

DES science requirements verification table

Marcelle Soares-Santos

Fermi National Accelerator Laboratory

ABSTRACT

This document presents the DES science requirements in the form of a simple table intended for a quick assessment of the DESDM data products. This table was compiled from the global DES science requirements document (des-docdb:20) and the Cluster Working Group science requirements document (des-docdb:3252). We propose that this table is used in the validation process of the DESDM Data Challenge products, starting with DC6B. This table needs to be updated to include requirements from other working groups.

Table 1. Requirements Verification Table (Template)

ID	DESCRIPTION	REQUIRED	MEASURED	STATUS
R-1	Number of nights to achieve science objectives at current data rate	525		
R-2	Main survey total area	$\geq 5000 \text{ deg}^2$		
R-3	Survey area chosen at Dec ≤ -30 deg at calibration regions to minimize galactic extinction to minimize stellar contamination to maximize contiguous area SN fields included in main survey area	$\sim 4000 \text{ deg}^2$ $\sim 1000 \text{ deg}^2$ Yes Yes Yes Yes		
R-4	10σ 1.5'' aperture depth over 90% of the area in g-band r-band i-band z-band Y-band Completeness at this depth Purity at this depth Position accuracy at this depth	24.6 24.1 24.3 23.8 21.5 $\geq 97.5\%$ $\geq 95\%$ $\leq 100 \text{ mas}$		
R-5	Number of SNe Ia light curves measured out to $z < 1.2$ Fraction of photometric time spent on SN fields	~ 3000 $\leq 10\%$		
R-6	Photometric calibration accuracy	$\leq 2\%$		
R-7	Effective number of galaxies per sq-arcmin for WL, i-band gri combined	≥ 8 ≥ 12		
R-8	Photoz dispersion for 90% of the galaxies at $0.1 < z < 1.5$ for clusters at $z < 1.3$ and $N_{gals}(L > L^*) > 10$	≤ 0.12 ≤ 0.02		
R-9	Systematic errors \leq statistical errors for combined DE constraints	Yes		
R-10	Coadd spatially varying systematic mag error on 0.05-4 deg scales	$< 2\%$		
R-11	Zeropoint error for $g - r$, $r - i$, $i - z$ colors $z - Y$ color	0.5% 1%		
R-12	i -band magnitude	0.5%		
R-13	System response curves precision effect on synthesized magnitudes mag residuals	$< 2\%$ $< 0.5\%$		
R-14	Coadd and single epoch global astrometry error Positions reported in J2000 system	$\leq 100 \text{ mas}$ Yes		

Table 1—Continued

ID	DESCRIPTION	REQUIRED	MEASURED	STATUS
R-15	Bandpass to bandpass relative astrometry error	≤ 100 mas		
R-16	Single epoch image to image relative astrometry error	≤ 15 mas		
R-17	Multiplicative shear measurement error	< 0.004		
	Additive residual shear	$< 4 \times 10^{-4}$		
R-18	PSF median r, i, z FWHM	< 0.9 arcsec		
	PSF FWHM for ≥ 1 exposure per band pass over 95% of the area	$\leq 0.9''$		
R-19	Mean PSF ellipticity whisker length for stars per exposure in r, i, z	$\leq 0.2''$		
R-20	Residual mean PSF whisker length on scales of $10' - 1\text{deg}$ in r, i, z	$< 0.06''$		
R-21	Uncertainty on PSF FWHM color dependence at zenith in $r \times g-i$	$< 0.0001''/\text{mag}$		
	$i \times r-z$	$< 0.001''/\text{mag}$		
	$z \times i-z$	$< 0.0006''/\text{mag}$		
	Uncertainty on PSF ellipticity color dependence at zenith in $r \times g-i$	$< 0.0005/\text{mag}$		
	$i \times r-z$	$< 0.001/\text{mag}$		
	$z \times i-z$	$< 0.0006/\text{mag}$		
R-22	For $0.1 < z < 1.5$ and $\Delta z = 0.1$,* uncertainty on z_{bias}	$< 0.001(1+z)$		
	$\sqrt{Cov_{ij}(z_{bias})}$ for $i \neq j$	$< 0.0005(1+z)$		
	uncertainty on photoz dispersion	< 0.003		
R-23	For $0.1 < z < 1.5$ and $\Delta z = 0.1$, $f_g(2)^\dagger$	$< 10\%$		
	$f_g(3)$	$< 1.5\%$		
	uncertainty in $f_g(2)$	$< 1\%$		
R-24	For $0.2 < z < 1.3$, uncertainty in cluter photoz bias	< 0.003		
	dispersion	< 0.0016		
R-25	For SN host galaxies at $i < 24$, photoz error	$< 0.05(1+z)$		
	outlier [‡] rate at $z > 0.3$	$< 1\%$		
R-26	Survey mask area uncertainty	$< 1\%$		
	depth uncertainty in each homogeneous patch	0.1 mag		
R-27	Galaxy catalog completeness at $n_g < 50$ galaxies/arcmin ²	$> 93\%$		
R-28	Stars/galaxies ratio accuracy at 100 arcmin ² scales	$< 1\%$		
	Other contaminants/galaxies ratio accuracy at 100 arcmin ² scales	$< 1\%$		
R-29	For a 90% sample, stars/galaxies ratio accuracy in z bins	$< 1\%$		
	other contaminants/glxs ratio accuracy in z bins	$< 1\%$		

Table 1—Continued

ID	DESCRIPTION	REQUIRED	MEASURED	STATUS
R-30	Coadd galaxy catalog artifact count fluctuations on 0.05 – 4 deg scales For a 90% sample, artifact count fluctuations in each photoz bin	< 2% < 5%		
R-31	Fraction of deblended BCGs at $i < 22$ with magnitude errors > 0.1 Misidentification rate of stars as galaxies at $i < 22$	< 1% < 1%		
R-32	Catalog noise induced cluster richness-mass scatter*	< 5%		
R-33	SN fields difference-frame catalog 10σ $1''$ aperture i-band depth 10 σ i-band completeness 5 σ i-band completeness impurity noise after 2 5σ detections	24 > 95% > 70% $\leq 20\%$		
R-34	Survey season	Sep-Feb		
R-35	Main survey airmass limit SN survey airmass limit	< 1.5 < 2.0		
R-36	Time between SN field visits per bandpass, average	5 days		
R-37	maximum	7 days		
R-38	SN survey exposure time for g-band r-band i-band z-band	10 min 20 min 30 min 50 min		
R-39	Sky background counts/pixel,* linear term $B_l/\sqrt{B_c}$ quadratic term $B_q/\sqrt{B_c}$	< 0.014 < 7×10^{-7}		
R-40	Shear of the Jacobian of the WCS solution	< 4×10^{-4}		
R-41	Single epoch photometric calibration accuracy	< 10%		
R-42	SN data processing time	< 20 h		
R-43	Single epoch difference imaging calibration accuracy	< 5%		
CWG REQUIREMENTS				
CR-1	Survey area, total minium contiguous patch measurement uncertainty	$\geq 5000 \text{ deg}^2$ $\geq 1600 \text{ deg}^2$ $\leq 0.1\%$		

Table 1—Continued

ID	DESCRIPTION	REQUIRED	MEASURED	STATUS
CR-2	10σ limiting mag at $\geq 97.5\%$ completeness, g-band	22.8		
	r-band	23.4		
	i-band	24.5		
	z-band	23.3		
CR-3	Color calibration dispersion	$\leq 2\%$		
CR-4	Cluster photoz at $z < 1.3$ and $N_{gals}(L > L_\star) > 10$, σ_z	≤ 0.02		
	$\sigma(z_{bias})$	≤ 0.003		
	$\sigma(\sigma_z^2)$	≤ 0.0016		
CR-5	Richness-mass scatter induced by catalog noise for $M \geq 10^{13.5} M_\odot$	$\leq 5\%$		
CR-6	Galaxy catalog completeness variation at $10 - 100$ galaxies/arcmin ²	$< 5\%$		
CR-7	Galaxy catalog purity variation for galactic latitudes $20 < b < 90$	$< 5\%$		
CR-8	Rejection rate of stars misclassified as galaxies at $15 < i < 21$	$> 99\%$		
CR-9	BCG deblended magnitude errors at $i < 22$ for 99% of the sample	≤ 0.1 mag		
CR-10	Largest possible overlapping area with SPT	Yes		
CR-11	Mock catalogs for cluster selection function estimates	Yes		

*Unless otherwise noted, all tests in photoz bins use this binning choice.

† $f_g(x) \equiv$ number of galaxies with photoz error $> x\sigma_z$.

‡Defined as $\Delta z/z > 0.2$.

*For clusters at $0.2 < z < 1.3$ in a fixed mass bin above $10^{13.5} M_\odot$.

* $B = B_c + B_l x + B_q x^2$ is the sky background measured at a distance x from the center of the image.