

GD&T-Geometric Dimensioning & Tolerancing



כנס ריתוך 2023 לשכת המהנדסים והאדריכלים



רונן קומרין,

עובד בקמ"ג בתחום הפיתוח, תכן הנדסי, ובעבר גם בעיבוד שבבי, משנת 1998.
מלמד את נושא ה-GD&T במכללה להנדסה SCE, קמ"ג, לשכת המהנדסים

השכלה:

תואר ראשון בהנדסת מכונות, מהמכללה להנדסה SCE באר שבע.
תואר ראשון בניהול, האוניברסיטה הפתוחה.
תואר שני בהנדסת אנרגיה, אוניברסיטת בן גוריון.

050-6244850
ronenkom@gmail.com

הסמכות:

1. **GDTP - Geometric Dimensioning & Tolerancing Professional – Senior Level - 3355**
2. **GDTP - Geometric Dimensioning & Tolerancing Professional - Technologist Level – 0843**

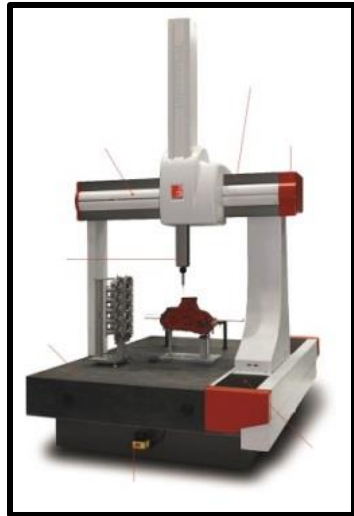
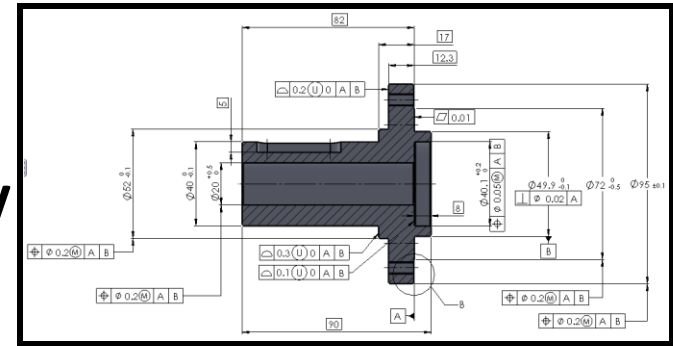
What is GD&T

GD&T - precise language

Geometry dimensions and tolerances is a precise language.

DESIGN

The information is define more clearly by the **designer**



QUALITY

The **Inspector** measure the part as defined by the designer

Mechanical

GD&T
Engineer

MANUFACTURING

The part is better understood by the **manufacturer**



What is GD&T

GD&T - language that provides uniformity



Uniform language

Engineering

Manufacturing

Inspection

Development

Customer

Assembly

Materials

Gage Planning

Marketing



same drawings interpretation



The immediate effect is

reduce disputes, guesswork
and assumptions

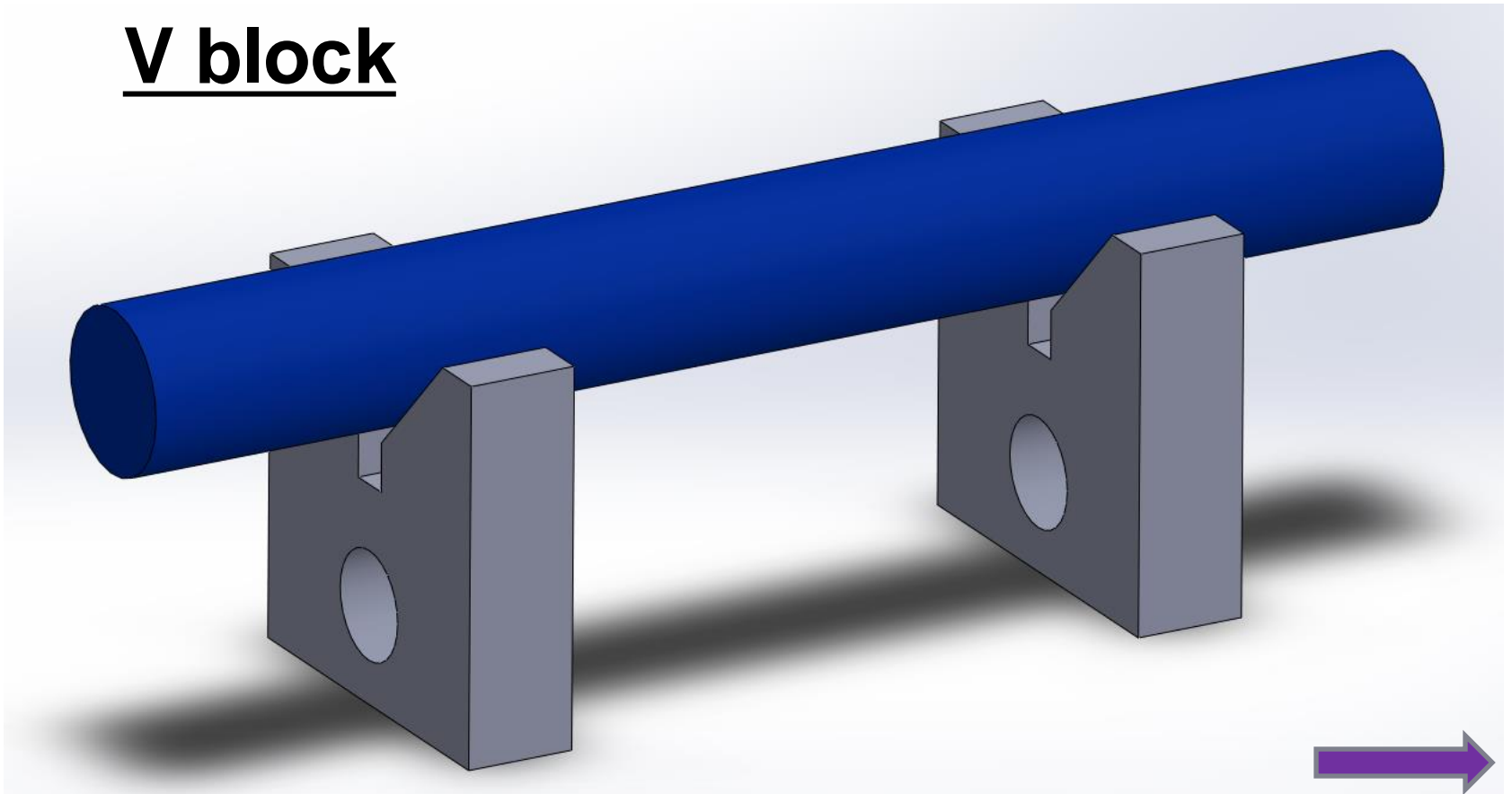
drawing clarity

follow the manufacturing process

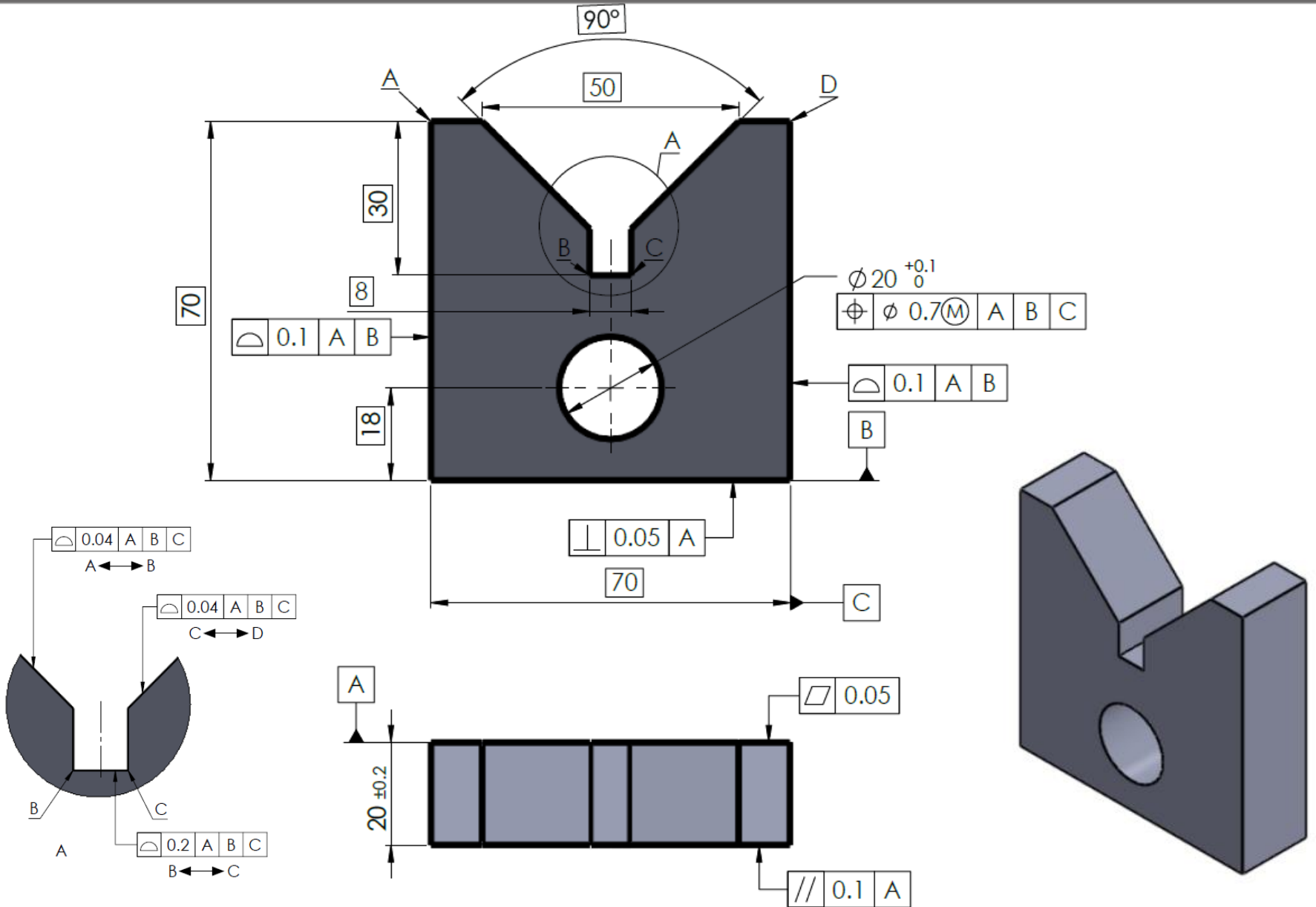
So what is it GD&T

Application

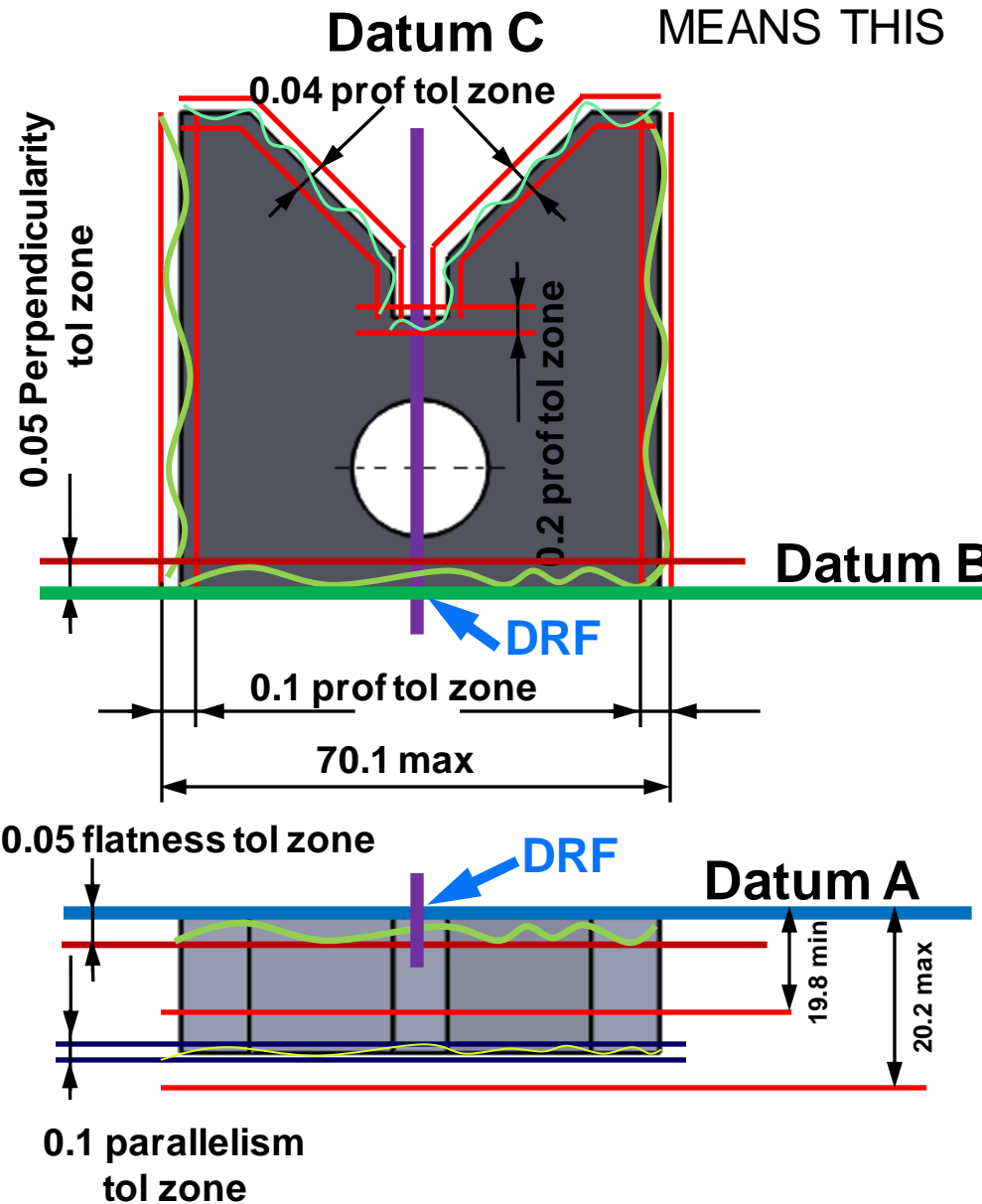
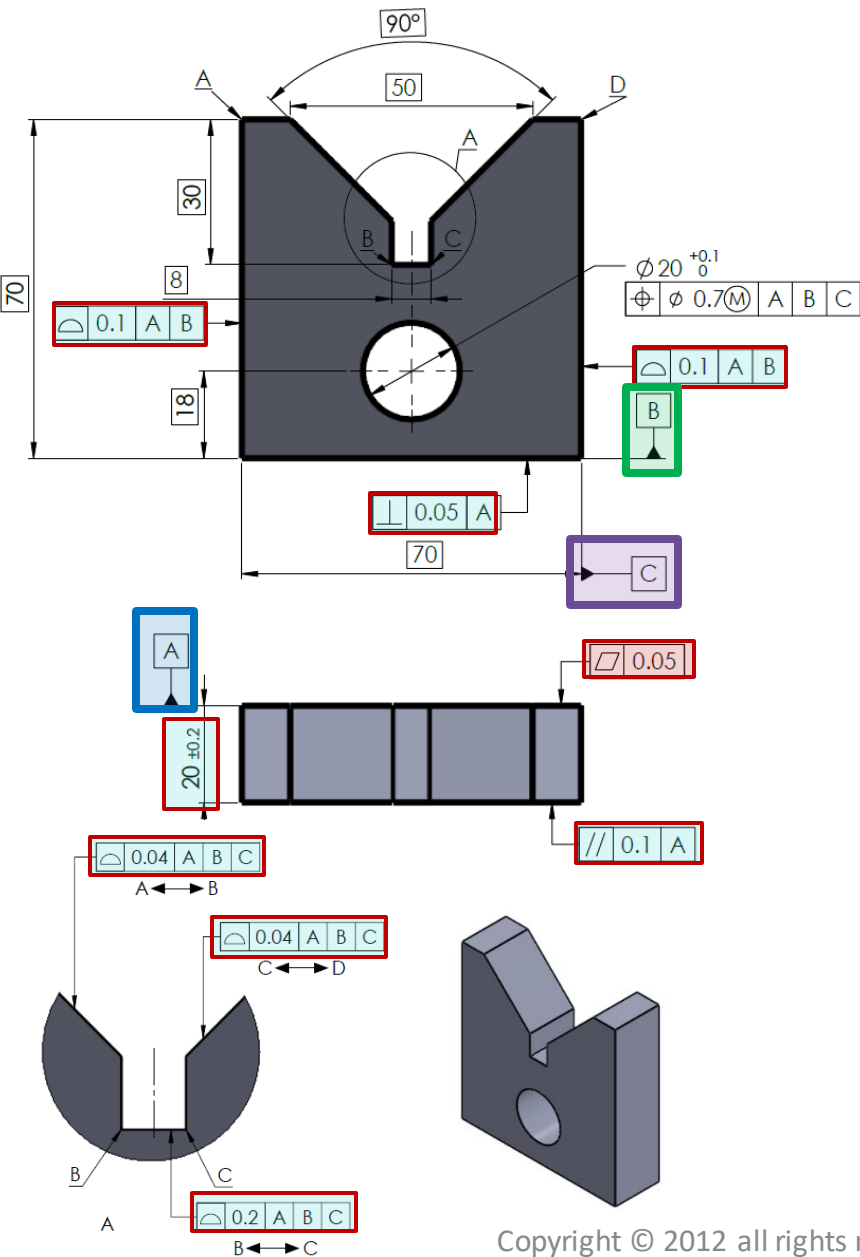
V block



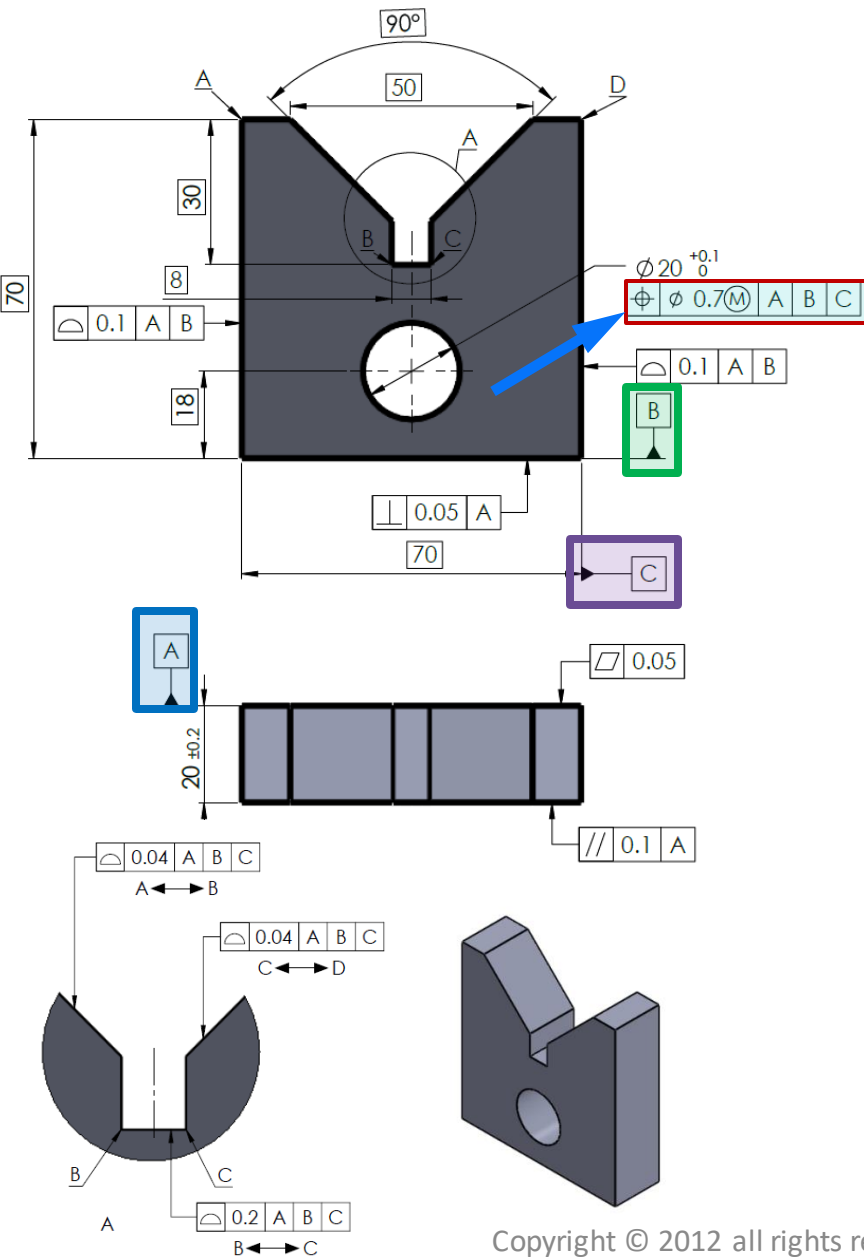
Geometric Dimensioning & Tolerancing



Geometric Dimensioning & Tolerancing

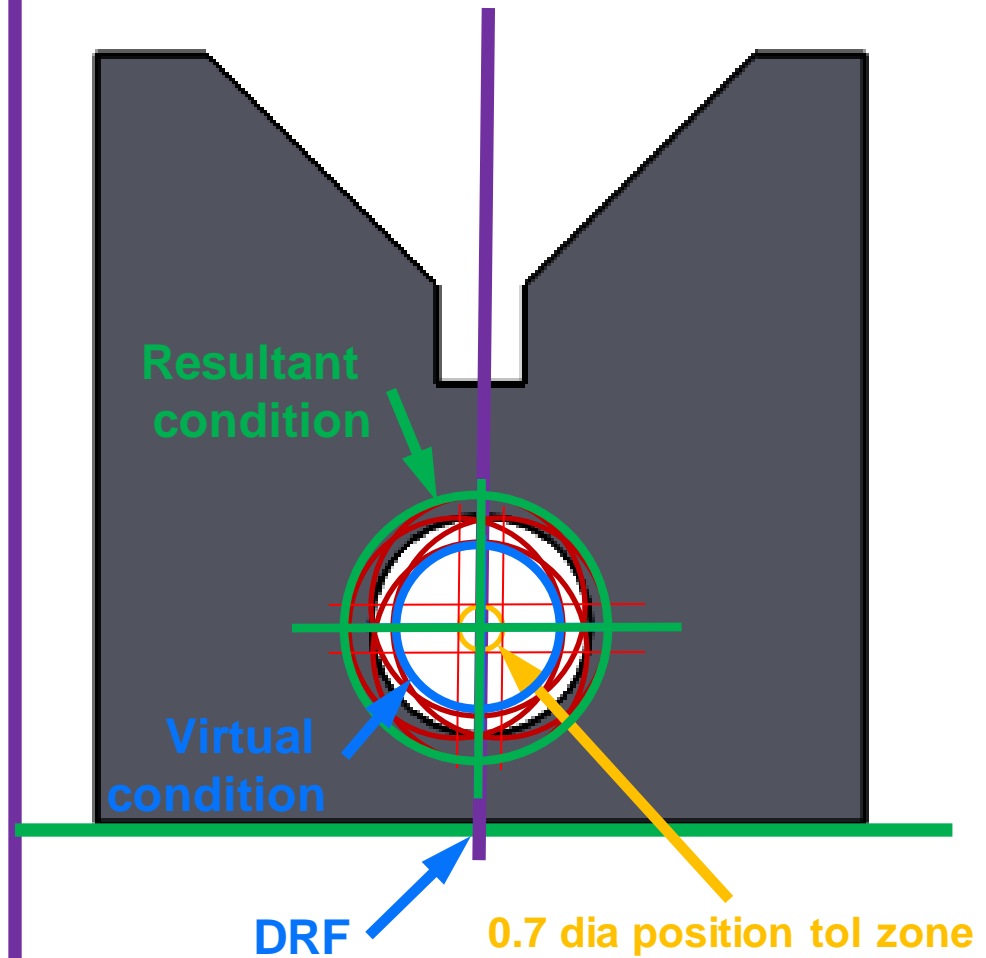


Geometric Dimension & Tolerancing



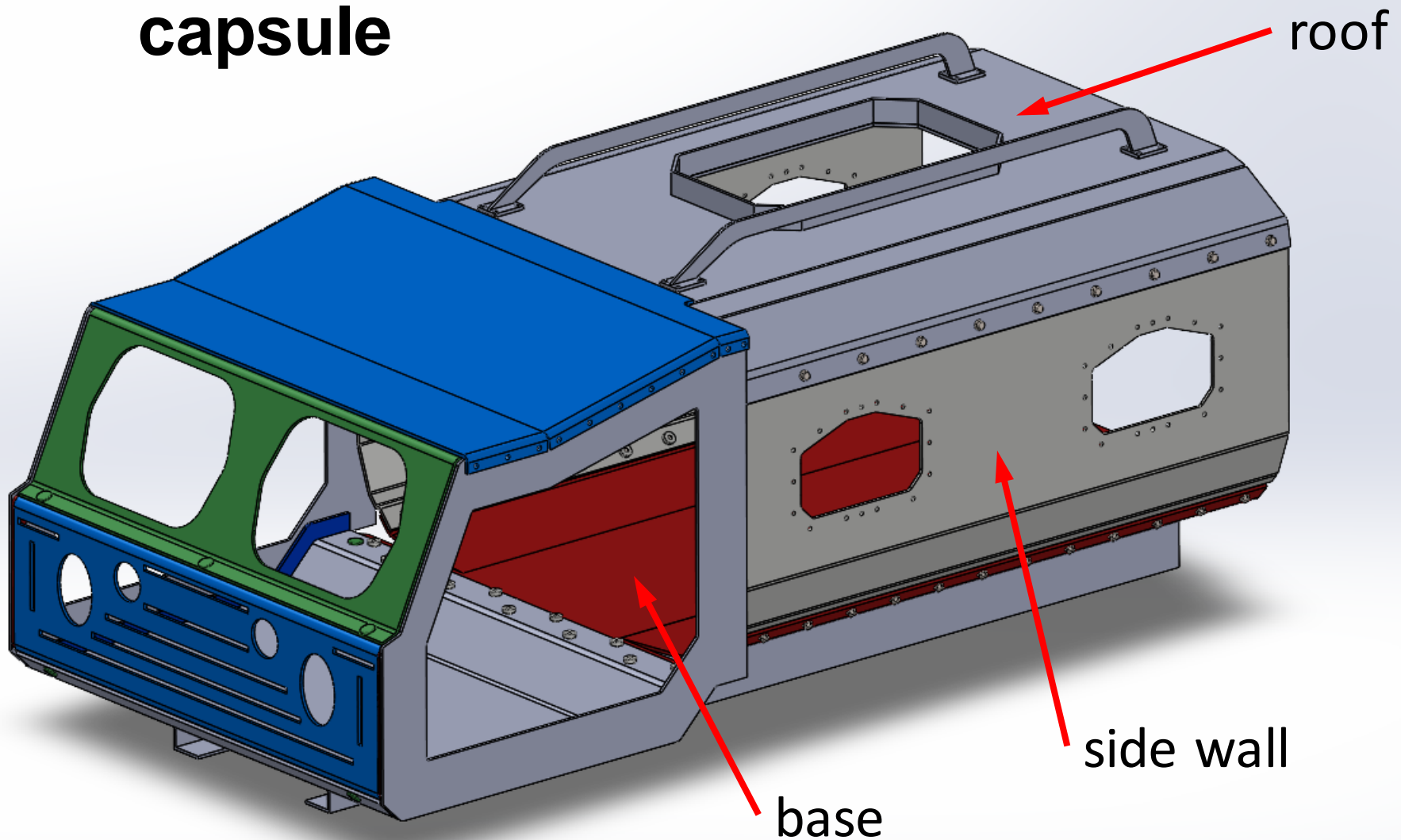
Datum C

MEANS THIS

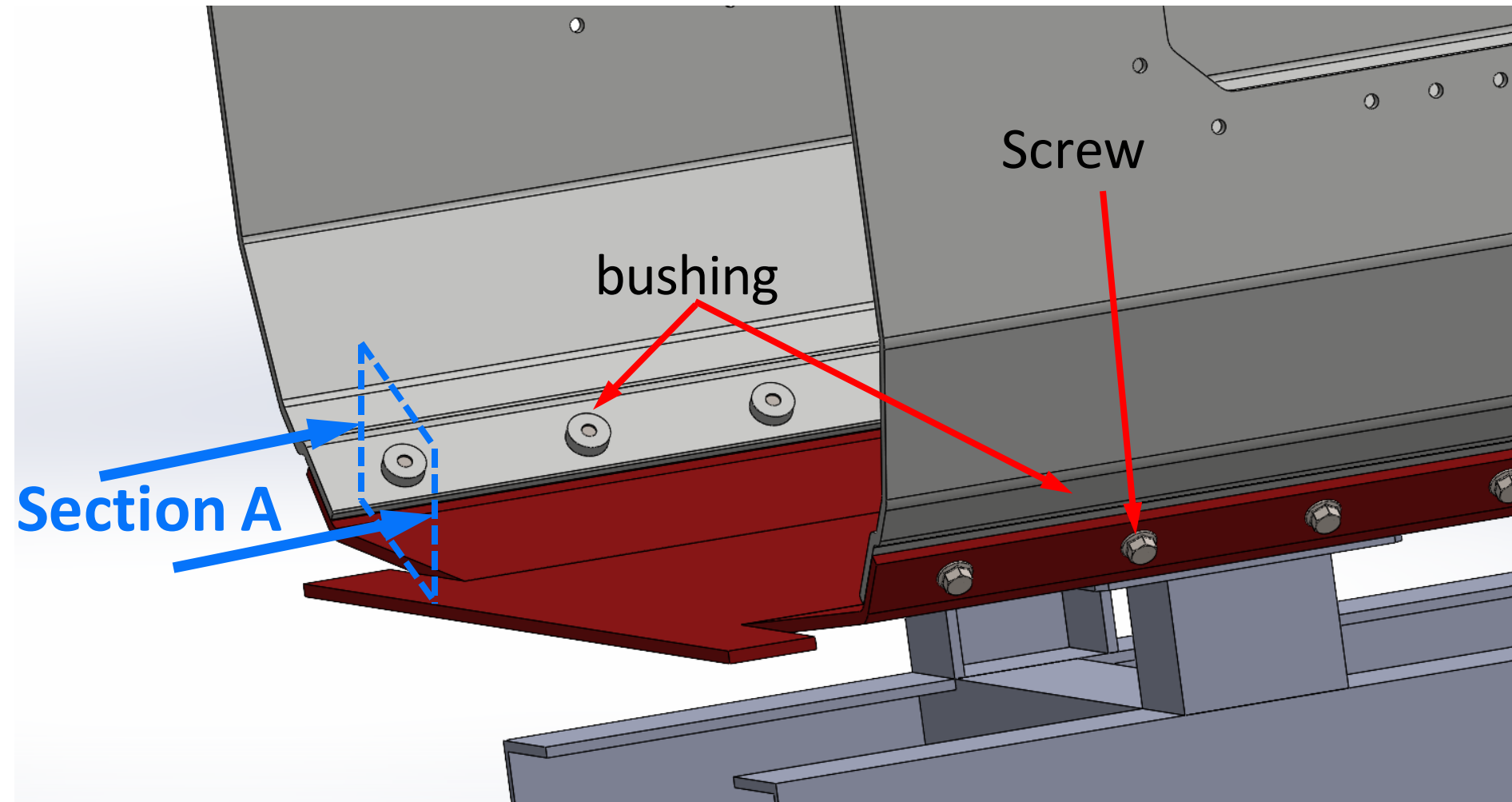


Geometric Dimension & Tolerancing

capsule

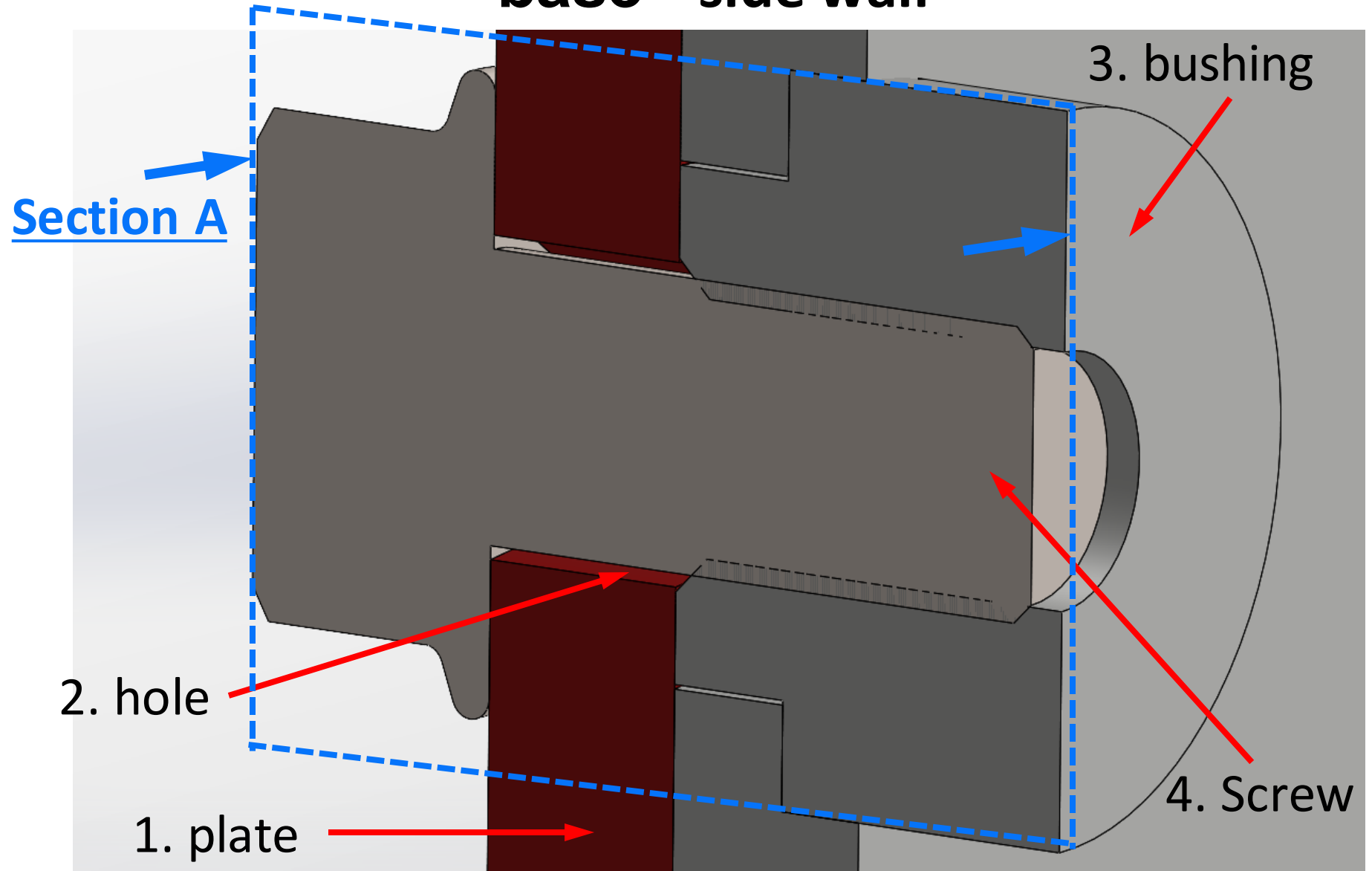


base - side wall



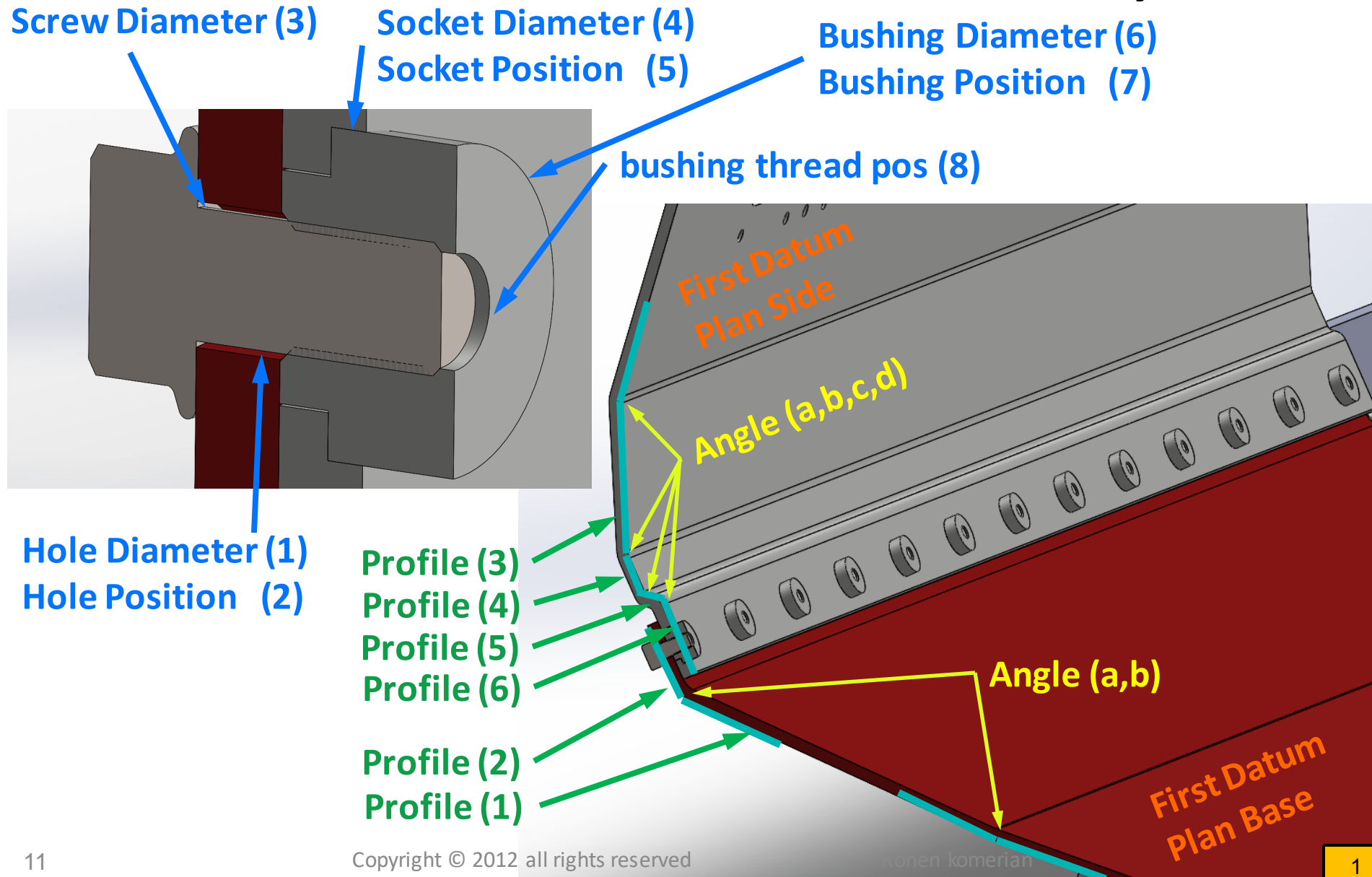
Geometric Dimensioning & Tolerancing

base - side wall

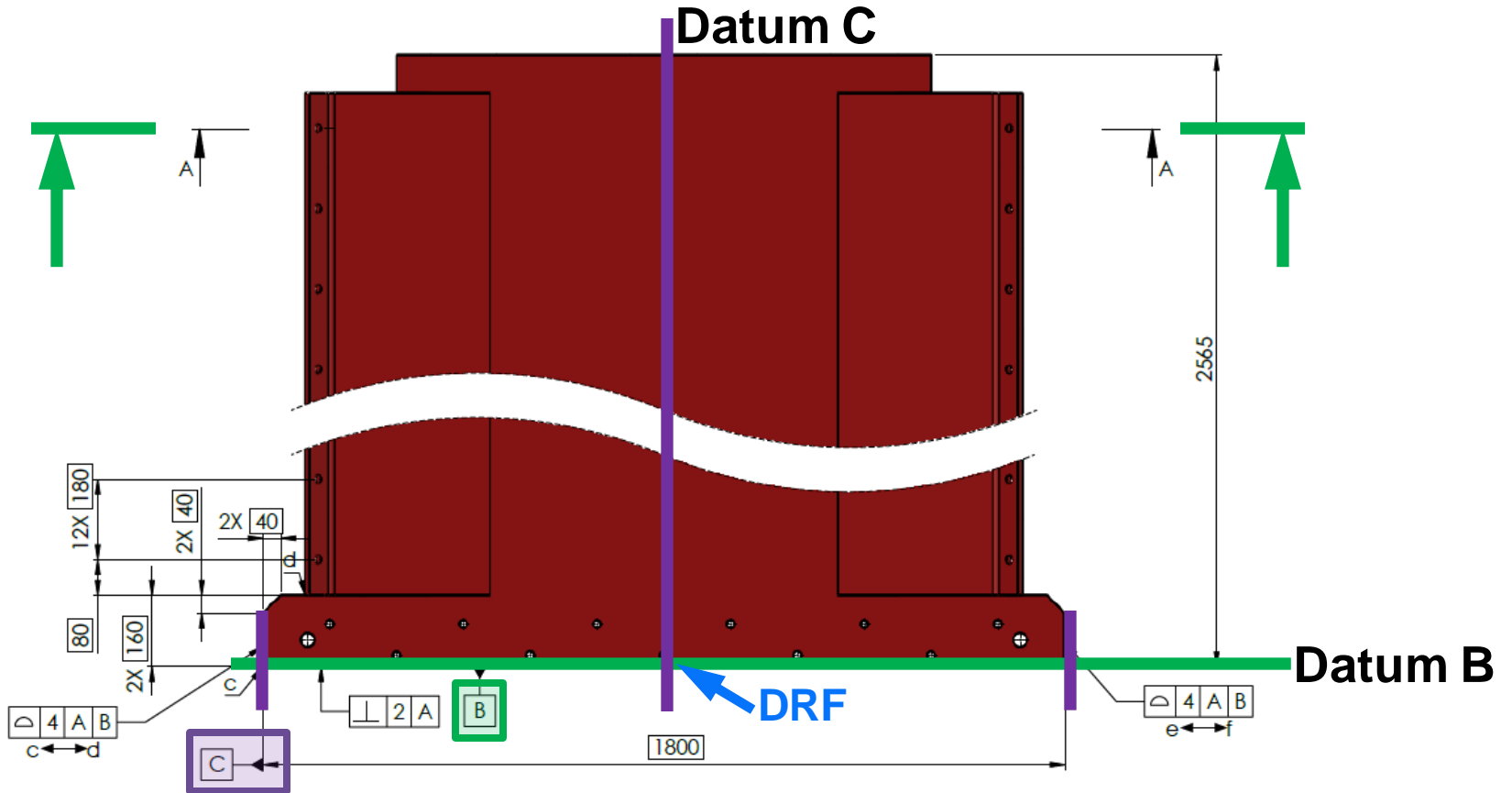
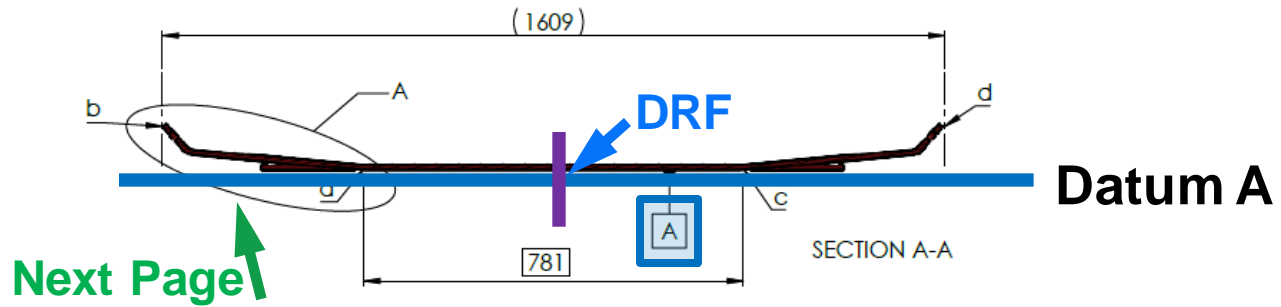


Geometric Dimension & Tolerancing

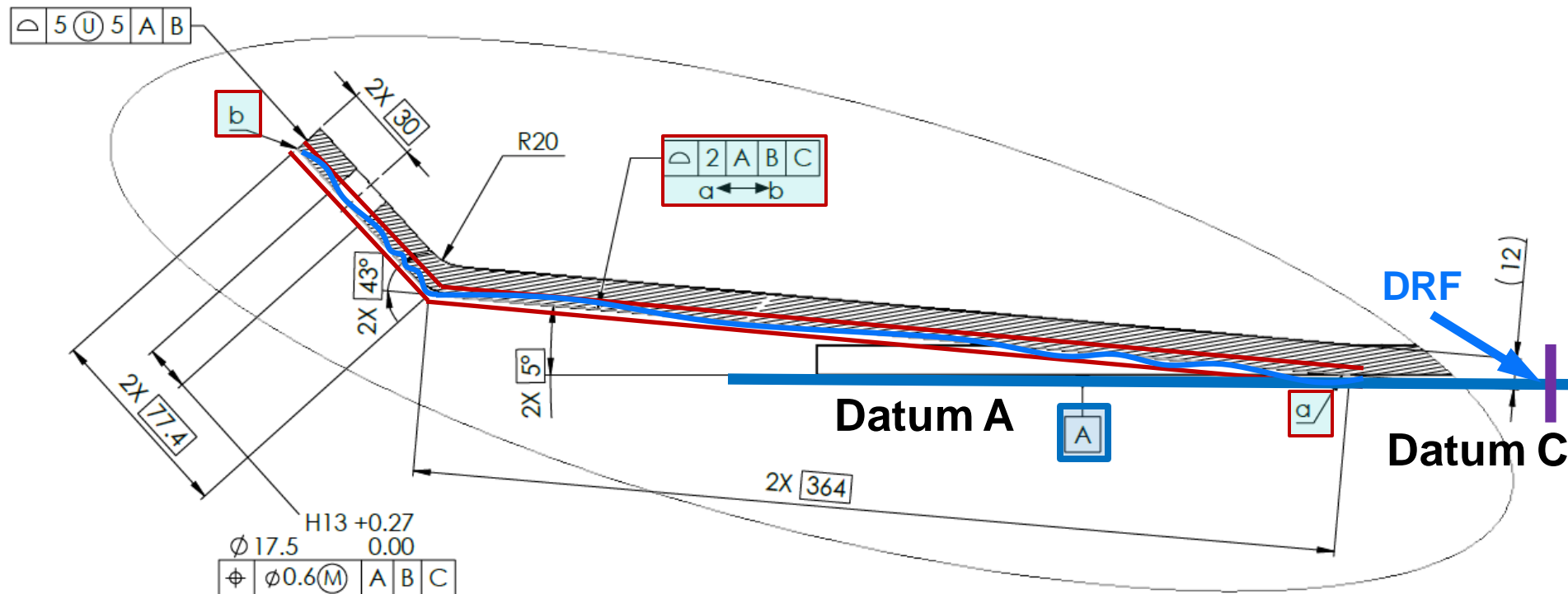
How does the tolerance stuck look like in this system?



Geometric Dimensioning & Tolerancing



Geometric Dimensioning & Tolerancing



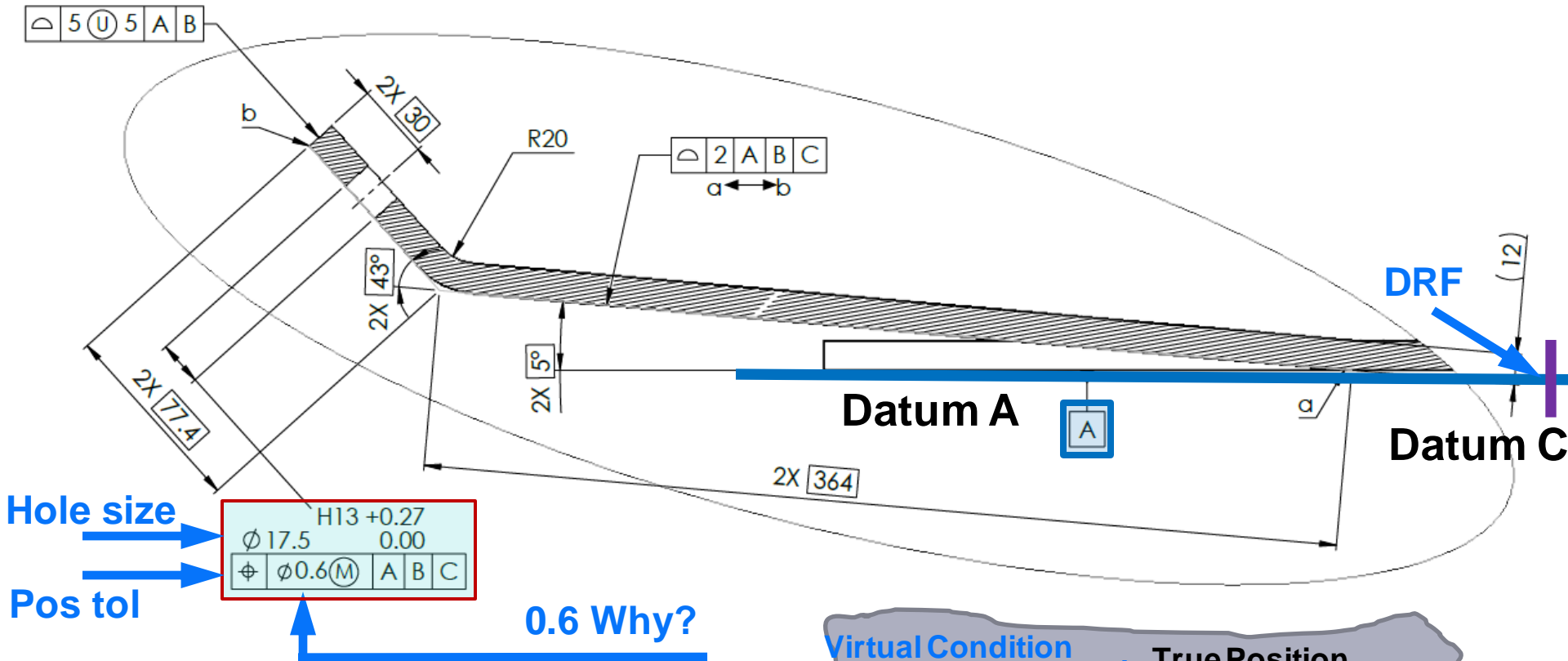
The process

1. The hole position is made **before** the **bending** process.
2. The hole position refers to a **temporary position** and refers to a **temporary DRF**.

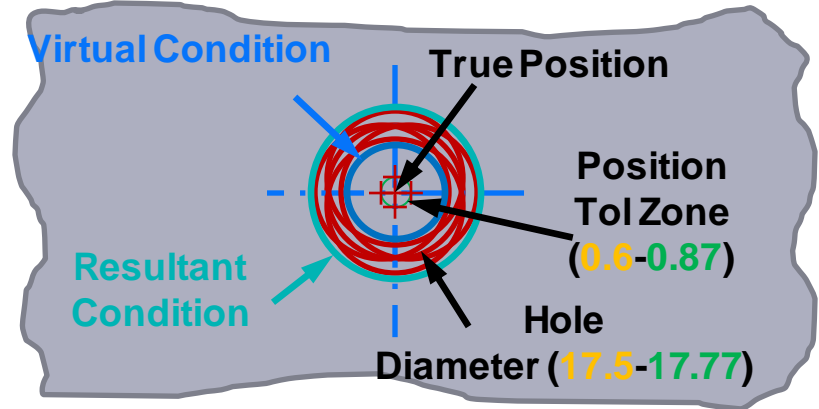
The measurement

1. The hole position measurement occurs **after** the **bending** process and relates to a **fixed DRF**.
2. The bent profile **does not affect** the hole position

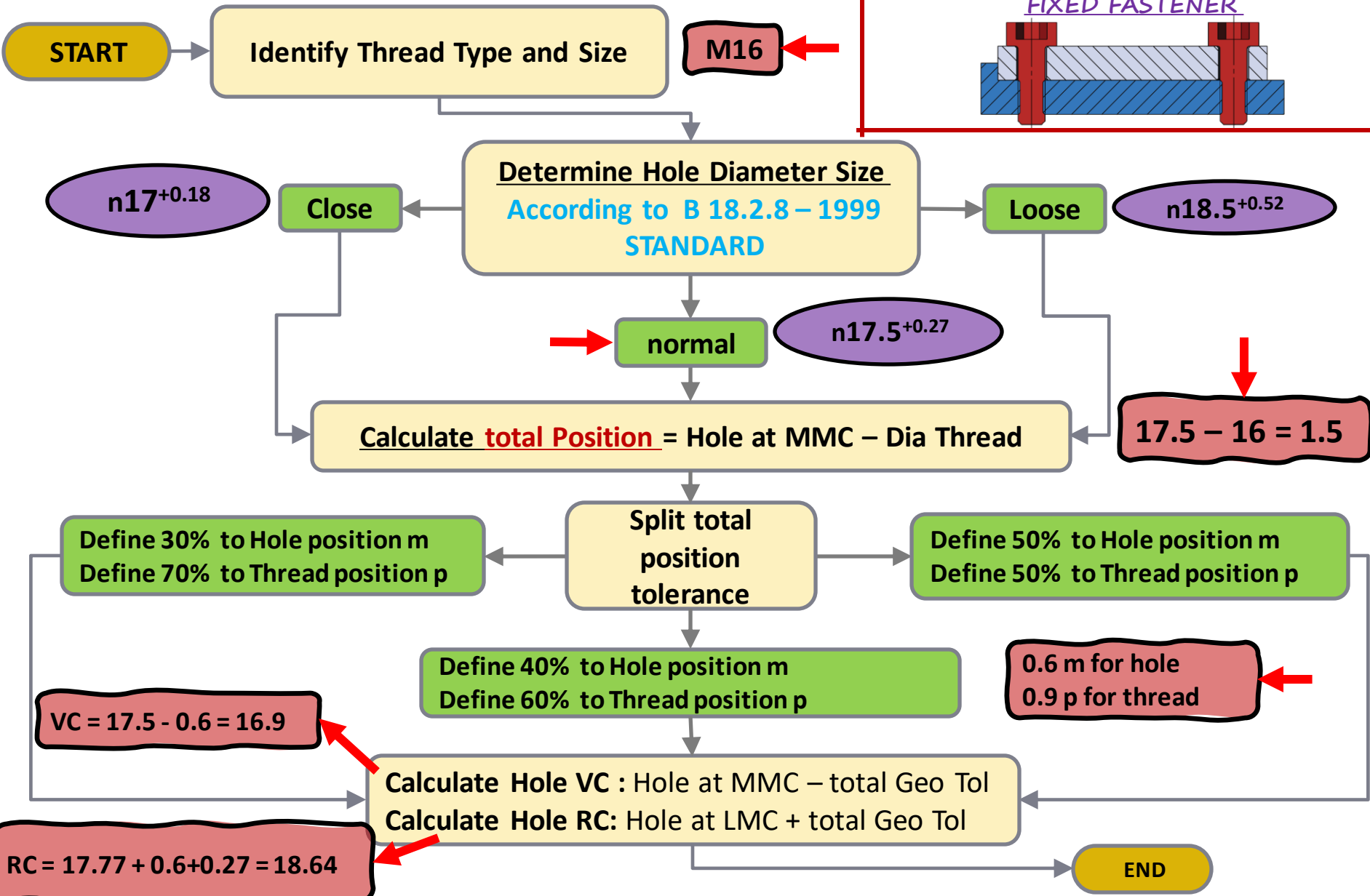
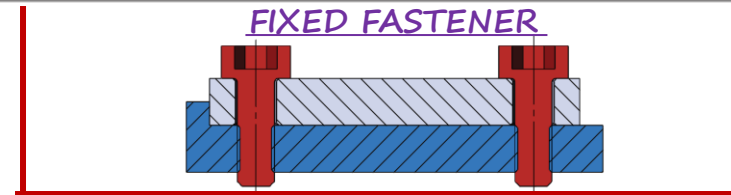
Geometric Dimensioning & Tolerancing



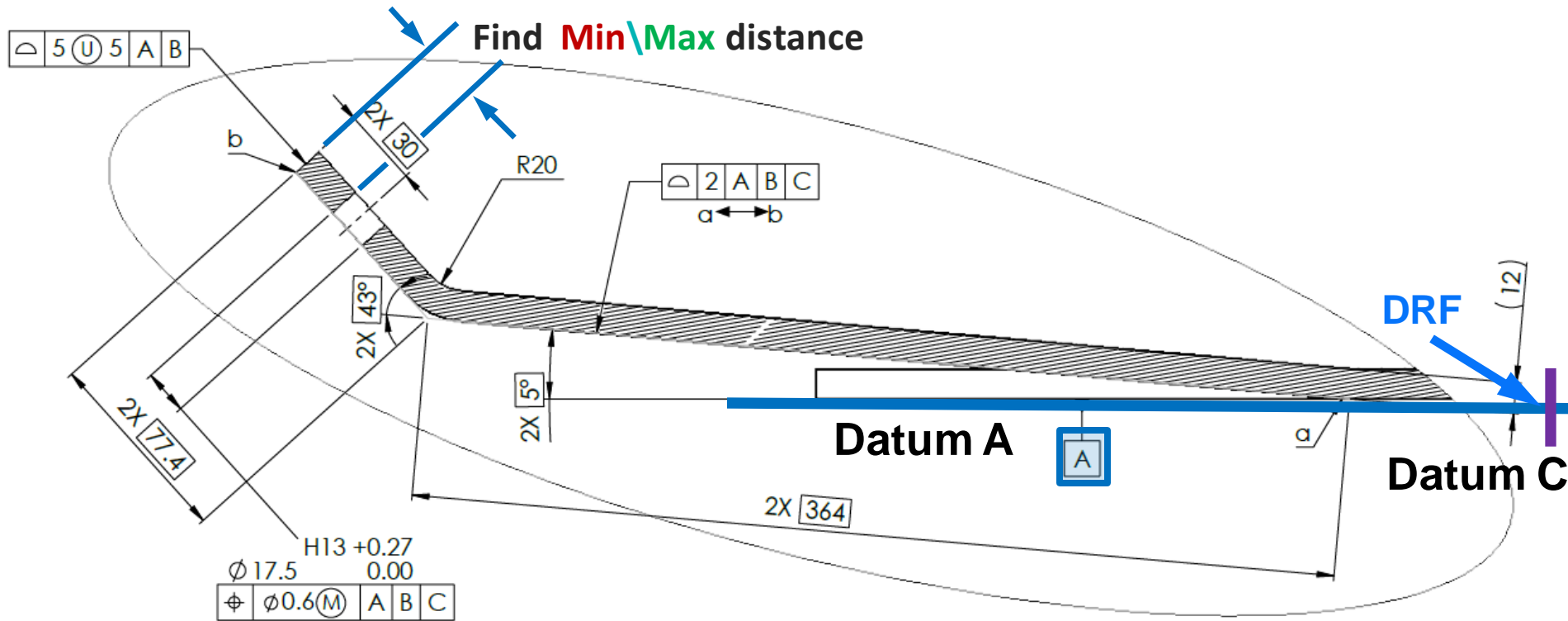
Hole VC = hole MMC – Position Tolerance
 $= 17.5 - 0.6 = 16.9$
Hole RC = hole LMC + total Position Tolerance
 $= 17.77 + (0.6 + 0.27) = 18.64$



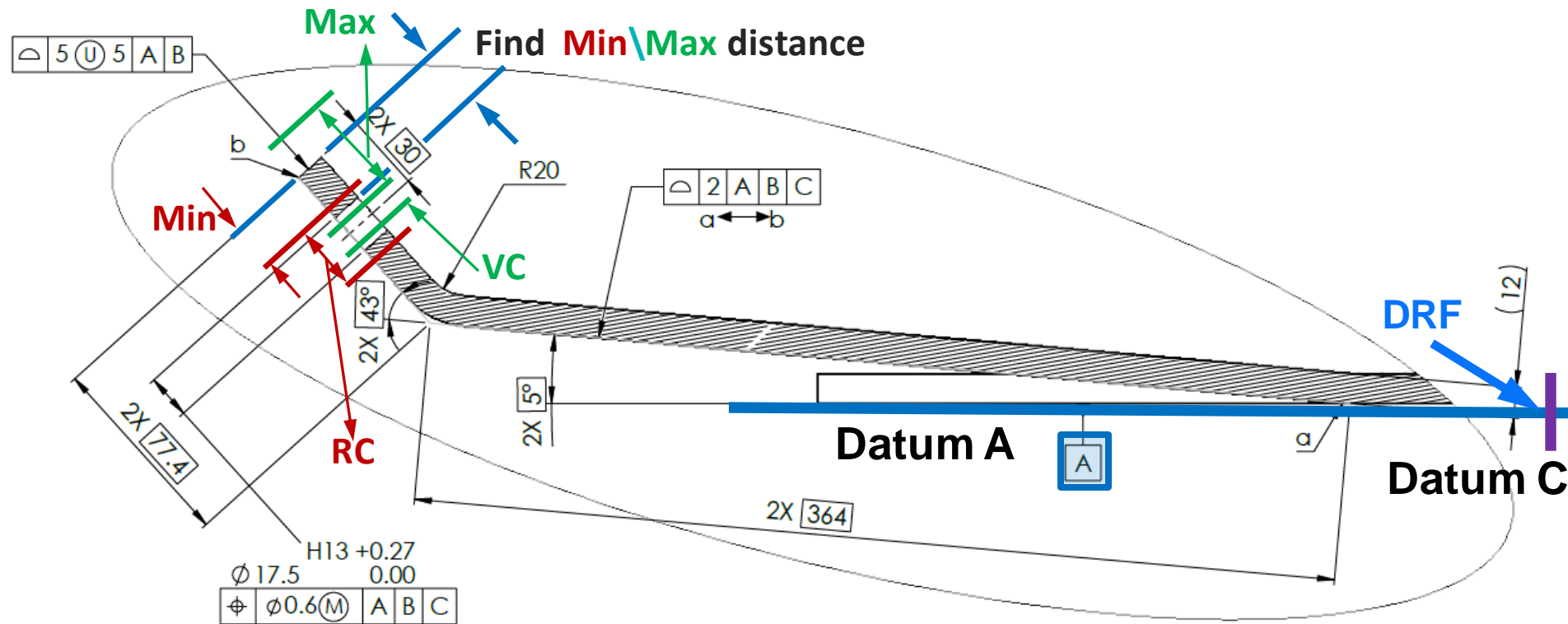
Position – Fix fastener case when projected tolerance zone is use



Geometric Dimensioning & Tolerancing



Geometric Dimensioning & Tolerancing



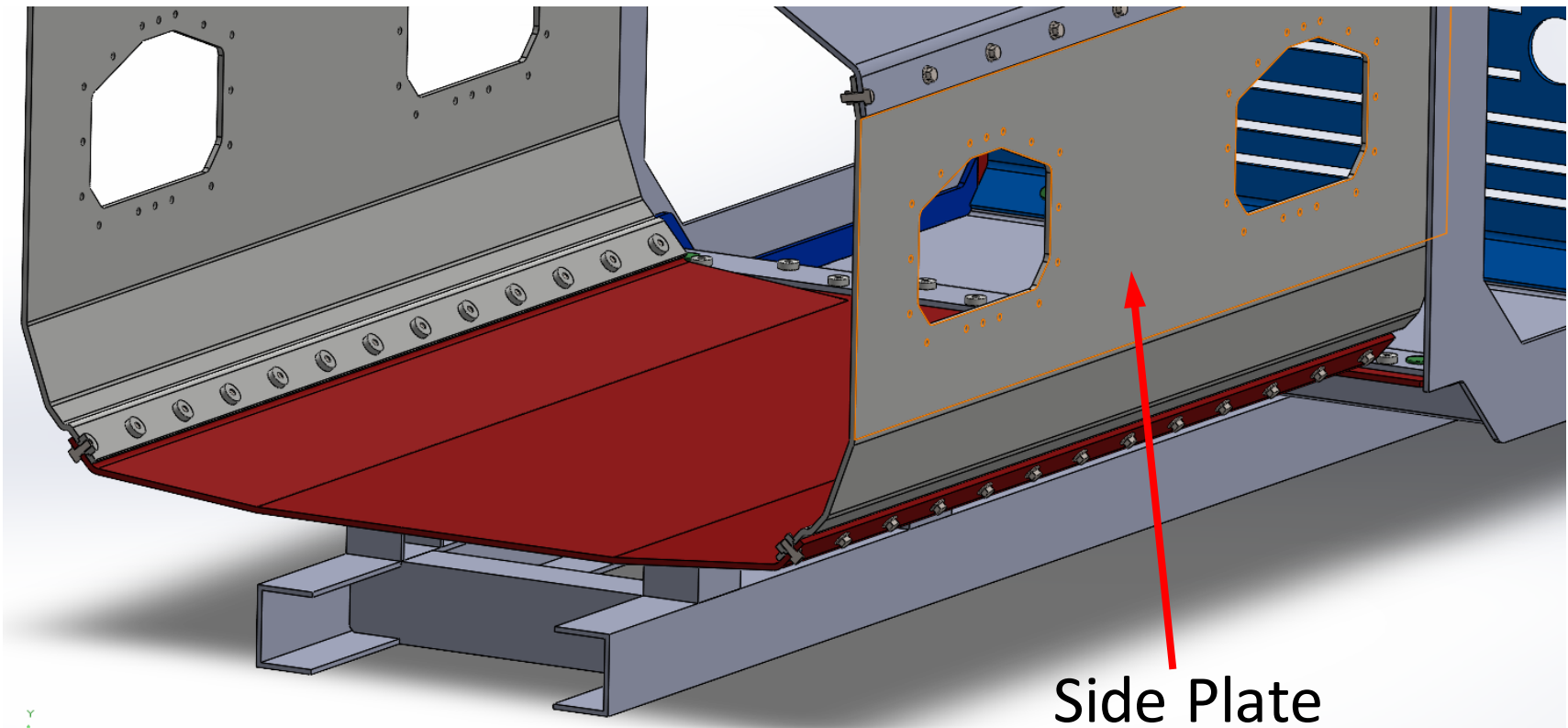
Hole RC = 18.64

$$Min = 30 - \frac{RC}{2} = 30 - \frac{18.64}{2} = 20.68$$

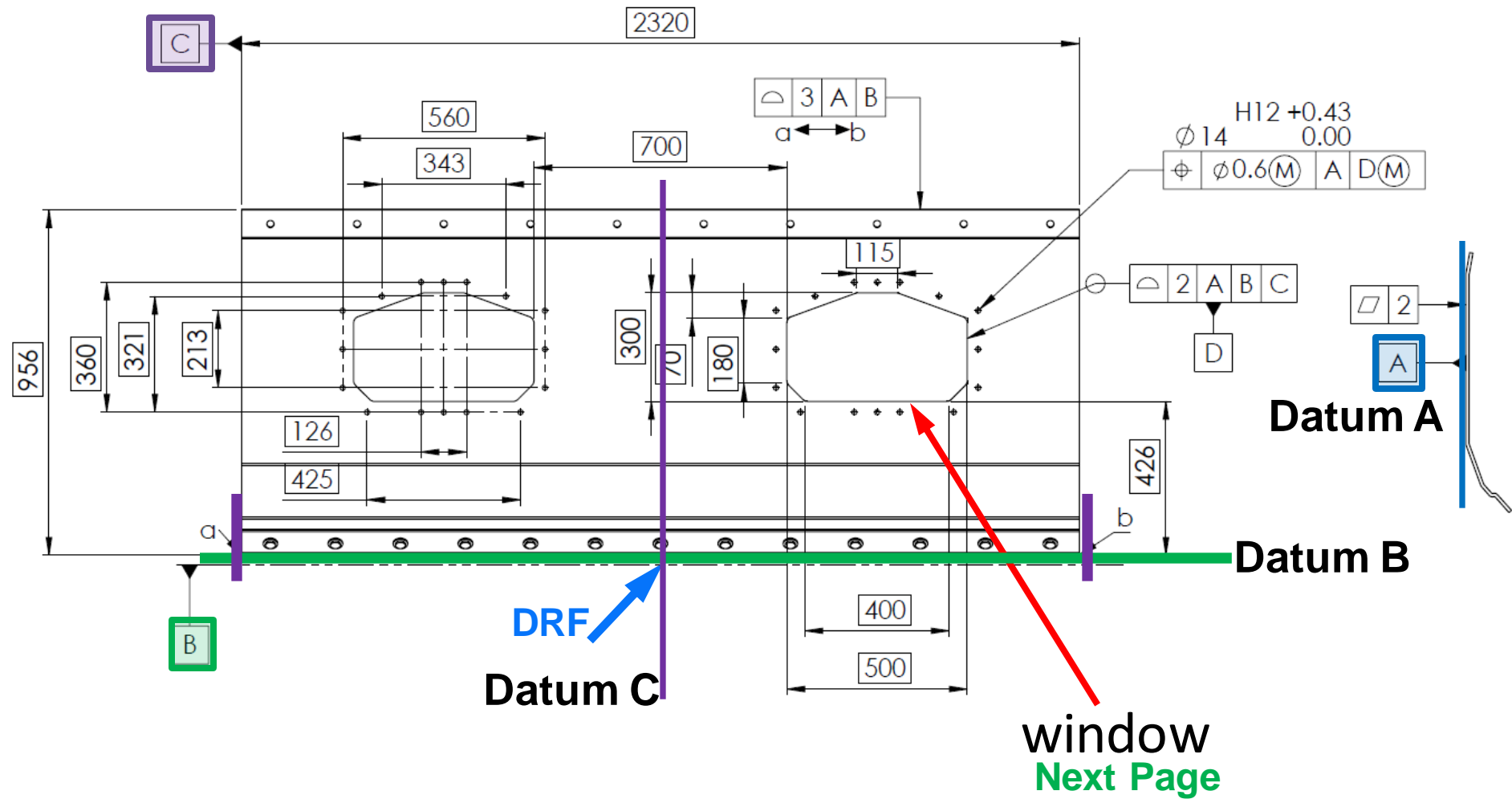
Hole VC = 16.9

$$Max = 35 - \frac{VC}{2} = 35 - \frac{16.9}{2} = 26.55$$

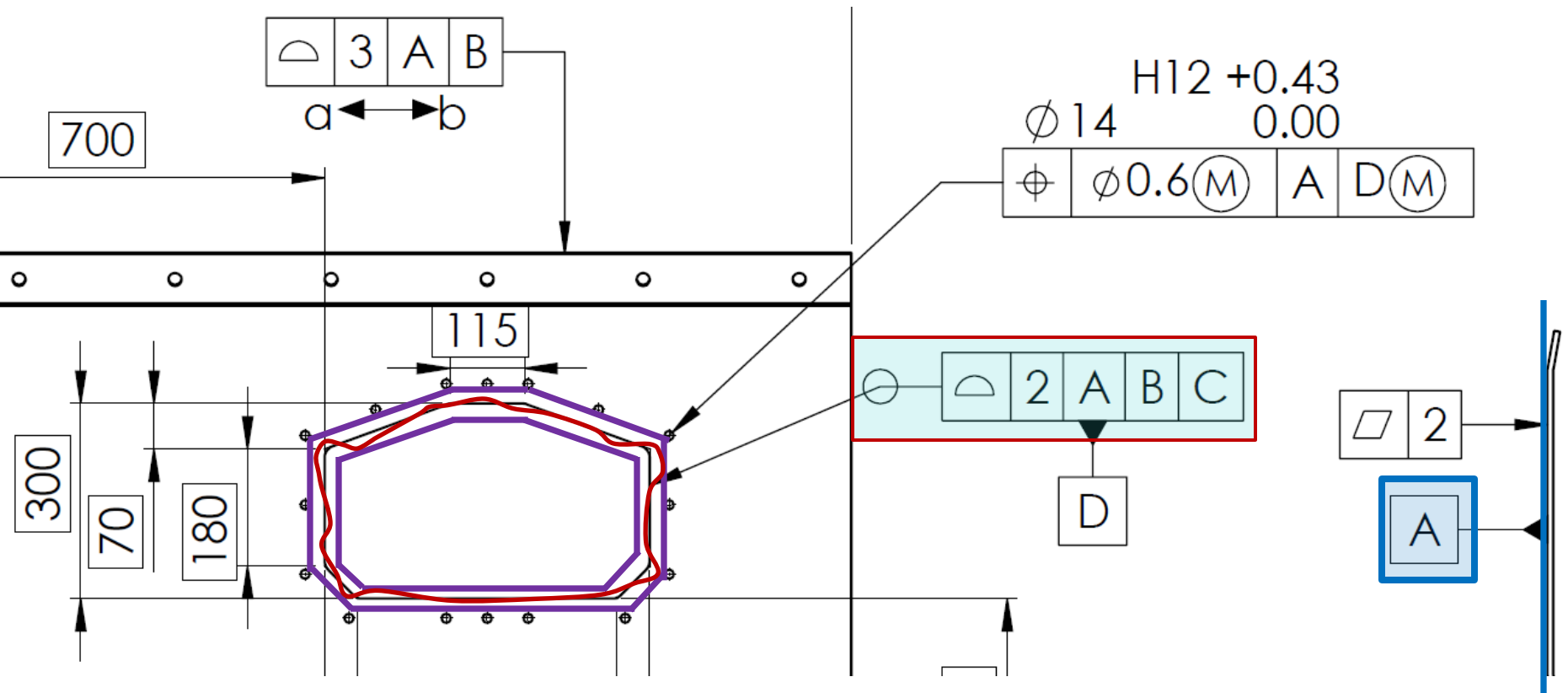
Geometric Dimension & Tolerancing



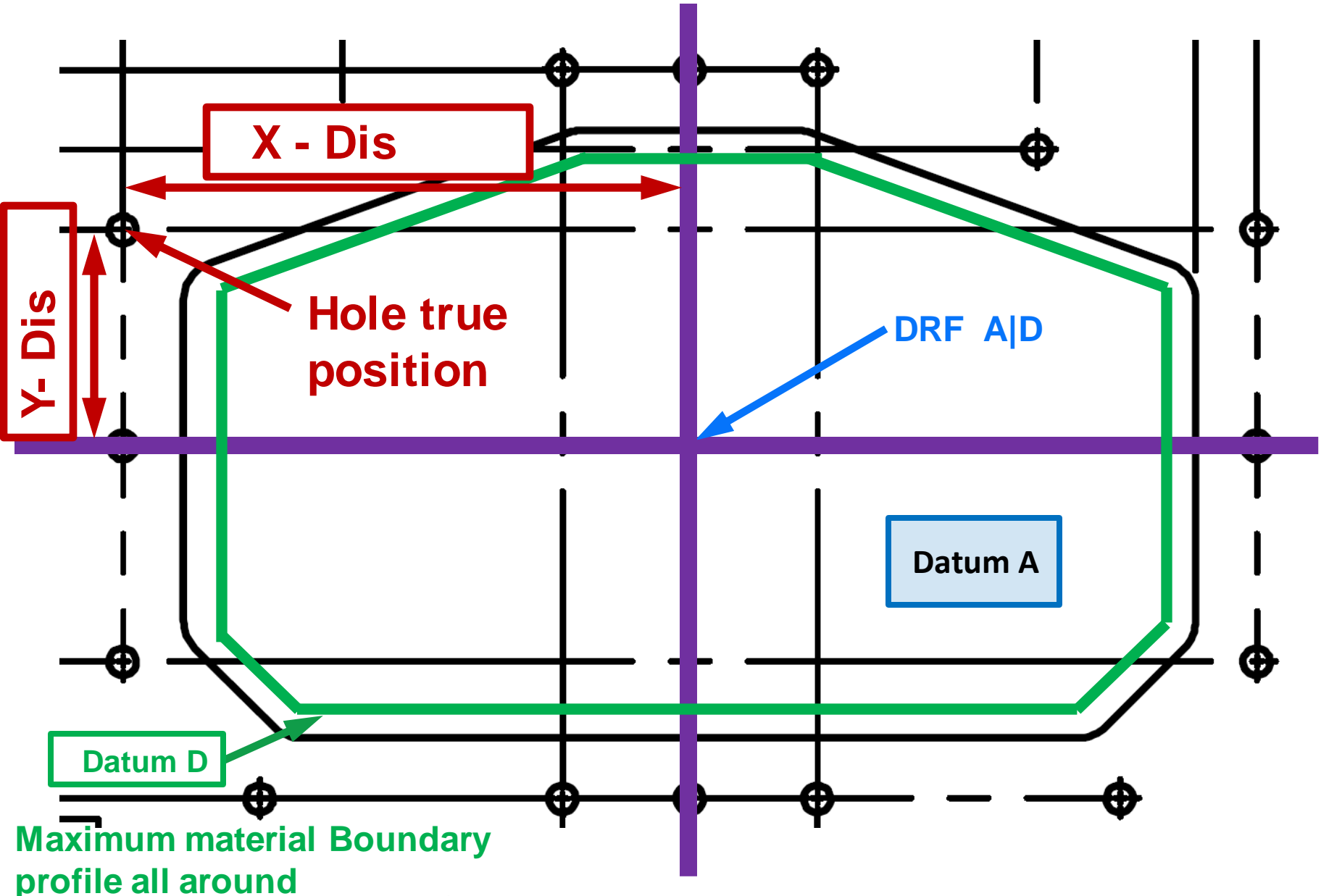
Geometric Dimensioning & Tolerancing



Geometric Dimension & Tolerancing



Geometric Dimensioning & Tolerancing



Maximum material Boundary
profile all around

THE END

THANK YOU,
QUESTIONS?

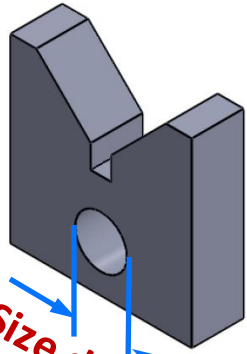
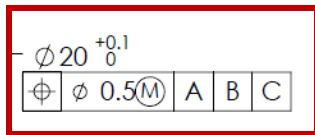
RONEN KOMERIAN

What is required to design and manufacture this component

Example 3

How to measure a hole diameter

On drawing



Several methods of measurement

- caliper



- Telescoping Gage Set



- pin gage



- Cmm measurement



What is required to design and manufacture this component

Example 3

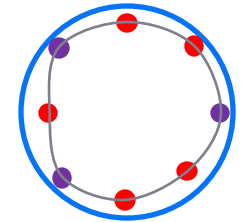
How to measure a hole diameter

Cmm measurement

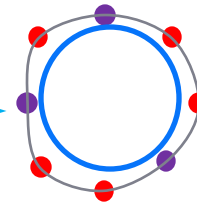
For a cylinder, a minimum of 6 points is required
3 points in 2 sections

cmm results option

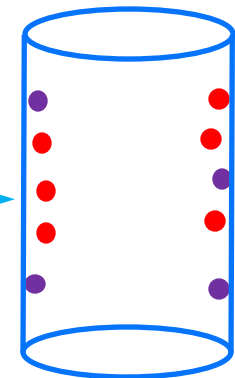
1) circumscribed cylinder



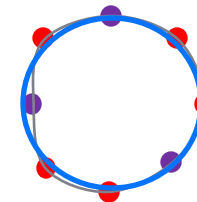
2) inscribed cylinder



3) AME Related \ Unrelated

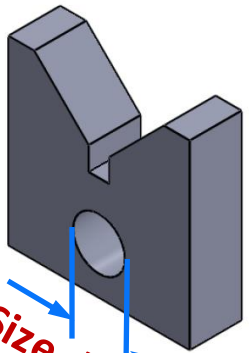


4) Average



On drawing

$\phi 20^{+0.1}_0$
 $\phi 0.5(M) A B C$



Size diameter?



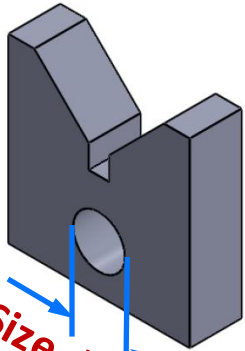
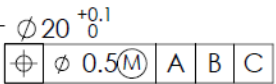
What is required to design and manufacture this component

How to measure a hole diameter

Example 3

Cmm Average result:
5 measurement points were taken

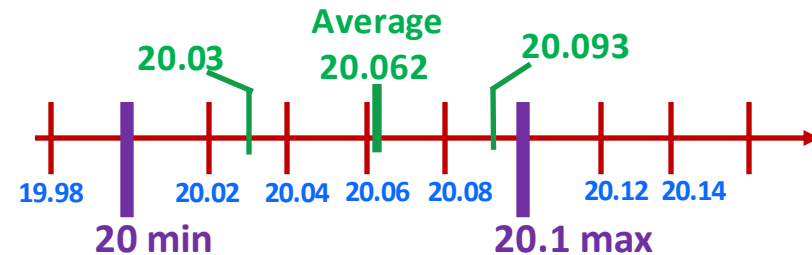
On drawing



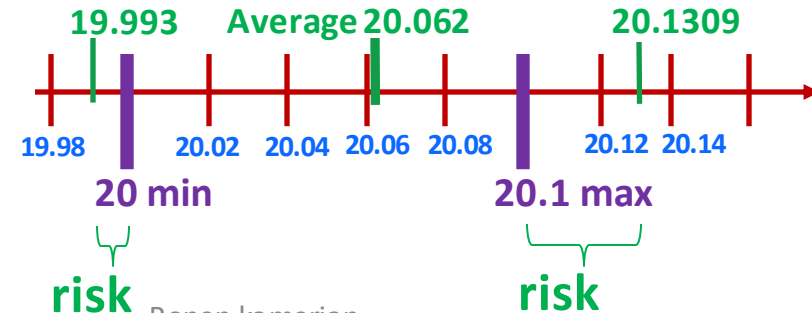
Size diameter?

	Sampling number	Diameter Measurement
	1	20.07
	2	20.09
	3	20.09
	4	20.01
n=	5	20.05
	\bar{x}	Average 20.062
	\hat{s}	standard deviation 0.033466401
	D.O.F=n-1	5-1=4

Confidence interval	90%		
α	0.1		
$\alpha/2$	0.05		
$t(\alpha/2)$	2.132		
Minimum value	>	μ	> Maximum value
20.03009115	>	μ	> 20.09390885



Confidence interval	99%		
α	0.01		
$\alpha/2$	0.005		
$t(\alpha/2)$	4.604		
Minimum value	>	μ	> Maximum value
19.99309364	>	μ	> 20.13090636



Confidence interval equation

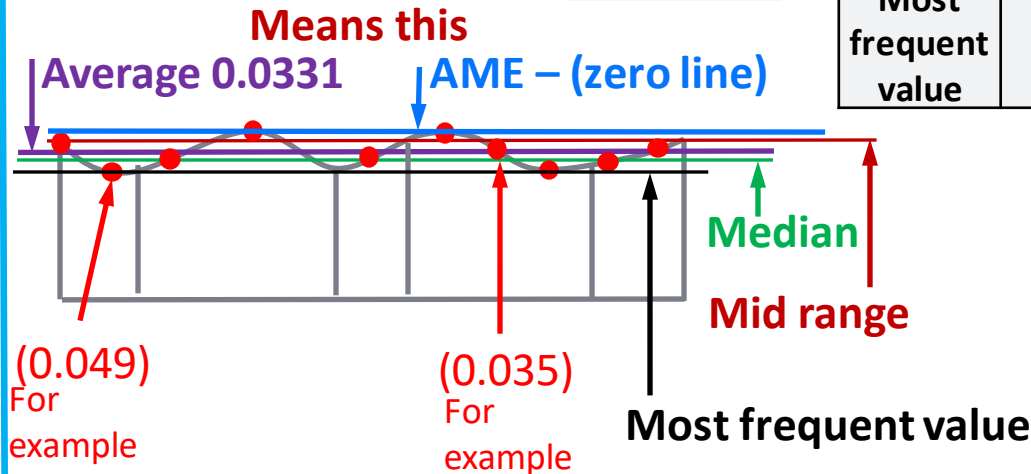
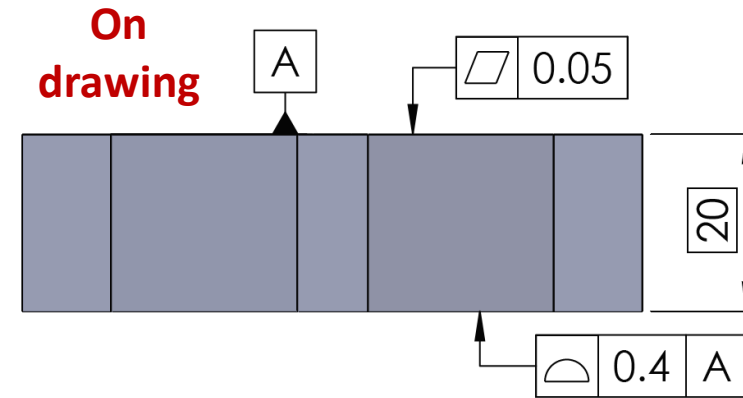
$$p\left(\bar{x} - t_{\alpha/2} \frac{\hat{s}}{\sqrt{n}} < \mu < \bar{x} + t_{\alpha/2} \frac{\hat{s}}{\sqrt{n}}\right) = 1 - \alpha$$

	Sampling number	Diameter Measurement
	1	20.07
	2	20.09
	3	20.09
	4	20.01
n=	5	20.05
	\bar{x}	Average 20.062
	\hat{s}	standard deviation 0.033466401
	D.O.F=n-1	5-1=4

What is required to design and manufacture this component

Example 3 How to measure a Datum plane

Cmm Average result:
10 measurement points were taken

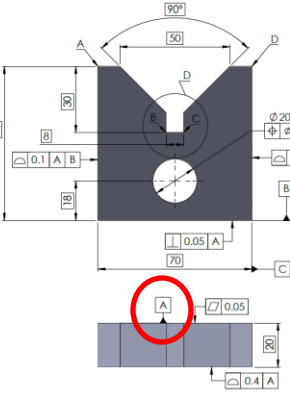


1	0.008
2	0.01
3	0.035
4	0.012
5	0.048
6	0.049
7	0.045
8	0.049
9	0.05
10	0.025

$$\sqrt{\frac{\sum_{i=1}^n (x_i - \tilde{x})^2}{n}}$$

\tilde{x} -indicators	Least squares root	
Average	0.0331	0.01683
mid-range	0.029	0.01732
Median	0.04	0.01819
Most frequent value	0.049	0.02315

On drawing



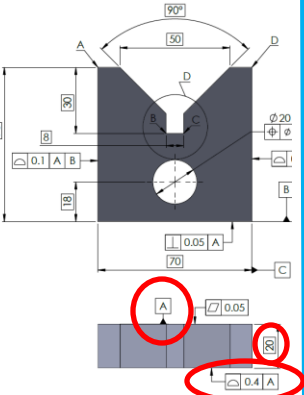
What is required to design and manufacture this component

Example 3

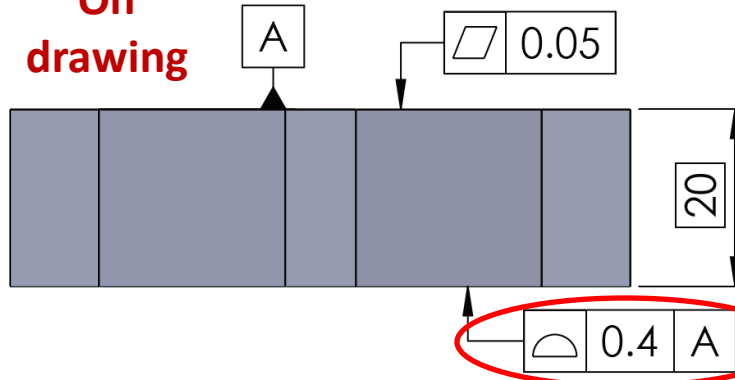
How to measure a Datum plane

Cmm Average result:
10 measurement points were taken

On drawing

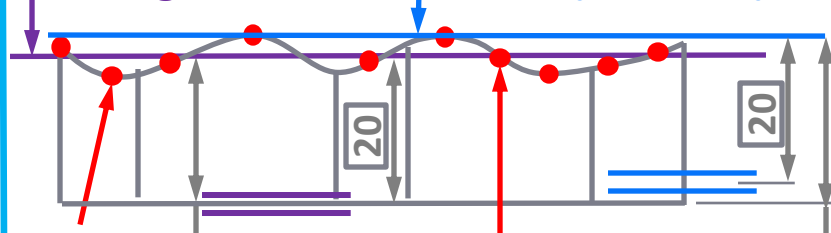


On drawing



Means this

Average 0.0331 AME – (zero line)



(0.049)
For example

20.18



(0.035)
For example

20.216



1	0.008	$\sqrt{\frac{\sum_{i=1}^n (x_i - \tilde{x})^2}{n}}$
2	0.01	
3	0.035	
4	0.012	
5	0.048	
6	0.049	
7	0.045	
8	0.049	
9	0.05	
10	0.025	
\tilde{x} -indicators		Least squares root
Average	0.0331	0.01683
mid-range	0.029	0.01732
Median	0.04	0.01819
Most frequent value	0.049	0.02315

