</sup>]]
kpc2 [[Parsec#Parsecs and kiloparsecs|kpc<sup>2</sup>]]
kpc3 [[Parsec#Parsecs and kiloparsecs|kpc<sup>3</sup>]]
kpc [[Parsec#Parsecs and kiloparsecs|kpc]]
Mpc2 [[Parsec#Megaparsecs and gigaparsecs|Mpc<sup>2</sup>]]
Mpc3 [[Parsec#Megaparsecs and gigaparsecs|Mpc<sup>3</sup>]]
Mpc [[Parsec#Megaparsecs and gigaparsecs|Mpc]]
Gpc2 [[Parsec#Megaparsecs and gigaparsecs|Gpc<sup>2</sup>]]
Gpc3 [[Parsec#Megaparsecs and gigaparsecs|Gpc<sup>3</sup>]]
Gpc [[Parsec#Megaparsecs and gigaparsecs|Gpc]]

== Nuclear physics and chemistry ==
cm-1 [[Wavenumber|cm<sup>-1</sup>]]
u [[Unified atomic mass unit|u]]
osmol [[Osmole (unit)|osmol]]
Osm [[Osmole (unit)|Osm]]
M [[Molarity|M]]
TM [[Molarity|M]] SI
GM [[Molarity|M]] SI
MM [[Molarity|M]] SI
kM [[Molarity|M]] SI

```



hM [[Molarity|M]] SI
daM [[Molarity|M]] SI
dM [[Molarity|M]] SI
cM [[Molarity|M]] SI
mM [[Molarity|M]] SI
uM [[Molarity|M]] 1e-6
nM [[Molarity|M]] SI
pM [[Molarity|M]] SI
kg.mol⁻¹ [[Molar mass|kg⋅mol⁻¹]]
kg/mol [[Molar mass|kg/mol]]
g.mol⁻¹ [[Molar mass|g⋅mol⁻¹]]
g/mol [[Molar mass|g/mol]]
eV/c² [[Electronvolt#Mass|eV/'c'²]]
keV/c² [[Electronvolt#Mass|keV/'c'²]]
MeV/c² [[Electronvolt#Mass|MeV/'c'²]]
GeV/c² [[Electronvolt#Mass|GeV/'c'²]]
TeV/c² [[Electronvolt#Mass|TeV/'c'²]]
μN [[Nuclear magneton|μspan style="display:inline-block;margin-bottom:-0.3em;vertical-align:middle">eV]]
μB [[Bohr magneton|μspan style="display:inline-block;margin-bottom:-0.3em;vertical-align:middle">eV]]
eV [[Electronvolt|eV]]
meV [[Electronvolt|meV]]
keV [[Electronvolt|keV]]
MeV [[Electronvolt|MeV]]
GeV [[Electronvolt|GeV]]
TeV [[Electronvolt|TeV]]
mol⁻¹ [[Avogadro constant|mol⁻¹]]
J.mol⁻¹ [[Joule per mole|J⋅mol⁻¹]]
J/mol [[Joule per mole|J/mol]]
kJ.mol⁻¹ [[Joule per mole|kJ⋅mol⁻¹]]
kJ/mol [[Joule per mole|kJ/mol]]
MJ.mol⁻¹ [[Joule per mole|MJ⋅mol⁻¹]]
MJ/mol [[Joule per mole|MJ/mol]]
GJ.mol⁻¹ [[Joule per mole|GJ⋅mol⁻¹]]
GJ/mol [[Joule per mole|GJ/mol]]
TJ.mol⁻¹ [[Joule per mole|TJ⋅mol⁻¹]]
TJ/mol [[Joule per mole|TJ/mol]]

== Numbers and phrases ==
pp [[Page (paper)|pp]]
ppb [[Parts per billion|ppb]] 1e-9
ppm [[Parts per million|ppm]] 1e-6
billiard [[Orders of magnitude (numbers)#1015|billiard]] 1e15
billion [[1,000,000,000|billion]] 1e9
billionth [[1,000,000,000|billionth]] 1e-9
billionths [[1,000,000,000|billionths]] 1e-9
decilliard [[Orders of magnitude (numbers)#1063|decilliard]] 1e63
decillion [[Orders of magnitude (numbers)#1033|decillion]] 1e33
decillionth [[Orders of magnitude (numbers)#1033|decillionth]] 1e-33
decillionths [[Orders of magnitude (numbers)#1033|decillionths]] 1e-33
milliard [[1,000,000,000|milliard]] 1e9
million [[Million|million]] 1e6
millionth [[Million|millionth]] 1e-6
millionths [[Million|millionths]] 1e-6
nonilliard [[Orders of magnitude (numbers)#1057|nonilliard]] 1e57
nonillion [[Orders of magnitude (numbers)#1030|nonillion]] 1e30
nonillionth [[Orders of magnitude (numbers)#1030|nonillionth]] 1e-30
nonillionths [[Orders of magnitude (numbers)#1030|nonillionths]] 1e-30
octilliard [[Orders of magnitude (numbers)#1051|octilliard]] 1e51
octillion [[Orders of magnitude (numbers)#1027|octillion]] 1e27
octillionth [[Orders of magnitude (numbers)#1027|octillionth]] 1e-27
octillionths [[Orders of magnitude (numbers)#1027|octillionths]] 1e-27
quadrilliard [[Orders of magnitude (numbers)#1027|quadrilliard]] 1e27
quadrillion [[Orders of magnitude (numbers)#1015|quadrillion]] 1e15
quadrillionth [[Orders of magnitude (numbers)#1015|quadrillionth]] 1e-15



```

quadrillionths [[Orders of magnitude (numbers)#1015|quadrillionths]] 1e-15
quintilliard [[Orders of magnitude (numbers)#1033|quintilliard]] 1e33
quintillion [[Orders of magnitude (numbers)#1018|quintillion]] 1e18
quintillionth [[Orders of magnitude (numbers)#1018|quintillionth]] 1e-18
quintillionths [[Orders of magnitude (numbers)#1018|quintillionths]] 1e-18
septilliard [[Orders of magnitude (numbers)#1045|septilliard]] 1e45
septillion [[Orders of magnitude (numbers)#1024|septillion]] 1e24
septillionth [[Orders of magnitude (numbers)#1024|septillionth]] 1e-24
septillionths [[Orders of magnitude (numbers)#1024|septillionths]] 1e-24
sextilliard [[Orders of magnitude (numbers)#1039|sextilliard]] 1e39
sextillion [[Orders of magnitude (numbers)#1021|sextillion]] 1e21
sextillionth [[Orders of magnitude (numbers)#1021|sextillionth]] 1e-21
sextillionths [[Orders of magnitude (numbers)#1021|sextillionths]] 1e-21
trilliard [[Orders of magnitude (numbers)#1021|trilliard]] 1e21
trillion [[Orders of magnitude (numbers)#1012|trillion]] 1e12
trillionth [[Orders of magnitude (numbers)#1012|trillionth]] 1e-12
trillionths [[Orders of magnitude (numbers)#1012|trillionths]] 1e-12

```

== Angles ==

%	%	Percent
percent	%	Percent
per cent	%	Percent
‰	‰	Per mil
per mil	‰	Per mil
per mill	‰	Per mil
per mille	‰	Per mil
permil	‰	Per mil
permill	‰	Per mil
permille	‰	Per mil
°	°	Degree (angle)
deg	°	Degree (angle)
'	'	Minute of arc
,	,	Minute of arc
arcmin	'	Minute of arc
arcminute	'	Minute of arc
"	"	Second of arc
''	"	Second of arc
arcsec	"	Second of arc
arcsecond	"	Second of arc
mas	[[Milliarcsecond mas]]	pi/648000000

] =]

```

-- If val has "|long scale=on" the following definitions are used
-- (then, if not found here, the normal definitions are used).

```

```

-- Unit code [[Link|Symbol]] Flags/Scale

```

```

local builtin_units_long_scale = [=]

```

== Long scale numbers and phrases ==

```

billion [[Orders of magnitude (numbers)#1012|billion]] 1e12
billionth [[Orders of magnitude (numbers)#1012|billionth]] 1e-12
billionths [[Orders of magnitude (numbers)#1012|billionths]] 1e-12
decillion [[Orders of magnitude (numbers)#1060|decillion]] 1e60
decillionth [[Orders of magnitude (numbers)#1060|decillionth]] 1e-60
decillionths [[Orders of magnitude (numbers)#1060|decillionths]] 1e-60
nonillion [[Orders of magnitude (numbers)#1054|nonillion]] 1e54
nonillionth [[Orders of magnitude (numbers)#1054|nonillionth]] 1e-54
nonillionths [[Orders of magnitude (numbers)#1054|nonillionths]] 1e-54
octillion [[Orders of magnitude (numbers)#1048|octillion]] 1e48
octillionth [[Orders of magnitude (numbers)#1048|octillionth]] 1e-48
octillionths [[Orders of magnitude (numbers)#1048|octillionths]] 1e-48
quadrillion [[Orders of magnitude (numbers)#1024|quadrillion]] 1e24
quadrillionth [[Orders of magnitude (numbers)#1024|quadrillionth]] 1e-24
quadrillionths [[Orders of magnitude (numbers)#1024|quadrillionths]] 1e-24

```



```
quintillion  [[Orders of magnitude (numbers)#1030|quintillion]]  1e30
quintillionth  [[Orders of magnitude (numbers)#1030|quintillionth]]  1e-30
quintillionths  [[Orders of magnitude (numbers)#1030|quintillionths]]  1e-30
septillion  [[Orders of magnitude (numbers)#1042|septillion]]  1e42
septillionth  [[Orders of magnitude (numbers)#1042|septillionth]]  1e-42
septillionths  [[Orders of magnitude (numbers)#1042|septillionths]]  1e-42
sextillion  [[Orders of magnitude (numbers)#1036|sextillion]]  1e36
sextillionth  [[Orders of magnitude (numbers)#1036|sextillionth]]  1e-36
sextillionths  [[Orders of magnitude (numbers)#1036|sextillionths]]  1e-36
trillion  [[Orders of magnitude (numbers)#1018|trillion]]  1e18
trillionth  [[Orders of magnitude (numbers)#1018|trillionth]]  1e-18
trillionths  [[Orders of magnitude (numbers)#1018|trillionths]]  1e-18

]=]

return { builtin_units = builtin_units, builtin_units_long_scale = builtin_units
```

Modul:Val/units/Doku

Dies ist die Dokumentationsseite für Modul:Val/units

The list of Val units is published at [Template:Val/list](#), and here is the place that produces that report. So preview [Vorlage:TI](#) from the edit box to see your changes before saving them. The file format and syntax are mostly self explanatory.

- The **field separator** is two or more spaces.
- You can enter new units in the "Unsorted units" section if you are not sure where else it might go.
- If the same *unit code* is defined twice on this page, the first one overrides the later one.
- For new entries the style guideline is [Wikipedia:UNITS](#).
- Convert and Val share units. If you have an issue with a unit pagename or a unit symbol, and that unit is not published at Val/list, you may decide to address it at [Template talk:Convert](#). To override entries at Convert, make an entry here.
- If you're not in a hurry, you may notice when editing Val/units that it consists of two Lua string assignments, and Lua comments. Be careful.

Questions or requests related to Val units are welcomed at [Template talk:Val](#). For feedback specifically about the terminology or procedural steps seen on this page, please use the talk page.

Below are the detailed procedures, examples, descriptions of testing and previewing, explanations about sorting Val expressions, and links to helpful pages. There's also further information about Val/Convert relations.

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Introduction

An entry defining a **unit** for Val is a single line under a [section](#) heading.^[1] It starts with the **unit code**, followed by at least two spaces and a [link](#). If you are adding a group of related units, you can enter a blank line around them to group them in the report at Val/list. An entry is ignored if it lacks at least *two adjacent space characters*.

```
codeVorlage:Spaces[[ pagename | symbol ]]
```

unit code

The keyboard typeable name of the symbol that users give Val's [Vorlage:Para](#), [Vorlage:Para](#), [Vorlage:Para](#) or [Vorlage:Para](#) parameters.

- Unit codes will be case sensitive.
- Prefer [Vorlage:Code](#) for the Greek letter μ , if you're not sure.
- Composite units have [dimensions](#) that multiply, divide, and apply powers to component units. Use [Vorlage:Code](#) to multiply, [Vorlage:Code](#) to divide, and a signed digit for powers. For multiplication, [Vorlage:Code](#) is deprecated. When adding a unit that includes division, consider also adding a version with multiplication by the negated power; for example, [Vorlage:Code](#) and [Vorlage:Code](#) (for m/s^2 and ms^2).

unit pagename

Title or section of an article. When linked with ul or upl, the title or one of its [redirects](#) can expand the abbreviation for the unit.^[2]

unit symbol

[Verifiable](#), standard symbol, formatted in accordance with [WP:UNITS](#).

- Templates will not work for producing the unit symbol for input to this module; only [Wikipedia HTML formatting](#) is accepted.
- Composite units use [Vorlage:Code](#) to multiply, [Vorlage:Code](#) to divide, and [Vorlage:Tag](#) for powers. Division is also the unit-inversion form that multiplies a negative numbered power, for example for m/s^2 and ms^2 (from [Vorlage:Code](#) and [Vorlage:Code](#)).
- If the hover-text just shows the abbreviation, it is not a user-friendly unit-symbol. When not linked, the unit's abbreviation can be spelled out with hover-text at the symbol by way of the *title* attribute of either [Vorlage:Tag](#) or [Vorlage:Tag](#).
- For more about HTML tags and HTML symbols such as [Vorlage:Code](#), see [Wikipedia:HTML](#).
- For more information about marking up your unit symbol see [WP:HTML#formatting](#).
- Examples of unit codes, and hover text are at [Template:Val/list](#).

unit code alias

The same unit/pagename/symbol, but by way of a different unit code.

Unit code aliases are commonly applied for

- capitalization, to make the unit code case insensitive.
- per units, for example m/s and ms [Vorlage:Sup](#).
- Greek letters, to allow for both US keyboard and Greek-character-input applications, for example the SI prefix μ

Preview page with this template/module

A feature, similar to a sandbox and testcases, that provides a preview of how the code currently in the edit box (sandbox) will look when applied to any page (testcases).

The preview of main interest is `Template:Val/list`^[3], but previewing other your own page of interest with your newly added unit in a val call and in a sorting table are also part of this procedure. `Template:Val/units/testcases` contains Val calls for all defined Val units.

How to add a unit

To maintain Val units,

1. **Vorlage:Edit** and make your changes.
2. Preview **Vorlage:Space Vorlage:Big Vorlage:Space** .
 - Look for any messages. An "Invalid definition" message is available automatically.
 - **Prove the intended link** from the preview.
 - Hover the mouse over the link, and read the hover-text or URL display somewhere in the browser.
3. Add any unit-code aliases.
4. Add any sorting if needed. Details about sorting are covered below.
5. Preview a test page. It will have template Val calls on it, and it may have a **sortable table** to test sorting. `Template:Val/units/testcases` is a test page containing Val calls for all units.
6. *Show changes* to prove no accidental edits occurred.
7. Save the page. Saving the page activates the changes immediately, and they go live. You're done adding your unit.

If you want a unit to add for practice, add one from **List of common physics notations**, or from **SI units#Units and prefixes**.

Changing or removing existing unit codes is possible by employing **Vorlage:TI** to see how Val unit codes may or may not be in use on the wiki. For example, to see about changing or removing unit code `J.s`, do a

`{{t|usage|val|"J.s"|0}}` → **Vorlage:Tlusage**.

Put any unit code in quotes if it contains dash, dot, or slash **Vorlage:Mdashanything** but a letter or number. See `Template:Val/units/test` for a list of these searches for each Val unit.

Examples

Say you're creating a new page or revamping an old page, and discover the need for a convenient way to make several entries containing c_0 , and link that symbol to the page *Speed of light*. The following entry will define your unit code as `c0`, your unit symbol as `'c'0`, and the unit's article as *Speed of light#Numerical value, notation, and units*.

`c0Vorlage:SpacesVorlage:BigSpeed of light#Numerical value, notation, and unit symbolVorlage:Big'c'0Vorlage:Big`

or as explained below at §[Advanced unit entry formats](#), you can also write

```
c0Vorlage:Spaces' 'c' '<sub>0</sub>Vorlage:SpacesSpeed of light#Numerical value,
notation, and units
```

Then preview with *Template:Val/list*, and check for an error message next to the new unit, and test the link you gave.

After that the page with the (saved) Val calls is used to test the linked and non-linked versions of the normal and the per units:

- `{{val|0.891|u=c0}}` → [Vorlage:Val](#)
- `{{val|0.891|ul=c0}}` → [Vorlage:Val](#)
- `{{val|0.891|up=c0}}` → [Vorlage:Val](#)
- `{{val|0.891|upl=c0}}` → [Vorlage:Val](#)

For an entire example that uses the other format to make a Val/unit entry.

1. Put this in a sandbox: `{{val|1.23|ul=tins}}` → [Vorlage:Val](#)
2. Edit [Module:Val/units](#) and insert a line like the following (do not save yet):


```
tinsVorlage:SpacetinsVorlage:SpacesContins unities
```
3. Under "Preview page with this module" enter *Template:Val/list*, and click *Show preview*. It shows Val/list through the version of Val/units in the edit box. Say there are no errors, the markup and hover-text look good, and the link navigates to the unit's page.
4. Then in the same way of previewing, put the [fullpagename](#) of the sandbox from step 1, and click *Show preview*.
5. *Save page* to save the edit to Module:Val/units.

If you want a unit to add for practice, add one from *List of common physics notations*, or from *SI units#Units and prefixes*. There are many examples of *composite* units that have their own page, so adding a unit code for one of those should link to its page. There are many articles that could use a new Val unit, such as molarity at [Resveratrol](#).

Either of the test pages of these examples could have the sortable test-table shown in the next section.

Testing a new unit

To test a *newly added* unit not used on any page, you will need to run the preview on a sandbox page you have already created. Here are all the test cases you can preview there before saving your changes here; they are the four [Vorlage:Para](#) parameters:

```
{{Val|9|u =          }}
{{Val|9|ul =         }}
{{Val|9|u=foo|up =   }}
{{Val|9|u=foo|upl =  }}
```

and the [sortable table](#):

```
{| class="wikitable sortable" summary="Sortable table to test Val sorting"
! Val number and unit
|-
| {{val|5|u=    }}
|-
| {{val|3|u=    }}
|-
| {{val|1|u=    }}
|-
| {{val|2|u=    }}
|-
| {{val|4|u=    }}
|}
```

This table falls into place unsorted, so when your unit accepts an **SI prefix** you can test, say, k, m, and G, with your unit, and compare with e notations 1e3, 1e6, and 1e9 in the number. For example, Val sorts these two as equal: 1e3 m (standard **e notation**) and 1 km.

What to look for

- The linked and non-linked markup should look exactly the same.
- Navigate to the new link. It is safe: you can go back in your browser to here.
- The two **Vorlage:Para** versions should have no space in front of them.
- For SI prefixes sorting 2e3 (or 2000) should be greater than k (kilo prefix).

Advanced unit-entry format

In the usual format

```
codeVorlage:Spaces[[pagename|symbol]]
```

the wikilink represents two fields itself, for a total of three fields per entry. But you cannot use a wikilink for composite units that need more than one pagename.

The other record type for adding a unit entry is also three fields. It has the same three fields, but they are in a different order.

```
codeVorlage:SpacessymbolVorlage:Spacespagename
```

This format separates each field with whitespace, and also takes tabs between fields two and three.

For a new composite unit you should probably link the whole composition, or link the largest portion which could have its own page.

- The val user can compose a *divisor* unit on the fly from existing unit codes, and with individually linked numerator and denominator. For example:

`{{val|99|u1=m|u2=d}}` → **Vorlage:Val**

- The val user can compose a *multiplier* unit on the fly by using the **Vorlage:Para** parameter to prepend to the unit, and *these* can also be individually linked. For example (in geology) there is already **Vorlage:Val** to use with **Vorlage:Para**:

`{{val|333|u1=uBP|end= ; [[megaannum|Ma]]}}` → **Vorlage:Val"**.

For example **Template:Val/list** says

`m.s-1 Vorlage:BigMetre per second|m⋅s^{−1}Vorlage:Big` linking to an article titled *Metre per second*, not

`m.s-1 Vorlage:BigMetre|mVorlage:Big⋅Vorlage:BigSecond|sVorlage:Big^{−1}` which has separate links to already existing unit codes.

Fourth field flags

The module must be told directly about sorting factors, spacing, and aliasing for a unit code.

There is an optional field that goes at the end after two or more spaces or one or more tabs. It is a flag mainly used to provide for that unit to be sorted in a table. Flags are mainly for sorting, and they work for either record type. Just add two or more spaces, or one or more tabs, and then the flag field. (Optional flags ALIAS and NOSPACE and ANGLE are for even more advanced users. See §Advanced unit flags below.)

Using SI requires that the unit symbol compare precisely to the unit code, and so never allows HTML or other characters in the symbol. Any difference between the unit symbol and unit code must be an SI prefix, such as k, M, or G.

Sorting

Vorlage:Details **Vorlage:Details**

Val's sorting scale factor is for comparison to other Val units that might be sorted with it.

Where **Sorting** is done on the wiki, it is done in **sortable tables**. Val entries in a sortable table will need a fourth field sorting flag. It can be a number, an equation, or an SI, but it flags the same function: a wikitable sorting "scale".

To display the sort key use **Vorlage:Para**. For example

- `{{val|999|u=uV|debug=yes}}` → 6996998999999999999♠999 μV
- `{{val|99|u=V|debug=yes}}` → 7001990000000000000♠99 V



- `{{val|1|u=kV|debug=yes}}` → `7003100000000000000♠`1 kV

Scale

For scaling a unit to sort properly, you need to pick a number for a sorting factor. There are numerous examples at [Template:Val/list](#) and at [Template:Val/sortkey/unit](#). A **system of units** will have its base units, for example 1 bit; then the scale for sorting a kilobyte unit is then 8000 (eight bits per byte, times a kilo, or thousand). Or a year scale is seconds so that all *times* sort by seconds, which is a base unit. In general the scale shows to be "base unit" of the same type times the "SI prefix", and if it's not that simple, then the unit system's number has associated a number to it, such as Avogadro's number.

For example, the following defines a unit with code `billion`, symbol `billion`, link `1,000,000,000`, and scale `1e9` ([Vorlage:Val](#)). After the following entry is saved to the database

<code>billion</code>	<code>billion</code>	<code>1,000,000,000</code>	<code>1e9</code>
----------------------	----------------------	----------------------------	------------------

`{{val|2|u=billion}}` would start sorting after `{{val|98.7|e=3}}`.

SI flag

[Vorlage:Common metric prefixes](#) SI is used because it scales Val expressions automatically, and it is a clean indicator that the unit will sort properly. It correctly scales any SI prefix for sorting, but not other unit codes.

For SI the unit symbol will not accept HTML, but will accept μ . HTML is not accepted at this time because in order to validate the entry, the unit code must differ from the unit symbol by exactly one valid **SI prefix**. If there is no difference, or too much difference, it is an invalid definition for sorting purposes. The exception is for the Greek letter μ : if you used a character input application to "install" the Greek letter μ in your symbol, for your "easy to type" unit code, [Vorlage:Key](#), these two are not a character mismatch.

All unit entries that use SI will have the same base unit as the symbol at Val/units, but they will display properly at Val/list.

For example, kilo is a thousand, but you're defining km² for kilometers squared, and need HTML. You can't use SI with HTML, so use `1000*1000`, or `1000000` in the sorting field. Use `1e-6` or `0.000001` or `1/100000` instead.

If the unit you are maintaining has SI prefixes and they are all likely to be sorted in a table, add up to twelve entries, one for each common SI unit. Some of these, like *Meter* in the example, may have their own article, but usually all go to the base unit's pagename. Here is how *meter* is defined.

<code>m</code>	<code>[[Metre m]]</code>	SI
<code>cm</code>	<code>[[Centimetre m]]</code>	SI
<code>dam</code>	<code>[[Decametre m]]</code>	SI
<code>dm</code>	<code>[[Decimetre m]]</code>	SI
<code>hm</code>	<code>[[Hectometre m]]</code>	SI



km	[[Kilometre m]]	SI
Mm	[[Megametre m]]	SI
mm	[[Millimetre m]]	SI
um	[[Micrometre μm]]	1/1000000
μm	[[Micrometre m]]	SI
nm	[[Nanometre m]]	SI
pm	[[Picometre m]]	SI

The information that was in the unit symbol is now fully specified in, and exhibited at, the unit code. SI specifies that the unit's symbol has been transformed from a symbol to a string for use in string comparison that will finally result in calculating a sorting factor. It conveniently uses the idea that the unit code is often equal to the symbol, especially with SI units. The field definitions are sacrificed for a simplicity in the user presentation, user calculation, and user entry.

In the other format, the following defines three unit codes for volts, V for sorting. V is the base unit with the SI prefix removed. A unit code defined in this manner will have its sort key scaled by the software according to the SI prefix produced by the difference between the unit code and unit symbol.

kV	V	Kilovolt	SI
μV	V	Microvolt	SI
uV	V	Microvolt	SI

Now `{{val|1|u=kV}}` will sort after `{{val|999|u=V}}` without having to resort to using a number, and with the clean representation at Val/list.

The symbol column shows "V" for each, but it is not the symbol—it is the base unit after removing the SI prefix so convert can work out what is intended to be the prefix. The following would give identical results:

kV	kV	Kilovolt	1e3
μV	μV	Microvolt	1e-6
uV	μV	Microvolt	1e-6

As you can see, without "SI", you define both the symbol, and the scale. You define the symbol with HTML or the Greek letter or other symbol, and you define the scale with a number or an equation. When "SI" is used, convert just does the right thing for the symbol and scale.

Alias a Convert unit

If you are here to change the link or markup of a unit, but it is not listed at Val/units, sometimes you can find the unit markup and link that you do want, already existing at [Template:Convert#Units](#). In that case you can change the unit code to whatever you'd prefer, and it will achieve your goal. For example, if `{{Val|1|C}}` is going to Celsius instead of Coulombs, you can define your own unit code, say "degC".

The following defines **degC** to refer to the unit known as °C in convert. There is no link because a link is defined at Convert.

degC	°C	ALIAS
------	----	-------

File format

If you want to reorganize sections here, note that the two lines `local builtin_units` and `local builtin_units_long_scale` require a blank line after them. The section **long scale**, with all the units like "billions" and "trillions", is under the latter, near the bottom of the page. All the rest of the units are in the former.

The file format is two Lua strings and a return statement with them in it: a string in quotes `[=[... builtin_units ...]=]`, and another string in quotes `[=[... builtin_units_long_scale ...]=]`. The first string, `builtin_units`, is short-scale, second string is long scale. The reason there are two strings is because of the difference between British and US terms surrounding "billion", "billionth", etc.

For each string there must be a blank line before the first line of the string and after the last line of the string. In other words the first two and last two characters of each string must be newlines.

There is one record per line, starting in first column, having 2-4 fields. The field separator is two or more spaces. Between first and second fields, use two or more spaces. Between all other fields, use two or more spaces, or one or more tabs. Entries without two spaces in them are ignored.

Advanced unit flags

You can alias Convert or Val units. But these are different things.

- A "unit code alias" is when the same *unit pagename and unit symbol* are defined twice. If a different *unit code* is assigned to the same unit symbol and unit pagename, (say, as a copy of the previous entry) it will work as a Val alias.
- A "unit alias" is when Val alias a Convert unit code. A unit of measurement is *here* denoted ALIAS to mean "they are defined *there*". Val *defaults* to Convert, but it's good to this explicit for certain Val units: the ones tempting to define here, but that you don't want defined here because, says ALIAS, they are *already* defined there.
- If your unit code is not listed at [Vorlage:TI](#), you can check for it at [Vorlage:TI](#), or at [Vorlage:TI](#)

For spacing and aliasing:

- ALIAS specifies that the unit's symbol is the code for a unit defined in [Vorlage:Tlf}](#).
- NOSPACE prevents the default insertion of a non-breaking space before the unit symbol.
- If you see the ANGLE flag, this identifies those special units that must displayed not only after the main Val number, but also after its **uncertainty#Measurements** numbers.(ANGLE also implies NOSPACE.)

Interaction with Convert

Val and Convert share unit codes, but their units of measurement are different.

- Most of the wiki's unit codes are managed by [Vorlage:TI](#).



- Some very few unit codes here, like C and F, mean something different there. Val caters to Coulombs and Farads, while Convert caters to Celsius and Fahrenheit. Convert and Val *unit codes* are mostly identical, like they are for `degC` and for `degF`.
- Val could need *any* unit, while not all units are needed in conversions, so Val needs *all* of Convert's units and some of its own.
- Sorting functionality is handled for Val by [Vorlage:Tlf.](#))
- At Convert the procedure for defining a unit is much more involved than it is here, because there every unit defined must reference associated units, conversion factors, alternate spellings, and many other attributes. [An entry at Convert](#) is defined as a multi-line, multi-attribute Lua table with its attendant syntax, and inside a larger Lua script. Therefore Convert is more conservative about adding units. Val may be more liberal in this respect if only because unit entry is simpler and "wikified". Therefore **WP:Be bold**. Bold customization may be a worthwhile risk at Val/units, or it may get removed. Although units used in *articles* have definite stylistic standards, there remains room for depending on Val for markup (but see **WP:Accessibility** about color, link, and text). You may want to customize some Val unit codes that will automate some Val markup for special articles, the *talk page*, etc. See **WP:HTML#formatting** for possibilities.

Notes

[Vorlage:Refs](#)

See also

- [Module:Val](#)
 - [Template:Val/units/test](#)
 - [Template:Val/units/testcases](#)
 - [Template:Val/units/loadtest](#)
 - [Template:Val/unitsfromconvert](#)
1. ↑ Module pages don't have section editing.
 2. ↑ A redirect page is easy to make; there are tools on the editor toolbars.
 3. ↑ The special relation between Val/units and Val/list is that the wikitext of Val/list is always generated by Val/units when that page is viewed, *so* when you **preview page with this module**, Val/list is generated using the contents of the edit box of Val/units.



Modul:Val/units/sandbox

Die Dokumentation für dieses Modul kann unter [Modul:Val/units/sandbox/Doku](#) erstellt werden

```
-- Definitions for units known to val
-- File format is two strings and a return statement with them in it:
-- string in quotes [= [ ... builtin_units ... ]=].
-- string in quotes [= [ ... builtin_units_long_scale ... ]=].
-- First string, builtin_units, is short-scale, second string is long scale.

-- Entry format:
-- One record per line, starting in first column, having 2-4 fields.
-- Field separator: two or more spaces
-- Between first and second fields: two or more spaces
-- Between all other fields: two or more spaces, or one or more tabs
-- Entries without two spaces in them are ignored.

-- There must be a blank line before the first entry and after the last.
-- I.e. the first two and last two characters of the string must be newlines.

-- Format of entry. Two record types:
--
-- One record type is a wikilink:
-- Unit-code      [[ pagename | Symbol-accepts-HTML-only ]]
-- Text-field separator is still two spaces. Two spaces not allowed in wikilink
--
-- The other record type is all fields:
-- Unit-code      symbol-accepts-HTML-only      pagename#section-OK
--
-- Plus there is an optional field that goes at the end after two or more spaces
-- Whether it is a number or an equation or the letters SI,
-- any of these three has the same function: a wikipable sorting "scale".
-- It is for sorting, and it works for either record type.
-- Difference is SI can't accept HTML. But SI correctly scales any SI prefix.
-- (Optional fields ALIAS and NOSPAC and ANGLE are for advanced users.)

-- "Invalid unit" error:
-- Using SI requires that the symbol equal unit-code, so never allows HTML.
-- Any difference between SI or symbol must be an SI prefix, such as k, M, or G.
-- A space at the end of an entry is an error. No space at each EOL.

local builtin_units = [=

== Test ==
Foo  [[Hz|<samp>Foo</samp>]]
Baz  [[Hertz|baz<sub>0</sub>]]
Baz  [[Kelvins|baz<sub>0</sub>]]
Bar  [[Foobar|bar<abbr title="super duper">0</abbr>]]
quux [[Foobar|<span title="super duper 2">bar</span>]]

== Unsorted units ==
c0  [[Speed of light#Numerical value, notation, and units|'c''<sub>0</sub>]]
lbf [[Pound (force)|<span title="pound-force">lb<sub>F</sub></span> ]]
N.s [[Newton-second|N&sdot;s]]
J.K-1 [[Joule per kelvin|J&sdot;K<sup>-1</sup>]]
C.mol-1 [[Faraday constant|C&sdot;mol<sup>-1</sup>]]
C/mol [[Faraday constant|C/mol]]
C.kg-1 [[Roentgen (unit)|C&sdot;kg<sup>-1</sup>]]
C/kg  [[Roentgen (unit)|C/kg]]
F.m-1 [[vacuum permittivity|F&sdot;m<sup>-1</sup>]]
```



```

F/m [[vacuum permittivity|F/m]]
e [[Elementary charge|'e']]
kB [[Kilobyte|kB]] 8e3
MB [[Megabyte|MB]] 8e6
GB [[Gigabyte|GB]] 8e9
TB [[Terabyte|TB]] 8e12
lx [[Lux (unit)|lx]]
nat [[nat (unit)|nat]]

== Time and frequency ==
byte/s [[Data rate units|byte/s]] 8
kB/s [[Data rate units#Kilobyte per second|<span title="Kilobytes per second">kB/s</span>]]
MB/s [[Data rate units#Megabyte per second|<span title="Megabytes per second">MB/s</span>]]
GB/s [[Data rate units#Gigabyte per second|<span title="Gigabytes per second">GB/s</span>]]
TB/s [[Data rate units#Terabyte per second|<span title="Terabytes per second">TB/s</span>]]
bit/s [[Bit per second|bit/s]] 1
bps [[Bit per second|bit/s]] 1
kbit/s [[Kilobit per second|kbit/s]] 1e3
Mbit/s [[Megabit per second|Mbit/s]] 1e6
Gbit/s [[Gigabit per second|Gbit/s]] 1e9
Tbit/s [[Terabit per second|Tbit/s]] 1e12
kT/s [[Transfer (computing)|<span title="Kilo transfers per second">kT/s</span>]]
MT/s [[Transfer (computing)|<span title="Mega transfers per second">MT/s</span>]]
GT/s [[Transfer (computing)|<span title="Giga transfers per second">GT/s</span>]]
year [[Year|year]] 31557600
years [[Year|years]] 31557600
yr [[Year#Symbols y and yr|yr]] 31557600
y [[Year|y]] 31557600
a [[Annum|a]] 31557600
Ga [[Gigaannum|Ga]] 3155760000000000
Ma [[Megaannum|Ma]] 31557600000000
ka [[Kiloannum|ka]] 31557600000
kyr [[kyr|kyr]] 31557600000
kya [[kyr|kya]] 31557600000
myr [[myr|myr]] 315576000000000
mya [[Mya (unit)|mya]] 315576000000000
byr [[Billion years|byr]] 3155760000000000000
bya [[Billion years ago|bya]] 3155760000000000000
Gyr [[billion years|Gyr]] 3155760000000000000
BP [[Before present|BP]]
uBP [[Radiocarbon dating#Calibration|<sup>14</sup>C yr BP]]
BC [[Before Christ|BC]] -1
AD [[Anno Domini|AD]] 1
BCE [[Before the Common Era|BCE]] -1
CE [[Common Era|CE]] 1
JD [[Julian date|JD]] 1
MJD [[Modified Julian date|MJD]] 1

s-1 [[Second|s<sup>-1</sup>]]
s-2 [[Second|s<sup>-2</sup>]]
s2 [[Second|s<sup>2</sup>]]

s [[Second|s]] SI
as [[Attosecond|s]] SI
cs [[Second|s]] SI
das [[Second|s]] SI
ds [[Second|s]] SI
Es [[Second|s]] SI
fs [[Femtosecond|s]] SI
Gs [[Second|s]] SI
hs [[Second|s]] SI
ks [[Second|s]] SI
ms [[Millisecond|s]] SI
µs [[Microsecond|s]] SI

```



```

us [[Microsecond|s]] SI
Ms [[Second|s]] SI
ns [[Nanosecond|s]] SI
ps [[Picosecond|s]] SI
Ps [[Second|s]] SI
Ts [[Second|s]] SI
Ys [[Second|s]] SI
ys [[Yoctosecond|s]] SI
Zs [[Second|s]] SI
zs [[Zeptosecond|s]] SI

```

```

Hz [[Hertz|Hz]] SI
aHz [[Hertz|Hz]] SI
cHz [[Hertz|Hz]] SI
daHz [[Hertz|Hz]] SI
dHz [[Hertz|Hz]] SI
EHZ [[Hertz|Hz]] SI
fHz [[Hertz|Hz]] SI
hHz [[Hertz|Hz]] SI
GHz [[Gigahertz|Hz]] SI
kHz [[Kilohertz|Hz]] SI
MHz [[Megahertz|Hz]] SI
mHz [[Hertz|Hz]] SI
uHz [[Hertz|Hz]] SI
µHz [[Hertz|Hz]] SI
nHz [[Hertz|Hz]] SI
pHz [[Hertz|Hz]] SI
PHz [[Hertz|Hz]] SI
THz [[Hertz|Hz]] SI
yHz [[Hertz|Hz]] SI
YHz [[Hertz|Hz]] SI
zHz [[Hertz|Hz]] SI
ZHz [[Hertz|Hz]] SI

```

```

== Length, area, volume ==
Å3 [[Ångström|Å<sup>3</sup>]]
fb-1 [[Barn (unit)|fb<sup>-1</sup>]]
m-1 [[Metre|m<sup>-1</sup>]]
m-2 [[Square metre|m<sup>-2</sup>]]
m-3 [[Cubic metre|m<sup>-3</sup>]]
km2 [[Square kilometre|km<sup>2</sup>]]
km3 [[Cubic kilometre|km<sup>3</sup>]]
µm2 [[Square metre|µm<sup>2</sup>]]
um2 [[Square metre|µm<sup>2</sup>]]
am2 [[Square metre|am<sup>2</sup>]]
cm2 [[Square centimetre|cm<sup>2</sup>]]
dam2 [[Square metre|dam<sup>2</sup>]]
dm2 [[Square metre|dm<sup>2</sup>]]
Em2 [[Square metre|Em<sup>2</sup>]]
fm2 [[Square metre|fm<sup>2</sup>]]
Gm2 [[Square metre|Gm<sup>2</sup>]]
hm2 [[Square metre|hm<sup>2</sup>]]
mm2 [[Square metre|mm<sup>2</sup>]]
Mm2 [[Square metre|Mm<sup>2</sup>]]
nm2 [[Square metre|nm<sup>2</sup>]]
pm2 [[Square metre|pm<sup>2</sup>]]
Pm2 [[Square metre|Pm<sup>2</sup>]]
Tm2 [[Square metre|Tm<sup>2</sup>]]
ym2 [[Square metre|ym<sup>2</sup>]]
Ym2 [[Square metre|Ym<sup>2</sup>]]
zm2 [[Square metre|zm<sup>2</sup>]]
Zm2 [[Square metre|Zm<sup>2</sup>]]
gal [[Gallon|gal]]
Gal [[Gal (unit)|Gal]]

```



```
uGal [[Gal (unit)|μGal]]
μGal [[Gal (unit)|μGal]]
mGal [[Gal (unit)|mGal]]
```

```
b [[Barn (unit)|b]] SI
ab [[Barn (unit)|b]] SI
cb [[Barn (unit)|b]] SI
dab [[Barn (unit)|b]] SI
db [[Barn (unit)|b]] SI
Eb [[Barn (unit)|b]] SI
fb [[Barn (unit)|b]] SI
Gb [[Barn (unit)|b]] SI
hb [[Barn (unit)|b]] SI
kb [[Barn (unit)|b]] SI
mb [[Barn (unit)|b]] SI
μb [[Barn (unit)|b]] SI
ub [[Barn (unit)|b]] SI
Mb [[Barn (unit)|b]] SI
nb [[Barn (unit)|b]] SI
pb [[Barn (unit)|b]] SI
Pb [[Barn (unit)|b]] SI
Tb [[Barn (unit)|b]] SI
Yb [[Barn (unit)|b]] SI
yb [[Barn (unit)|b]] SI
Zb [[Barn (unit)|b]] SI
zb [[Barn (unit)|b]] SI
```

== Velocity and acceleration ==

```
m.s-2 [[Metre per second squared|m&sdot;s<sup>-2</sup>]]
m/s2 [[Metre per second squared|m/s<sup>2</sup>]]
m.s-1 [[Metre per second|m&sdot;s<sup>-1</sup>]]
m/s [[Metre per second|m/s]]
km.s-1 [[Metre per second|km&sdot;s<sup>-1</sup>]]
km/s [[Metre per second|km/s]]
```

== Mass and energy ==

```
lm [[Pound (mass)|<span title="pound-mass">lm</span>]]
uJ [[Joule|μJ]]
J.s [[Joule-second|J&sdot;s]]
kWh [[Kilowatt hour|kWh]]
kW.h [[Kilowatt hour|kW&sdot;h]]
J/C [[Volt|J/C]]
J/kg [[Joule|J/kg]]
```

```
Da [[Dalton (unit)|Da]] SI
EDa [[Dalton (unit)|Da]] SI
PDa [[Dalton (unit)|Da]] SI
TDa [[Dalton (unit)|Da]] SI
GDa [[Dalton (unit)|Da]] SI
MDa [[Dalton (unit)|Da]] SI
kDa [[Dalton (unit)|Da]] SI
mDa [[Dalton (unit)|Da]] SI
uDa [[Dalton (unit)|Da]] SI
μDa [[Dalton (unit)|Da]] SI
nDa [[Dalton (unit)|Da]] SI
pDa [[Dalton (unit)|Da]] SI
fDa [[Dalton (unit)|Da]] SI
aDa [[Dalton (unit)|Da]] SI
```

```
g [[Gram|g]] SI
ag [[Attogram|g]] SI
cg [[Centigram|g]] SI
dag [[Gram|g]] SI
dg [[Decigram|g]] SI
```



```
Eg [[Exagram|g]] SI
fg [[Femtogram|g]] SI
Gg [[Gigagram|g]] SI
hg [[Kilogram#SI multiples|g]] SI
kg [[Kilogram|g]] SI
mcg [[Microgram|g]] SI
Mg [[Megagram|g]] SI
mg [[Milligram|g]] SI
ug [[Microgram|g]] SI
µg [[Microgram|g]] SI
ng [[Nanogram|g]] SI
Pg [[Petagram|g]] SI
pg [[Picogram|g]] SI
Tg [[Tonne|g]] SI
yg [[Yoctogram|g]] SI
Yg [[Yottagram|g]] SI
zg [[Zeptogram|g]] SI
Zg [[Zettagram|g]] SI

== Pressure and density ==
psi [[Pounds per square inch|psi]]
g.cm-3 [[Gram per cubic centimetre|g&sdot;cm<sup>-3</sup>]]
g/cm3 [[Gram per cubic centimetre|g/cm<sup>3</sup>]]
kg.m-3 [[Kilogram per cubic metre|kg&sdot;m<sup>-3</sup>]]
kg/m3 [[Kilogram per cubic metre|kg/m<sup>3</sup>]]
kg/cm3 [[Density#Formula and common units|kg/cm<sup>3</sup>]]
g/L [[Gram per litre|g/L]]
g/l [[Gram per litre|g/l]]
mcg/dL [[Gram per litre|µg/dL]]
mcg/dl [[Gram per litre|µg/dl]]
mg/mL [[Gram per litre|mg/mL]]
mg/ml [[Gram per litre|mg/ml]]
ug/dL [[Gram per litre|µg/dL]]
ug/dl [[Gram per litre|µg/dl]]
µg/dL [[Gram per litre|µg/dL]]
µg/dl [[Gram per litre|µg/dl]]
mg.L-1 [[Gram per litre|<abbr title="milligrams per liter">mg/L</abbr>]]
mg/L [[Gram per litre|<abbr title="milligrams per liter">mg/L</abbr>]]
mg.l-1 [[Gram per litre|<abbr title="milligrams per liter">mg/l</abbr>]]
mg/l [[Gram per litre|<abbr title="milligrams per liter">mg/l</abbr>]]

== Fracture toughness ==
MPa.m.5 [[Fracture toughness|MPa&sdot;m<sup>1/2</sup>]]
kPa.m.5 [[Fracture toughness|kPa&sdot;m<sup>1/2</sup>]]
Pa.m.5 [[Fracture toughness|Pa&sdot;m<sup>1/2</sup>]]

== Temperature ==
degC °C ALIAS
degF °F ALIAS
degR °R ALIAS

K [[Kelvin|K]] SI
YK [[Yottakelvin|K]] SI
ZK [[Zettakelvin|K]] SI
EK [[Kelvin|K]] SI
PK [[Petakelvin|K]] SI
TK [[Terakelvin|K]] SI
GK [[Gigakelvin|K]] SI
MK [[Megakelvin|K]] SI
kK [[Kilokelvin|K]] SI
hK [[Hectokelvin|K]] SI
daK [[Decakelvin|K]] SI
dK [[Decikelvin|K]] SI
cK [[Centikelvin|K]] SI
```



```
mK [[Millikelvin|K]] SI
µK [[Microkelvin|K]] SI
uK [[Microkelvin|K]] SI
nK [[Nanokelvin|K]] SI
pK [[Picokelvin|K]] SI
fK [[Femtokelvin|K]] SI
aK [[Attokelvin|K]] SI
zK [[Zeptokelvin|K]] SI
yK [[Yoctokelvin|K]] SI

== Electromagnetism ==
Wb [[Weber (unit)|Wb]]
N.A-2 [[Permeability (electromagnetism)|N&sdot;A<sup>-2</sup>]]
H.m-1 [[Permeability (electromagnetism)|H&sdot;m<sup>-1</sup>]]
V.m-1 [[Electric field|V&sdot;m<sup>-1</sup>]]
V/m [[Electric field|V/m]]

C [[Coulomb|C]] SI
YC [[Coulomb|C]] SI
ZC [[Coulomb|C]] SI
EC [[Coulomb|C]] SI
PC [[Coulomb|C]] SI
TC [[Coulomb|C]] SI
GC [[Coulomb|C]] SI
MC [[Coulomb|C]] SI
kC [[Coulomb|C]] SI
hC [[Coulomb|C]] SI
daC [[Coulomb|C]] SI
dC [[Coulomb|C]] SI
cC [[Coulomb|C]] SI
mC [[Coulomb|C]] SI
µC [[Coulomb|C]] SI
uC [[Coulomb|C]] SI
nC [[Coulomb|C]] SI
pC [[Coulomb|C]] SI
fC [[Coulomb|C]] SI
aC [[Coulomb|C]] SI
zC [[Coulomb|C]] SI
yC [[Coulomb|C]] SI

F [[Farad|F]] SI
YF [[Farad|F]] SI
ZF [[Farad|F]] SI
EF [[Farad|F]] SI
PF [[Farad|F]] SI
TF [[Farad|F]] SI
GF [[Farad|F]] SI
MF [[Farad|F]] SI
kF [[Farad|F]] SI
hF [[Farad|F]] SI
daF [[Farad|F]] SI
dF [[Farad|F]] SI
cF [[Farad|F]] SI
mF [[Farad|F]] SI
µF [[Farad|F]] SI
uF [[Farad|F]] SI
nF [[Farad|F]] SI
pF [[Farad|F]] SI
fF [[Farad|F]] SI
aF [[Farad|F]] SI
zF [[Farad|F]] SI
yF [[Farad|F]] SI

H [[Henry (unit)|H]] SI
```



YH [[Henry (unit)|H]] SI
ZH [[Henry (unit)|H]] SI
EH [[Henry (unit)|H]] SI
PH [[Henry (unit)|H]] SI
TH [[Henry (unit)|H]] SI
GH [[Henry (unit)|H]] SI
MH [[Henry (unit)|H]] SI
kH [[Henry (unit)|H]] SI
hH [[Henry (unit)|H]] SI
daH [[Henry (unit)|H]] SI
dH [[Henry (unit)|H]] SI
cH [[Henry (unit)|H]] SI
mH [[Henry (unit)|H]] SI
μH [[Henry (unit)|H]] SI
uH [[Henry (unit)|H]] SI
nH [[Henry (unit)|H]] SI
pH [[Henry (unit)|H]] SI
fH [[Henry (unit)|H]] SI
aH [[Henry (unit)|H]] SI
zH [[Henry (unit)|H]] SI
yH [[Henry (unit)|H]] SI

A [[Ampere|A]] SI
YA [[Ampere|A]] SI
ZA [[Ampere|A]] SI
EA [[Ampere|A]] SI
PA [[Ampere|A]] SI
TA [[Ampere|A]] SI
GA [[Ampere|A]] SI
MA [[Ampere|A]] SI
kA [[Ampere|A]] SI
hA [[Ampere|A]] SI
daA [[Ampere|A]] SI
dA [[Ampere|A]] SI
cA [[Ampere|A]] SI
mA [[Ampere|A]] SI
μA [[Ampere|A]] SI
uA [[Ampere|A]] SI
nA [[Ampere|A]] SI
pA [[Ampere|A]] SI
fA [[Ampere|A]] SI
aA [[Ampere|A]] SI
zA [[Ampere|A]] SI
yA [[Ampere|A]] SI

V [[Volt|V]] SI
YV [[Volt|V]] SI
ZV [[Volt|V]] SI
EV [[Volt|V]] SI
PV [[Volt|V]] SI
TV [[Volt|V]] SI
GV [[Volt|V]] SI
MV [[Volt|V]] SI
kV [[Volt|V]] SI
hV [[Volt|V]] SI
daV [[Volt|V]] SI
dV [[Volt|V]] SI
cV [[Volt|V]] SI
mV [[Volt|V]] SI
μV [[Volt|V]] SI
uV [[Volt|V]] SI
nV [[Volt|V]] SI
pV [[Volt|V]] SI
fV [[Volt|V]] SI



aV	[[Volt V]]	SI	
zV	[[Volt V]]	SI	
yV	[[Volt V]]	SI	
VA	[[Volt-ampere VA]]	SI	
YVA	[[Volt-ampere VA]]	SI	
ZVA	[[Volt-ampere VA]]	SI	
EVA	[[Volt-ampere VA]]	SI	
PVA	[[Volt-ampere VA]]	SI	
TVA	[[Volt-ampere VA]]	SI	
GVA	[[Volt-ampere VA]]	SI	
MVA	[[Volt-ampere VA]]	SI	
kVA	[[Volt-ampere VA]]	SI	
hVA	[[Volt-ampere VA]]	SI	
daVA	[[Volt-ampere VA]]	SI	
dVA	[[Volt-ampere VA]]	SI	
cVA	[[Volt-ampere VA]]	SI	
mVA	[[Volt-ampere VA]]	SI	
µVA	[[Volt-ampere VA]]	SI	
uVA	[[Volt-ampere VA]]	SI	
nVA	[[Volt-ampere VA]]	SI	
pVA	[[Volt-ampere VA]]	SI	
fVA	[[Volt-ampere VA]]	SI	
aVA	[[Volt-ampere VA]]	SI	
zVA	[[Volt-ampere VA]]	SI	
yVA	[[Volt-ampere VA]]	SI	
Ω	[[Ohm Ω]]	SI	
YΩ.m	[[Electrical resistivity and conductivity#Definition YΩ⋅m]]		1e24
ZΩ.m	[[Electrical resistivity and conductivity#Definition ZΩ⋅m]]		1e21
EΩ.m	[[Electrical resistivity and conductivity#Definition EΩ⋅m]]		1e18
PΩ.m	[[Electrical resistivity and conductivity#Definition PΩ⋅m]]		1e15
TΩ.m	[[Electrical resistivity and conductivity#Definition TΩ⋅m]]		1e12
GΩ.m	[[Electrical resistivity and conductivity#Definition GΩ⋅m]]		1e9
MΩ.m	[[Electrical resistivity and conductivity#Definition MΩ⋅m]]		1e6
kΩ.m	[[Electrical resistivity and conductivity#Definition kΩ⋅m]]		1e3
Ω.m	[[Electrical resistivity and conductivity#Definition Ω⋅m]]		1
mΩ.m	[[Electrical resistivity and conductivity#Definition mΩ⋅m]]		1e-3
µΩ.m	[[Electrical resistivity and conductivity#Definition µΩ⋅m]]		1e-6
uΩ.m	[[Electrical resistivity and conductivity#Definition uΩ⋅m]]		1e-6
nΩ.m	[[Electrical resistivity and conductivity#Definition nΩ⋅m]]		1e-9
pΩ.m	[[Electrical resistivity and conductivity#Definition pΩ⋅m]]		1e-12
fΩ.m	[[Electrical resistivity and conductivity#Definition fΩ⋅m]]		1e-15
aΩ.m	[[Electrical resistivity and conductivity#Definition aΩ⋅m]]		1e-18
zΩ.m	[[Electrical resistivity and conductivity#Definition zΩ⋅m]]		1e-21
yΩ.m	[[Electrical resistivity and conductivity#Definition yΩ⋅m]]		1e-24
R	[[Rayleigh (unit) R]]	SI	
G	[[Gauss (unit) G]]	SI	
aG	[[Attogauss G]]	SI	
cG	[[Centigauss G]]	SI	
daG	[[Decagauss G]]	SI	
dG	[[Decigauss G]]	SI	
EG	[[Exagauss G]]	SI	
fG	[[Femtogauss G]]	SI	
GG	[[Gigagauss G]]	SI	
hG	[[Hectogauss G]]	SI	
kG	[[Kilogauss G]]	SI	
MG	[[Megagauss G]]	SI	
mG	[[Milligauss G]]	SI	
uG	[[Microgauss G]]	SI	
µG	[[Microgauss G]]	SI	



```

nG [[Nanogauss|G]] SI
PG [[Petagauss|G]] SI
pG [[Picogauss|G]] SI
TG [[Teragauss|G]] SI
yG [[Yoctogauss|G]] SI
YG [[Yottagauss|G]] SI
zG [[Zeptogauss|G]] SI
ZG [[Zettagauss|G]] SI

T [[Tesla (unit)|T]] SI
aT [[Attotesla|T]] SI
cT [[Centitesla|T]] SI
daT [[Decatesla|T]] SI
dT [[Decitesla|T]] SI
ET [[Exatesla|T]] SI
fT [[Femtotesla|T]] SI
GT [[Gigatesla|T]] SI
hT [[Hectotesla|T]] SI
kT [[Kilotesla|T]] SI
MT [[Megatesla|T]] SI
mT [[Millitesla|T]] SI
uT [[Microtesla|T]] SI
µT [[Microtesla|T]] SI
nT [[Nanotesla|T]] SI
PT [[Petatesla|T]] SI
pT [[Picotesla|T]] SI
TT [[Teratesla|T]] SI
yT [[Yoctotesla|T]] SI
YT [[Yottatesla|T]] SI
zT [[Zeptotesla|T]] SI
ZT [[Zettatesla|T]] SI

```

== Astrophysics ==

```

au [[Astronomical unit|au]]
c [[Speed of light|'c']]
ly [[Light-year|ly]]
dex [[decimal exponent|dex]]
Earth mass [[Earth mass|'M'<sub></sub>]]
Earth radius [[Earth radius|'R'<sub></sub>]]
M_Earth [[Earth mass|'M'<sub></sub>]]
R_Earth [[Earth radius|'R'<sub></sub>]]
M+ [[Earth mass|'M'<sub></sub>]]
R+ [[Earth radius|'R'<sub></sub>]]
Jupiter mass [[Jupiter mass|'M'<sub>J</sub>]]
Jupiter radius [[Jupiter radius|'R'<sub>J</sub>]]
M_Jupiter [[Jupiter mass|'M'<sub>J</sub>]]
R_Jupiter [[Jupiter radius|'R'<sub>J</sub>]]
Solar mass [[Solar mass|'M'<sub>#x2609;</sub>]]
solar mass [[Solar mass|'M'<sub>#x2609;</sub>]]
M_Solar [[Solar mass|'M'<sub>#x2609;</sub>]]
M_solar [[Solar mass|'M'<sub>#x2609;</sub>]]
R_Solar [[Solar radius|'R'<sub>#x2609;</sub>]]
R_solar [[Solar radius|'R'<sub>#x2609;</sub>]]
Solar radius [[Solar radius|'R'<sub>#x2609;</sub>]]
solar radius [[Solar radius|'R'<sub>#x2609;</sub>]]
Solar luminosity [[Solar luminosity|'L'<sub>#x2609;</sub>]]
solar luminosity [[Solar luminosity|'L'<sub>#x2609;</sub>]]
L_solar [[Solar luminosity|'L'<sub>#x2609;</sub>]]
L_Solar [[Solar luminosity|'L'<sub>#x2609;</sub>]]
Lo [[Solar luminosity|'L'<sub>#x2609;</sub>]]
pc2 [[Parsec|pc<sup>2</sup>]]
pc3 [[Parsec|pc<sup>3</sup>]]
kpc2 [[Parsec#Parsecs and kiloparsecs|kpc<sup>2</sup>]]
kpc3 [[Parsec#Parsecs and kiloparsecs|kpc<sup>3</sup>]]

```



```

kpc [[Parsec#Parsecs and kiloparsecs|kpc]]
Mpc2 [[Parsec#Megaparsecs and gigaparsecs|Mpc<sup>2</sup>]]
Mpc3 [[Parsec#Megaparsecs and gigaparsecs|Mpc<sup>3</sup>]]
Mpc [[Parsec#Megaparsecs and gigaparsecs|Mpc]]
Gpc2 [[Parsec#Megaparsecs and gigaparsecs|Gpc<sup>2</sup>]]
Gpc3 [[Parsec#Megaparsecs and gigaparsecs|Gpc<sup>3</sup>]]
Gpc [[Parsec#Megaparsecs and gigaparsecs|Gpc]]

== Nuclear physics and chemistry ==
cm-1 [[Wavenumber|cm<sup>-1</sup>]]
u [[Unified atomic mass unit|u]]
osmol [[Osmole (unit)|osmol]]
Osm [[Osmole (unit)|Osm]]
M [[Molarity|M]]
TM [[Molarity|M]] SI
GM [[Molarity|M]] SI
MM [[Molarity|M]] SI
kM [[Molarity|M]] SI
hM [[Molarity|M]] SI
daM [[Molarity|M]] SI
dM [[Molarity|M]] SI
cM [[Molarity|M]] SI
mM [[Molarity|M]] SI
uM [[Molarity|M]] 1e-6
nM [[Molarity|M]] SI
pM [[Molarity|M]] SI
kg.mol-1 [[Molar mass|kg&sdot;mol<sup>-1</sup>]]
kg/mol [[Molar mass|kg/mol]]
g.mol-1 [[Molar mass|g&sdot;mol<sup>-1</sup>]]
g/mol [[Molar mass|g/mol]]
eV/c2 [[Electronvolt#Mass|eV/'c''<sup>2</sup>]]
keV/c2 [[Electronvolt#Mass|keV/'c''<sup>2</sup>]]
MeV/c2 [[Electronvolt#Mass|MeV/'c''<sup>2</sup>]]
GeV/c2 [[Electronvolt#Mass|GeV/'c''<sup>2</sup>]]
TeV/c2 [[Electronvolt#Mass|TeV/'c''<sup>2</sup>]]
μN [[Nuclear magneton|μ<span style="display:inline-block;margin-bottom:-0.3em;vertical-align:middle">
μB [[Bohr magneton|μ<span style="display:inline-block;margin-bottom:-0.3em;vertical-align:middle">
eV [[Electronvolt|eV]]
meV [[Electronvolt|meV]]
keV [[Electronvolt|keV]]
MeV [[Electronvolt|MeV]]
GeV [[Electronvolt|GeV]]
TeV [[Electronvolt|TeV]]
mol-1 [[Avogadro constant|mol<sup>-1</sup>]]
J.mol-1 [[Joule per mole|J&sdot;mol<sup>-1</sup>]]
J/mol [[Joule per mole|J/mol]]
kJ.mol-1 [[Joule per mole|kJ&sdot;mol<sup>-1</sup>]]
kJ/mol [[Joule per mole|kJ/mol]]
MJ.mol-1 [[Joule per mole|MJ&sdot;mol<sup>-1</sup>]]
MJ/mol [[Joule per mole|MJ/mol]]
GJ.mol-1 [[Joule per mole|GJ&sdot;mol<sup>-1</sup>]]
GJ/mol [[Joule per mole|GJ/mol]]
TJ.mol-1 [[Joule per mole|TJ&sdot;mol<sup>-1</sup>]]
TJ/mol [[Joule per mole|TJ/mol]]

== Numbers and phrases ==
pp [[Page (paper)|pp]]
ppb [[Parts per billion|ppb]] 1e-9
ppm [[Parts per million|ppm]] 1e-6
billiard [[Orders of magnitude (numbers)#1015|billiard]] 1e15
billion [[1,000,000,000|billion]] 1e9
billionth [[1,000,000,000|billionth]] 1e-9
billionths [[1,000,000,000|billionths]] 1e-9
decilliard [[Orders of magnitude (numbers)#1063|decilliard]] 1e63

```



```

decillion [[Orders of magnitude (numbers)#1033|decillion]] 1e33
decillionth [[Orders of magnitude (numbers)#1033|decillionth]] 1e-33
decillionths [[Orders of magnitude (numbers)#1033|decillionths]] 1e-33
billionard [[1,000,000,000|billionard]] 1e9
million [[Million|million]] 1e6
millionth [[Million|millionth]] 1e-6
millionths [[Million|millionths]] 1e-6
nonilliard [[Orders of magnitude (numbers)#1057|nonilliard]] 1e57
nonillion [[Orders of magnitude (numbers)#1030|nonillion]] 1e30
nonillionth [[Orders of magnitude (numbers)#1030|nonillionth]] 1e-30
nonillionths [[Orders of magnitude (numbers)#1030|nonillionths]] 1e-30
octilliard [[Orders of magnitude (numbers)#1051|octilliard]] 1e51
octillion [[Orders of magnitude (numbers)#1027|octillion]] 1e27
octillionth [[Orders of magnitude (numbers)#1027|octillionth]] 1e-27
octillionths [[Orders of magnitude (numbers)#1027|octillionths]] 1e-27
quadrilliard [[Orders of magnitude (numbers)#1027|quadrilliard]] 1e27
quadrillion [[Orders of magnitude (numbers)#1015|quadrillion]] 1e15
quadrillionth [[Orders of magnitude (numbers)#1015|quadrillionth]] 1e-15
quadrillionths [[Orders of magnitude (numbers)#1015|quadrillionths]] 1e-15
quintilliard [[Orders of magnitude (numbers)#1033|quintilliard]] 1e33
quintillion [[Orders of magnitude (numbers)#1018|quintillion]] 1e18
quintillionth [[Orders of magnitude (numbers)#1018|quintillionth]] 1e-18
quintillionths [[Orders of magnitude (numbers)#1018|quintillionths]] 1e-18
septilliard [[Orders of magnitude (numbers)#1045|septilliard]] 1e45
septillion [[Orders of magnitude (numbers)#1024|septillion]] 1e24
septillionth [[Orders of magnitude (numbers)#1024|septillionth]] 1e-24
septillionths [[Orders of magnitude (numbers)#1024|septillionths]] 1e-24
sexilliard [[Orders of magnitude (numbers)#1039|sexilliard]] 1e39
septillion [[Orders of magnitude (numbers)#1021|septillion]] 1e21
septillionth [[Orders of magnitude (numbers)#1021|septillionth]] 1e-21
septillionths [[Orders of magnitude (numbers)#1021|septillionths]] 1e-21
trilliard [[Orders of magnitude (numbers)#1021|trilliard]] 1e21
trillion [[Orders of magnitude (numbers)#1012|trillion]] 1e12
trillionth [[Orders of magnitude (numbers)#1012|trillionth]] 1e-12
trillionths [[Orders of magnitude (numbers)#1012|trillionths]] 1e-12

```

== Angles ==

%	%	Percent
percent	%	Percent
per cent	%	Percent
‰	‰	Per mil
per mil	‰	Per mil
per mill	‰	Per mil
per mille	‰	Per mil
permil	‰	Per mil
permill	‰	Per mil
permille	‰	Per mil
°	°	Degree (angle)
deg	°	Degree (angle)
'	'	Minute of arc
,	,	Minute of arc
arcmin	'	Minute of arc
arcminute	'	Minute of arc
"	"	Second of arc
''	"	Second of arc
arcsec	"	Second of arc
arcsecond	"	Second of arc
mas	[[Milliarcsecond mas]]	pi/648000000

] =]

```

-- If val has "|long scale=on" the following definitions are used
-- (then, if not found here, the normal definitions are used).
-- Unit code [[Link|Symbol]] Flags/Scale

```



```
local builtin_units_long_scale = [=]  
  
== Long scale numbers and phrases ==  
billion  [[Orders of magnitude (numbers)#1012|billion]]  1e12  
billionth  [[Orders of magnitude (numbers)#1012|billionth]]  1e-12  
billionths  [[Orders of magnitude (numbers)#1012|billionths]]  1e-12  
decillion  [[Orders of magnitude (numbers)#1060|decillion]]  1e60  
decillionth  [[Orders of magnitude (numbers)#1060|decillionth]]  1e-60  
decillionths  [[Orders of magnitude (numbers)#1060|decillionths]]  1e-60  
nonillion  [[Orders of magnitude (numbers)#1054|nonillion]]  1e54  
nonillionth  [[Orders of magnitude (numbers)#1054|nonillionth]]  1e-54  
nonillionths  [[Orders of magnitude (numbers)#1054|nonillionths]]  1e-54  
octillion  [[Orders of magnitude (numbers)#1048|octillion]]  1e48  
octillionth  [[Orders of magnitude (numbers)#1048|octillionth]]  1e-48  
octillionths  [[Orders of magnitude (numbers)#1048|octillionths]]  1e-48  
quadrillion  [[Orders of magnitude (numbers)#1024|quadrillion]]  1e24  
quadrillionth  [[Orders of magnitude (numbers)#1024|quadrillionth]]  1e-24  
quadrillionths  [[Orders of magnitude (numbers)#1024|quadrillionths]]  1e-24  
quintillion  [[Orders of magnitude (numbers)#1030|quintillion]]  1e30  
quintillionth  [[Orders of magnitude (numbers)#1030|quintillionth]]  1e-30  
quintillionths  [[Orders of magnitude (numbers)#1030|quintillionths]]  1e-30  
septillion  [[Orders of magnitude (numbers)#1042|septillion]]  1e42  
septillionth  [[Orders of magnitude (numbers)#1042|septillionth]]  1e-42  
septillionths  [[Orders of magnitude (numbers)#1042|septillionths]]  1e-42  
sextillion  [[Orders of magnitude (numbers)#1036|sextillion]]  1e36  
sextillionth  [[Orders of magnitude (numbers)#1036|sextillionth]]  1e-36  
sextillionths  [[Orders of magnitude (numbers)#1036|sextillionths]]  1e-36  
trillion  [[Orders of magnitude (numbers)#1018|trillion]]  1e18  
trillionth  [[Orders of magnitude (numbers)#1018|trillionth]]  1e-18  
trillionths  [[Orders of magnitude (numbers)#1018|trillionths]]  1e-18  
  
]=]  
  
return { builtin_units = builtin_units, builtin_units_long_scale = builtin_units
```