Bra belysning på jobbet

Skärma av lampan, så att du inte blir bländad.

Testa belysningen på din arbetsplats

Fel ljusriktning kan ge reflexbländning och dålig kontrast.

Rätt ljusriktning ger bra kontrast och inga reflexer.

Med hjälp av ”spegeln” på motsatta sidan kan du lätt kontrollera ***ett*** vanligt belysningsproblem, nämligen ***bländning.***
Gör så här:

Placera ”spegeln” på ditt arbetsbord eller där du normalt håller blicken fäst.

Om du ser ljuskällor i spegeln, t ex en oskyddad lampa, ett fönster eller den blanka reflektorn i ljusarmaturen, finns det risk för reflexbländning i halvblanka och blanka material.

Flytta ”spegeln” till olika punkter i din närhet.

Svårt att helt undvika reflexer

Genom spegelprovet får du på ett enkelt sätt reda på om reflexbländningen är kraftig eller ej. Men det är svårt att helt och hållet undvika reflexer från takarmaturer.

Blanka ytor och arbetsmaterial ökar risken för bländning. Bord och andra arbetsytor bör vara matta.

Prova dig fram

Finns det risk för reflexbländning kan du kanske åtgärda det genom att förse ljusarmaturerna med bländskydd eller ändra lampans placering. Kanske kan du flytta arbetsplatsens läge i förhållande till ljusarmaturen. Prova dig fram tills du hittar ett bra läge.

Arbetarskyddsfonden

Arbetarskyddsfonden, som tagit fram denna bok, arbetar för att förbättra arbetsmiljön så att risken för arbetsskador och yrkessjukdomar minskar. Fonden stöder forskning och utveckling, utbildning och information på arbetsmiljöområdet.

Fondens verksamhet bekostas av en liten del av de sociala avgifter, som alla arbetsgivare betalar för sina anställda. I fondens styrelse sitter bl a representanter för de stora arbetsmarknadsorganisationerna.

Bra belysning på jobbet

Problem med belysning finns överallt i arbetslivet. På kontor och verkstäder, på inom- och utomhusarbetsplatser. Många människor i arbetslivet upplever att de har mer eller mindre uttalade problem.

I flera undersökningar, som genomförts med stöd av arbetarskyddsfonden, har arbetsmiljön i olika branscher kartlagts. Utredningarna, som också tagit upp belysningsfrågor, visar både hur det står till i olika typer av företag och i många fall hur man kan rätta till problemen.

En samlad information

Arbetarskyddsfondens styrelse har sett det som angeläget att samla de erfarenheter och praktiska förslag till lösningar som framkommit vid dessa undersökningar och föra ut resultaten i en bred information.

Denna skrift är ett viktigt led i den informationen. Arbetarskyddsfondens fackkonsult vid framtagningen har varit ingenjör Sven Hökfelt, Elektriska Prövningsanstalten AB, ELPA, i samarbete med informationskonsult Erik Järhult, InformationsProducenterna. En grupp med representanter för arbetarskyddsstyrelsen, LO, TCO och SAF har aktivt följt arbetet. Materialet har också granskats av en expertpanel.

Branschhäften och affischer

På några områden med speciella belysningsproblem och där undersökningar har visat hur man praktiskt kan komma tillrätta med problemen har särskilda branschhäften tagits fram.

I början av 1980 finns branschhäften inom dessa områden:

- ***Verkstadsindustrin***
- ***Gjuteriindustrin***
- ***Grafiska branschen***
- ***Restaurangbranschen***

Allt eftersom fler undersökningar blir klara kan det bli aktuellt med ytterligare branschhäften.

Beställ kostnadsfritt trycksakerna och de två affischerna om bländning och underhåll som tagits fram. Använd beställningskupongen på sid. 89.

En allmänbelysning bestående av oskärmade lysrör ger svåra bländningsproblem som den övre bilden till vänster visar. Med väl avbländade armaturer, riktigt avvägd belysningsstyrka och en ljus färgsättning kan man skapa en god arbetsmiljö.

Innehåll

Del I
Praktiskt inriktad faktadel

Bra belysning är en viktig del av arbetsmiljön. Samspelet mellan ljuset, det man ser på och människan är avgörande. Del I förklarar – med exempel från arbetslivet – hur samspelet fungerar. Vi slutar med att visa hur man gör när man undersöker belysningen.

Belysningen och arbetsmiljön

Belysningen är en viktig del av arbetsmiljön. Man ska inte behöva irriteras av reflexer och bländning, så att man av den anledningen känner sig trött och kanske får huvudvärk. Man behöver se ordentligt vad man gör och var man går för att jobbet ska bli rätt utfört och man inte ska riskera skador. Belysningen ska vara utformad för att passa även äldre och människor som bär glasögon.

Är belysningen bra och riktigt anpassad betyder det mycket för trivseln och arbetsresultatet.

Bläddra och hitta idéer

Den här boken ger många förslag och praktiska lösningar på vanliga belysningsproblem. Ta och bläddra en stund innan du börjar läsa på allvar. Säkert hittar du åtskilliga exempel som stämmer in med just din arbetssituation.

Även om miljön i exemplen inte alltid kommer från den verksamhet du själv jobbar med, tror vi ändå att du känner igen själva belysningsproblemet. Och framför allt: här finns idéer hur du kan åtgärda liknande problem på din arbetsplats.

Hur kan ”Bra belysning på jobbet” utnyttjas?

För att åstadkomma bra belysning på ett företag krävs anpassning till förhållandena vid respektive företag. ”Bra belysning på jobbet” vänder sig till alla i ett företag som på ett eller annat sätt kan bli engagerade i arbetet med att förbättra belysningsförhållandena.

Vilka de är styrs idag av de bestämmelser vi har på arbetsmiljöområdet och de informations- och förhandlingsbestämmelser som finns.

Förändring av belysningen innebär ju dels att arbetsmiljön påverkas, dels att förhållandena för arbetstagarna förändras.

Detta innebär att bestämmelserna i såväl arbetsmiljölag, arbetsmiljöavtal som medbestämmandelag är aktuella.

Några viktiga punkter ur avtals- och lagbestämmelserna är:

- ***Skyddsombuden ska delta i planeringen av arbetsmiljön. Det gäller helt naturligt då också belysningsfrågor.***
- ***De anställda ska ha möjligheter att kunna påverka sin arbetssituation och en förändring av belysningen är en del av denna.***
- ***Både anställda och skyddsombud ska påtala brister de upplever i arbetsmiljön – brister som kan innefatta belysningsproblem.***
- ***Skyddskommittén ska upprätta handlings- och åtgärdsprogram för arbetsmiljöområdet.***
- ***Skyddskommittén ska behandla frågor om projektering, planering av nya eller ändrade anordningar, arbetsmetoder, processer och lokaler samt granska ritningar och andra handlingar som rör arbetsmiljön.***
- ***Arbetsgivarsidan har informationsskyldighet mot arbetstagarsidan såväl enligt medbestämmandelagen som arbetsmiljöavtalet.***
- ***Förändringar av arbetsmiljön kan också leda till förhandlingar innan åtgärder får vidtas.***

Samråds- och överläggningsskyldigheterna innebär alltså att många personer i ett företag har behov av att ta del av det material som presenteras i handboken.

Gå till verket systematiskt

Liksom i allt annat miljöarbete är det viktigt med systematik. Belysningsproblem är inte alltid lätta, även om det ibland kan tyckas så. Många faktorer samverkar och man måste pröva sig fram.

Del I i boken ger viktiga bakgrundsfakta, del II visar exempel på problem och lösningar. I del III finns avsnitt om underhåll och planering.

Till hjälp finns en detaljerad checklista som kan utnyttjas när du går igenom din arbetsplats eller de arbetsplatser du på ett eller annat sätt ansvarar för.

En sådan granskning ska inte vara någon engångsföreteelse utan bör återkomma regelbundet. Gör samtidigt upp en åtgärds- och tidplan för frågor som går att lösa direkt eller utan större kostnader/utredningar.

Självfallet ska belysningsfrågor också tas upp vid normala skyddsronder.

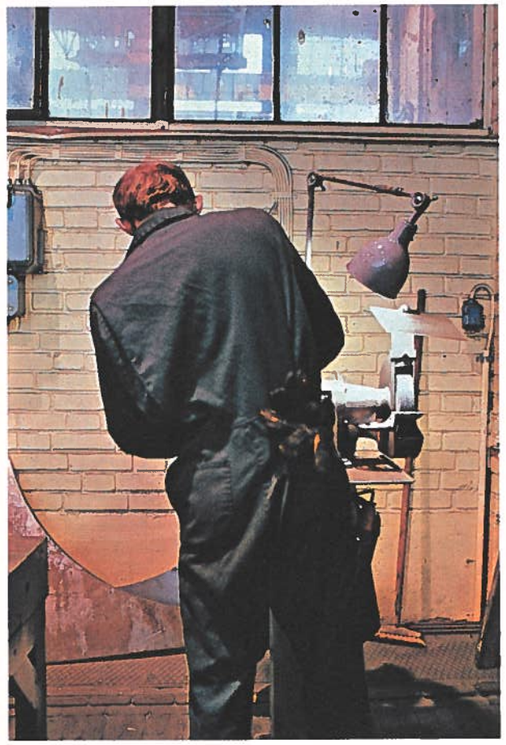
För vidare de problem som inte kan lösas direkt tillsammans med närmaste arbetsledare eller skyddsombud till högre chef eller till skyddskommittén.

Dyrt? Besvärligt? Det behöver det inte vara. En riktig belysningsplanering, rätt färgsättning och placering av armaturer, regelbundet underhåll kostar inga stora pengar men kan ge fina resultat. Det kan du se på nästa uppslag.

Spara energi – utnyttja ljuset rätt

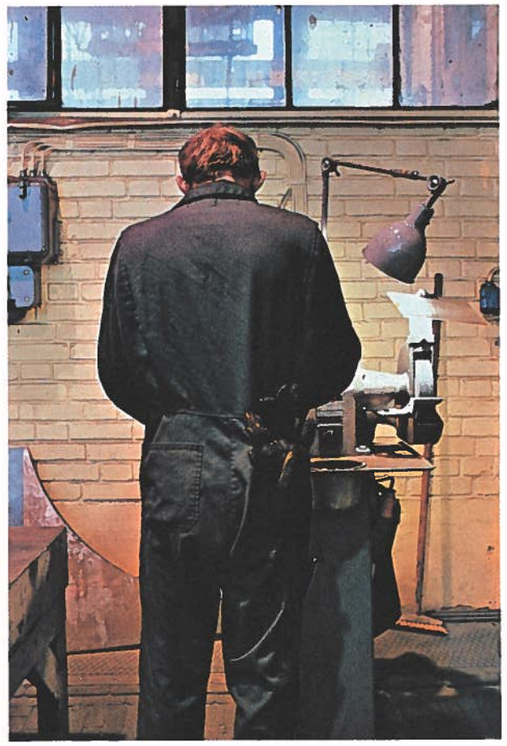
Just med tanke på att vi alla måste spara energi är det viktigt att utnyttja ljuset på bästa sätt. Rätt utformade och placerade armaturer tillsammans med lämplig färgsättning ger både god synmiljö och lägre driftkostnader.

Att se till belysningen behöver inte bli dyrt om man är lite påhittig



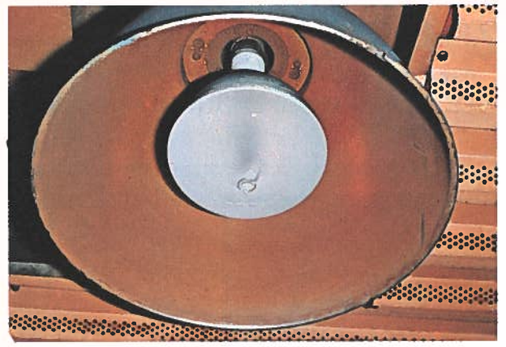
Problem

För att inte bli bländad av reflexer från slipmaskinens skyddsglas tvingas den anställde stå i en onaturlig ställning, som frestar på ryggen. Eftersom han är van tänker han inte på att det är belysningen det är fel på.



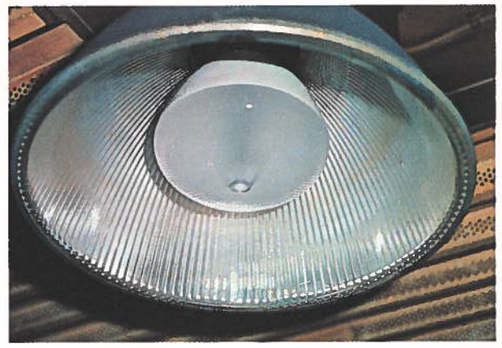
Åtgärd

Ställ in platsbelysningen noggrant. Pröva olika lägen för att uppnå bästa ljusriktning. Justera skyddsglasets läge. För många arbeten är bästa ljusriktningen snett bakifrån. Det ger de bästa förutsättningarna att se bra och samtidigt få en riktig arbetsställning.



Problem

I lokaler där man svetsar är armaturernas reflektorer ofta gjorda av aluminium. I svetsröken från svetselektroden finns ämnen, som gör att det blanka aluminiumet oxiderar och smutsas ner om svetsröken kommer ut i lokalen och inte sugs ut. Bilderna visar armaturer som suttit uppe ca 2 år.



Åtgärd

Byt armaturerna till en typ med glasreflektor. Glas angrips nämligen inte av svetsröken och kan lätt hållas rent. En annan typ har kvar aluminiumreflektorn men ljusarmaturen täcks av glas undertill. Man bör kräva att leverantören garanterar att smuts och svetsrök inte kan tränga in under glaset och angripa aluminiumet.

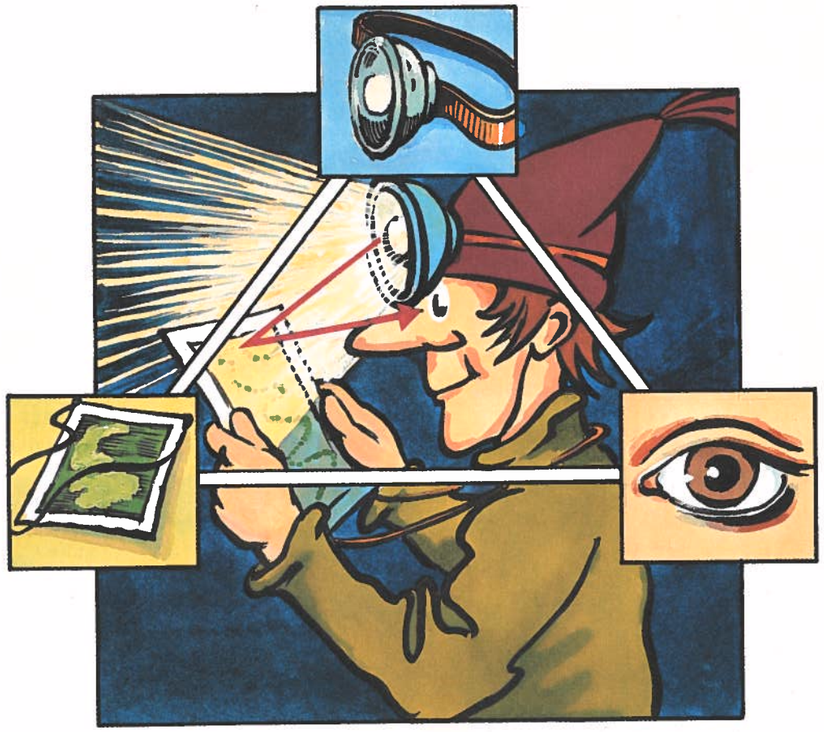
Problem

Lokalen upplevs som mörk och dyster trots att belysningsstyrkan från takarmaturen är hög.

Åtgärd

Placera lamporna närmare väggen. Är väggen målad i mörk färg, måla om till en ljus färg som reflekterar ljuset mycket bättre. Utan ökad belysningsstyrka upplevs rummet väsentligt ljusare.

Det viktiga samspelet



Det är tre saker som tillsammans avgör hur man uppfattar det man ser, nämligen

1 ***ljuset** – vare sig det kommer från solen eller en lampa*

2 ***synobjektet** – det man ser på – både direkt och i omgivningen – och hur det man ser på kan reflektera ljus och färger*

3 ***ögat** – det vill säga människans förmåga att uppfatta ljus och mörker, rörelser och färger m m.*

Om någon av de tre faktorerna inte är rätt avvägd påverkas hela samspelet.

Triangeln på bilden illustrerar detta samspel. Den röda pilen från lampa till karta till öga visar ljusets väg.

Med hjälp av synen skaffar vi oss information om omvärlden. Huvuddelen av all information förmedlas via ögonen. Resterande information svarar de andra fyra sinnena för – hörseln, känseln, smaken och luktsinnet. Synen och synförhållandena spelar alltså en avgörande roll. Därför är det viktigt att skapa så goda förutsättningar som möjligt för att se bra.

Många exempel

I denna bok finns många exempel på hur vi förbättrat seendet i olika arbetssituationer genom att i tänkandet använda det viktiga samspelet mellan **ljuset – synobjektet – ögat.**

Detta har i en del fall skett t ex genom att använda särskild platsbelysning och att öka kontrasten mellan synobjekt och bakgrund. Ibland behöver arbetstagaren nya glasögon utprovade för aktuellt synavstånd, vilket ofta är längre än normalt läsavstånd.

För bra seende hjälper det inte om belysningsstyrkan på synobjektet i sig är tillräcklig om ljusets riktning och kontrasten är fel eller om belysningsarmaturerna bländar.

Det kan t ex hända att belysningsstyrkan från lamporna i tak är tillräcklig, men att färger på väggar och golv är för mörka och ”suger åt” sig ljuset. Ytorna kan då inte återkasta det ljus som behövs för att rummet ska upplevas ljust och behagligt. I den situationen bör man först och främst se över möjligheterna att måla golv, väggar och tak i ljusare färg – inte öka belysningsstyrkan.

I vissa fall räcker inte människans ögon till utan hjälpmedel som förstoringsglas eller specialslipade glasögon behövs. Arbete vid dataterminaler t ex är mycket synkrävande med olika synavstånd.

Rätt färg till rätt lampa!

När man väljer ljuskälla, t ex glödlampa eller högtrycksnatriumlampa, behöver man tänka på vilka färger arbetslokalen och synobjektet ska ha. Också här kommer samspelet in i bilden. Ett föremål kan ge olika färgintryck beroende på vilken lamptyp som används.

Olika ljuskällor innehåller nämligen olika mycket av blå, grön, gul och röd strålning. Man kan bara se de färger som finns i ljuset. För att rätt kunna bedöma de färger som ska användas i ett rum måste man se dem i samma slags belysning som den som ska användas.

Mörka lokaler

Man bör komma ihåg att en mörk och/eller smutsig lokal upplevs som mörk även i kraftig belysning. En ljus färgsättning ger inte bara ett ljusare intryck. Den kan också få andra betydelsefulla effekter på arbetsplatsen – minskat antal olycksfall och allmänt förbättrade arbetsförhållanden. En ljus färgsättning avslöjar direkt bristande ordning m m och leder därför till att arbetsplatsen hålls renare.

Det är alltså inte bara ljuset som avgör vad och hur vi ser. Det är minst lika viktigt att det vi ska se på framträder ordentligt. Detta kan påverkas på flera olika sätt. Många av de åtgärder som vi visar i den här boken är både enkla och inte speciellt dyra att genomföra.

Belysningsplanering och val av ytfärger bör samordnas så att man utnyttjar både belysningen och ljusets reflektionsförmåga så långt möjligt.

Innan vi går in på de praktiska exemplen tar vi på några sidor framåt upp de tre delarna i samspelet var för sig.

Ljus, lampor och armaturer

Vi behöver ljus för att se.

Ljus – både solljus och elektriskt ljus – är en elektromagnetisk strålning. Solljus innehåller både synligt ljus, värmestrålning (IR-strålning) och ultraviolett strålning (UV-strålning).

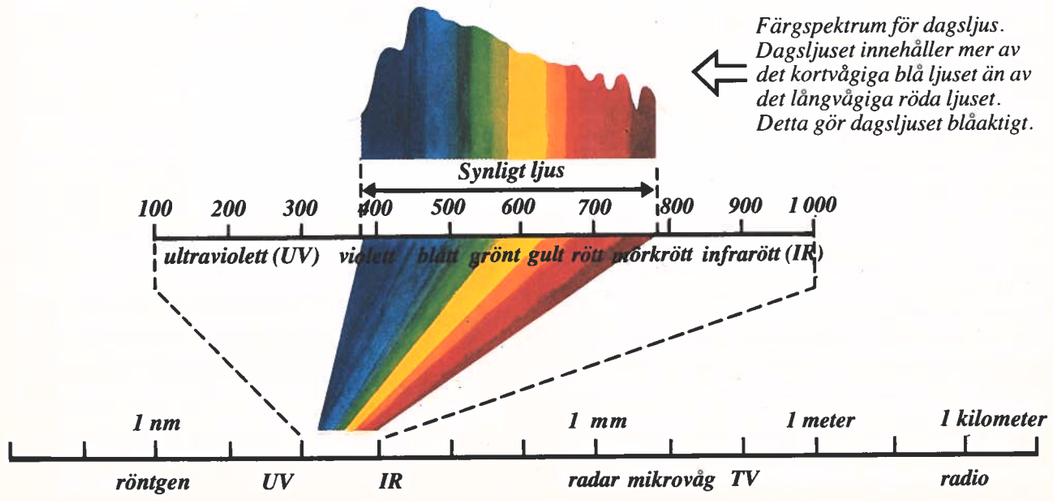
Det finns andra välkända elektromagnetiska vågrörelser – t ex radiovågor och röntgenstrålar. Det är bl a våglängden som skiljer de olika typerna. En radiovåg på mellanvåg har en längd mellan vågtopparna på ett par hundra meter, medan solljusets våglängd inte är ens en tusendels millimeter. De våglängder ögat är känsligt för ger olika färgintryck som diagrammet nedan vill visa.

Det vita solljuset innehåller strålning av alla våglängder. Låter man solljus lysa genom en prisma – en slipad glasbit – delar ljuset upp sig i regnbågens alla färger – rött, gult, grönt och blått. Varje våglängd av det synliga ljuset ger upphov till sin egen färg. Dagsljuset har en jämn färgfördelning (färgspektrum).

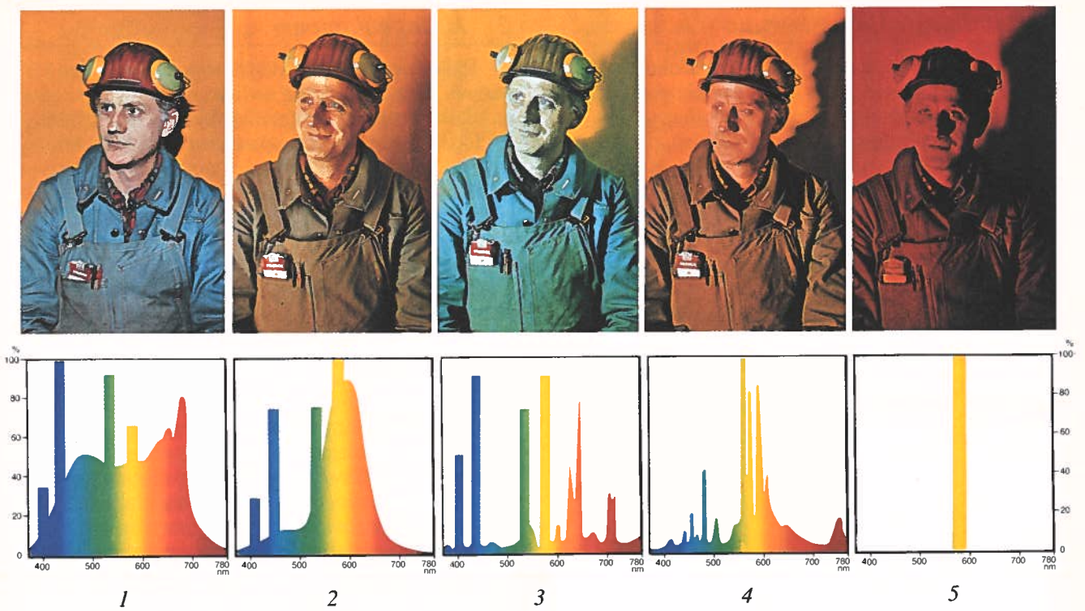
Olika elektriska lampor strålar ut ljus med olika våglängder, alltså ger de upphov till olika färger. Vi gjorde ett experiment och lät en varvsarbetare sitta i ljuset av några vanligt förekommande lampor. Så här förändrades hans utseende!

Elektromagnetisk strålning

Den elektromagnetiska strålningens våglängdsområde. Den del av våglängdsskalan som omfattar våglängderna 100 – 1 000 nanometer har förstorats och placerats i den övre delen av bilden. 1 nm = 1 miljarddels meter. Det ljus man kan se ligger inom 380 - 780 nm våglängd.



Färgspektrum för dagsljus. Dagsljuset innehåller mer av det kortvågiga blå ljuset än av det långvågiga röda ljuset. Detta gör dagsljuset blåaktigt.



1 *2* *3* *4* *5*

1 Belysningen från detta lysrör av dagsljustyp gör att alla färger går fram ganska bra, proportionerna mellan färgerna är goda. Hade vi tagit bilderna utomhus i dagsljus hade färgerna blivit ganska lika. Jämför bilden och spektralkurvan!

2 Här kommer belysningen från ett lysrör av varmvit typ, som är den mest använda av alla lysrörstyper. Denna ljuskälla ger mycket gulgrönt ljus, som ögat är mycket mottagligt för. Huden har ganska stort inslag av blå och röda färger och dessa färger kommer inte fram så bra i denna belysning. Däremot överrepresenteras de gula färgerna. Jämför bilden och spektralkurvan!

3 Den vita kvicksilverlampan har ganska stark strålning inom den blå, gula och röda delen av spektrum. I detta ljus framhävs de blågröna färgerna mera än i ljuset från högtrycksnatriumlampor och varmvita lysrör. Jämför bilden och spektralkurvan!

4 Högtrycksnatriumlampan ger ljus som är starkast inom den gula och oranga delen av spektrum. Högtrycksnatriumlampan ger ljus, som ger bra möjligheter att se gula och oranga färger. Jämför bilden och spektralkurvan!

5 Här har vi utnyttjat en lågtrycksnatriumlampa, som främst används som vägbelysning och i hamnar. Dess ljus är helt koncentrerat till en enda våglängd inom det gula färgområdet, nämligen natriumgult. Ljuset ger ingen möjlighet att särskilja färger. Ställer du t ex en blå bil under en lågtrycksnatriumlampa en mörk natt går det inte att se att den är blå! Jämför bilden och spektralkurvan!

De vanligaste ljuskällorna

Då man väljer ljuskälla måste flera faktorer beaktas. Valet påverkar t ex belysningsekonomi och kvalitet. Ifråga om ekonomin gäller att få ljuskällor som har högt ljusutbyte och lång livslängd.

När det gäller kvalitén, exempelvis att rätt kunna se och avgöra färger, vilket är viktigt inom grafisk industri, sjukvård och beklädnadsindustrier, gäller att ställa speciella krav på ljuskällans färgåtergivningsförmåga. I detta fall är det endast vissa typer av ljuskällor som kan komma ifråga.

I det följande ges en kortfattad beskrivning av olika typer av ljuskällor. Sammanställningen avser ljuskällor för normala belysningsändamål, varför speciallampor lämnas utanför.

Man delar in elektriska lampor i två huvudgrupper – glödlampor och urladdningslampor. I glödlamporna upphettas en metalltråd när elströmmen passerar, i urladdningslamporna passerar strömmen en gasblandning som då ger upphov till strålning.

Tekniska fakta om olika lampor finns i slutet av boken på sid. 86.

1 *Glödlampor*

Glödlampor tillverkas i många olika utföranden och för olika behov. Normallampor kan vara klara, matta eller opaliserade. Det finns kronljuslampor, päronlampor, klotlampor, rörlampor m m.

Glödlampans ljusutbyte är lågt. Av den anledningen är glödlampor mindre lämpliga för allmänbelysning, där man behöver mycket ljus. Däremot lämpar sig glödlampor för koncentrerad platsbelysning på kontor, vid arbetsbord och som maskinbelysningar.

Glödlampor är spänningskänsliga. En höjning av spänningen på elnätet med 1% minskar t ex en lampas livslängd med ca 15%, medan lampans ljusflöde endast ökar 3 - 4%. Välj därför glödlampor med spänning som är riktigt avpassad.

Standardlampor har en livslängd på 1 000 timmar.

Glödlampan betonar röda färger.

2 *Halogenlampor*

En vidareutveckling av glödlampan är halogenlampan. Den har förutom den vanliga gasblandningen en tillsats av någon halogen, vanligen brom eller jod. En fördel med halogenlampan är att ljusflödet blir praktiskt taget oförändrat under lampans livslängd. Glaskolven svärtas inte ned. Halogenlamporna har normalt såväl längre livslängd som större ljusutbyte än vanliga glödlampor med samma effekt. Den lämpar sig väl för t ex strålkastare och arbetslampor.

3 *Lysrör*

Lysröret är den mest använda ljuskällan i arbetslivet. Det är en urladdningslampa. Lysröret finns i effekter mellan 4 och 215 Watt. Belysningsekonomin är relativt god. Värmestrålningen är väsentligt lägre jämfört med glödlampor. Dessutom ger lysröret fler alternativ vid val av ljusfärg. Lysrör kan grovt indelas i tre ljusfärgsområden: varmvit, vit resp dagsljus. Bäst färgåtergivning ger lysrör av dagsljustyp, men de är mindre ekonomiska och bör främst användas då det ställs krav på att kunna bedöma färger.

Lysrör upp till 40 Watt kan användas inom kontor, sjukhus och industrilokaler, där takhöjden inte överstiger 3 - 4 m. För 65 Watts lysrör kan takhöjden vara upp till 6 meter.

Lysrör har en livslängd på ca 7 500 timmar.

4 *Kvicksilverlampor*

I kvicksilverlampor alstras ljuset vid högt tryck i en gasblandning som innehåller kvicksilver.

Kvicksilverlampor har en livslängd på 6 000 timmar. Ljusutbytet är i stort sett lika för klara och vita (ljuspulverbelagda) lampor. Färgåtergivningen är betydligt bättre hos den vita än hos den klara kvicksilverlampan.

Kvicksilverlampan används i lokaler med högre takhöjd samt utomhus.

5 *Metallhalogenlampor*

Genom tillsats av metallhalogener i urladdningskammaren hos en kvicksilverlampa kan man få väsentligt bättre färgåtergivningsförmåga. Lamptypen förekommer med olika beteckningar som t ex metallhalogen-, kvicksilverhalogen- och dysprosiumlampor. Egenskaperna varierar mellan fabrikanterna. Genomgående har lamptypen såväl högt ljusutbyte som god färgåtergivningsförmåga.

Metallhalogenlampor finns idag i varianter som lämpar sig väl för användning i t ex lokaler med stor takhöjd.

6 *Lågtrycksnatriumlampor*

Lågtrycksnatriumlampan är den ljuskälla som har det största ljusutbytet av alla ljuskällor. Den används främst utomhus – på vägar och bangårdar. Ljusstrålningen är koncentrerad till den gula natriumlinjen (589 nm). Ljuset ger därför ingen möjlighet att särskilja färger. Av arbetsmiljöskäl bör man undvika att använda denna ljuskälla för inomhusbelysning utom i vissa speciella fall. Livslängd ca 9 000 timmar.

7 *Högtrycksnatriumlampor*

Högtrycksnatriumlampor ger stort ljusutbyte och relativt bra färgåtergivning. Högtrycksnatriumlampans ljus ger bra möjligheter att se gula och oranga färger och viss möjlighet att även se blå, gröna och röda färger.

Den finns från 70 Watt till 1 000 Watt, vilket ger stora möjligheter att använda samma typ av ljuskälla i industrilokaler med varierande takhöjd. Livslängden är också här ca 9 000 timmar.

Högtryckslampor, som får sin yttre glaskolv sönderslagen men trots detta fortsätter att brinna, ska omedelbart bytas ut eftersom de då strålar ut UV-ljus. Detta gäller såväl kvicksilverlampor som högtrycksnatriumlampor och metallhalogenlampor.

Ett annat sätt att beskriva lampors färgåtergivning

I den här boken beskriver vi lampornas förmåga att återge färger med hjälp av diagrammet med strålningsspektra. Vissa lamptillverkare använder istället Ra-index tillsammans med färgtemperatur (K). I arbetarskyddsstyrelsens bok Belysning och belysningsplanering finns dessa termer förklarade. Låt oss bara konstatera att vid krav på god färgåtergivning ska Ra-index vara över 90 och färgtemperaturen över 5 000 K.

Armaturen ska rikta ljuset och blända av

I Arbetarskyddsnämndens utbildningsmaterial om belysning finns en bra sammanfattning på de krav man ska ställa på en god armatur:

- den ska skydda mot bländning och i övrigt fördela ljuset så att ljusspridning och skuggbildning blir lämpligt avvägda i arbetslokalen
- den ska ha en säker konstruktion som uppfyller skyddskrav bl a i fråga om elsäkerhet, brand- och explosionsrisker, buller och beröringsskydd
- den ska kunna rengöras och underhållas på ett enkelt sätt och utan fara för den person som utför arbetet
- den ska vara tillverkad av ett material som är färgbeständigt och som inte alltför snabbt nedsmutsas
- den ska ha en tillräckligt kraftig konstruktion som fungerar tillförlitligt och som tål påfrestningar både vid uppmontering och användning under lång tid
- den ska på ett ekonomiskt riktigt sätt ta till vara det ljus som ljuskällan producerar
- den ska i fråga om platsbelysning vara enkel att ställa in, flytta och reglera alltefter de olika arbetsmoment som förekommer.

Synobjekt, närfält, omfält

Synobjektet, som är vår andra punkt i samspelet mellan ljuset–synobjektet–ögat, kan med fördel delas upp i flera delar.

När man vill undersöka förhållandena på en arbetsplats är det lämpligt att skilja mellan

- *synobjekt – det man direkt ser på*
- *närfält – den närmaste omgivningen runt synobjektet*
- *omfält – det man ser när man lyfter blicken, t ex väggar, tak och golv.*

Om man t ex i sitt arbete måste se små detaljer störs koncentrationen av bländande fönster, armaturer, blanka arbetsytor, reflexer m m som finns i synriktningen. Man behöver en lugn bakgrund och en riktig ljusriktning för att detaljerna ska gå fram.

Luminans – ett nyckelord

Vi ser inte det ljus som träffar en yta eller ett föremål. En del av ljuset "sugs" ju upp, en del reflekteras åt annat håll. Vad vi ser är det ljus som reflekteras och träffar våra ögon.

Detta enkla faktum glöms tyvärr ofta bort när man talar om belysning. Man diskuterar hur mycket ljus en ljuskälla ger – hur stor belysningsstyrkan är – men det viktigaste är ändå hur mycket ljus som föremålet vi ser reflekterar.

Luminans kallas den ljushet, som en yta, ett föremål eller ett lysande föremål (t ex en lampa som du direkt ser på) ger. Luminansen mäts i candela per kvadratmeter (cd/m²).

Luminans är ett nyckelord som ofta används i den här boken.

Tillsammans med färgintrycken är luminanser och olikheterna i luminans (luminansfördelningen) mellan olika ytor av största betydelse för vårt seende. Varierar luminanserna för mycket försvåras seendet. Bländning – som är ett av de vanligaste belysningsproblemen i arbetslivet – beror på stora skillnader i luminanser, t ex en oskärmad armatur som är placerad i ett mörkt tak.

Reflektans

Luminansen är ett mått på hur ljus ytan är. Hur ljus ytan ser ut beror dels på hur mycket ljus som träffar den, dels på hur stor del av ljuset som reflekteras. En mörk yta reflekterar lite ljus, en spegel mycket ljus.

Reflektansfaktorn anger – oftast i procent – hur mycket ljus en yta reflekterar. Reflektansfaktorn har stor praktisk betydelse bl a vid färgsättning av lokaler. Flera färgfabrikanter anger reflektansfaktorn hos sina färger. På sid. 21 finns en lista med lämpliga reflektanser för industrilokaler.

Skuggor

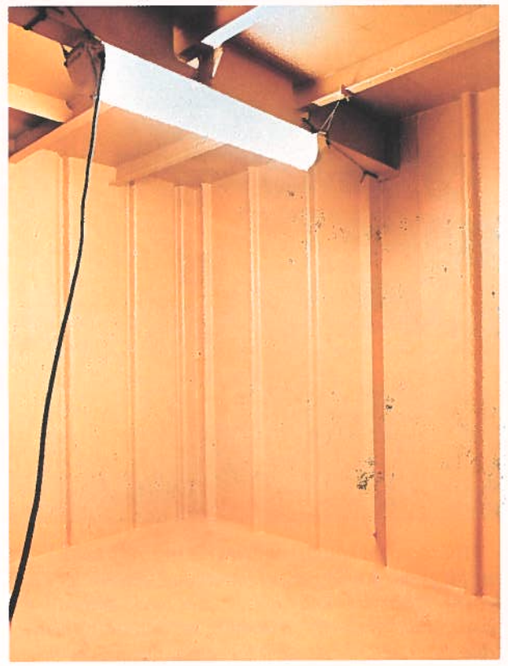
Väl avvägda skuggor hjälper till att framhäva ett föremål och kan göra en lokal trivsammare att arbeta i. Hårda skuggor – som kommer från en enda armatur – kan man undvika genom att utnyttja flera armaturer, så ljuset kommer från flera riktningar.

Självskuggning är ett vanligt problem. Med kroppen skymmer man det man ska se. Pröva med att flytta armaturen för att få en annan ljusriktning eller kanske går det att ändra arbetsställning?

Ljusa färger ger bättre luminans med samma belysning

Färgsätts ett rum med genomgående ljusa färger höjs luminansnivån betydligt i jämförelse med användning av enbart mörka färger. Brist på kontraster i rummets färger kan innebära att högre belysningsstyrka krävs för att rummet ska upplevas på ett riktigt sätt. Med tillgång till ljusa färgytor, mot vilka mindre

Det här är ett utrymme i ett tankfartyg som dels målats med traditionell brunröd rostskyddsfärg, dels med en ny gul färg med samma rostskyddande egenskaper. Belysningen är densamma. Den ljusa färgen



höjer luminansnivån och samtidigt minskar bländningen genom att skillnaden i luminans (ljushet) mellan armatur och bakgrund minskas. Vid ljusmätning konstaterades att luminansen höjts 8 gånger.

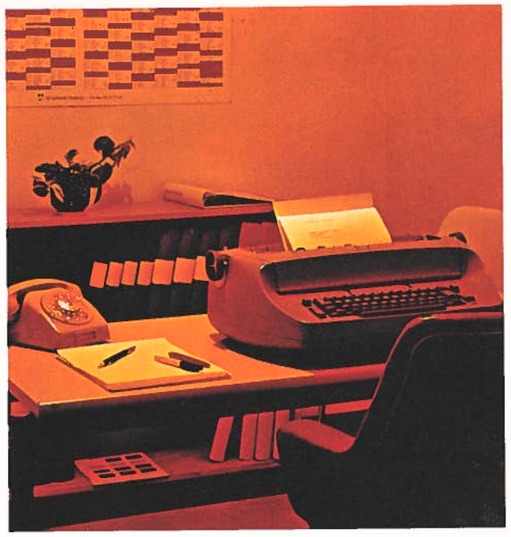
ljusa ytor kontrasterar, upplevs rummet ändå ljust och stimulerande. Av dessa skäl bör belysningsplanering och färgplanering samordnas.

En bra regel när man står inför en nybyggnation eller ommålning är att kräva att få se de färger som ska användas i den belysning som ska utnyttjas. Vid större ommålningar kan det vara bra att få en större provyta målad, vilket underlättar bedömningen.

Ljusfärg och färgsättning hör ihop

I förra avsnittet om ljuskällor visade vi att olika lampor ger ljus med olika ljusfärg.

För att rätt kunna bedöma de färger som ska användas i ett rum måste de betraktas i samma slags belysning som ska komma till användning. För att föremål och färgade ytor ska få vad man upplever som riktiga färger är det avgörande att dessa färger finns i ljuskällans strålning.



Bilderna på kontorsrummet illustrerar praktiskt hur färgerna på väggar och inredning framträder i ett provrum, när det i ena fallet belyses med glödljus, i andra fallet med ett lysrörsljus som är av dagsljustyp. Glödljuset betonar de röda färgerna, medan det aktuella lysröret ger en mer rättvisande bild av färgerna.

Luminansfördelning (ljushetsfördelning)

Det är ur arbetsmiljösynpunkt viktigt hur lokaler färgsätts och hur belysningen ordnas. Ljusa tak t ex minskar risken för bländning från takarmaturer. Likaså bör man måla fönsterväggar ljusa.

Olika delar av lokalen bör vara olika ljusa för att man ska uppleva ljusfördelningen som behaglig. Att lyfta blicken från en ljus yta till en mörk omgivning medför att ögat kraftigt måste ställa om sig.

Det finns en grundregel som säger när en luminansfördelning är som bäst. Det man direkt ser på (synobjektet) ska då vara ca tre gånger så ljust som den närmaste omgivningen (närfältet), som i sin tur ska vara tre gånger ljusare än omfältet.

Val av reflektanser och färger

Vid val av ljuskällor och färger på tak, väggar och golv måste man beakta sambandet mellan ljus-ytfärgseende. Detta för att utnyttja ljuset, färgsammansättningen och ytfärgens förmåga att reflektera ljusfärgerna på ett riktigt sätt.

Ju högre reflektansfaktor en yta har, desto mera ljus återkastar den. Belysningsstyrkan (lux) måste därför bedömas med hänsyn till de belysta ytornas reflektansförmåga.

Vid val av färger för en arbetslokal där ljuskällan utgörs av exempelvis högtrycksnatriumlampor bör gula eller oranga väggfärger väljas, vilket framgår av ljuskällans spektrala strålning.

Några exempel på lämpliga reflektansfaktorer i industrilokaler

Yta ***Reflektansfaktor***

Golv ***20-30%***
Golven behöver inte vara mörka utan så ljusa som möjligt. Golvytan bör vara slitstark och lätt att rengöra. För att markera olika zoner på golvet (arbetsområde, gångar och lastningsområde) används gul markering.

Väggar ***55-65%***
Nedsmutsningen sänker reflektansfaktorn avsevärt. Väggen behöver därför tåla rengöring. För att minska kontrasterna i blickfältet är det lämpligt att belysa väggar och tak.

Tak ***50-85%***
För att utjämna luminansförhållandet mellan ljusarmatur och tak är det av stor betydelse att taket blir så ljust som möjligt. Från belysningssynpunkt är det väsentligt att taket kan rengöras.

Pelare ***60-70%***
Om pelare är fristående på golv bör dessa (åtminstone till 2 m över golv) målas med signalfärg. Detta för att man tydligt ska kunna observera dem.

Dörrar ***40%***
Bör ha annan färg än väggfärgen.

Arbetsbord ***60%***
Ett ljust arbetsbord hjälper till att kasta ljus mot delar av arbetsstycket som ej är åtkomligt för ljus uppifrån.

Maskiner ***40-50%***
Man bör tillvarata färgens möjligheter att markera samhörighet mellan olika delar av lokalen eller grupper av maskiner. Det kan t ex vara lämpligt att maskiner inom samma produktionsband målas i samma färg.

Traverser, kranar, portar som är rörliga. ***40-50%***
Bör ha en signalfärg som väcker uppmärksamhet.

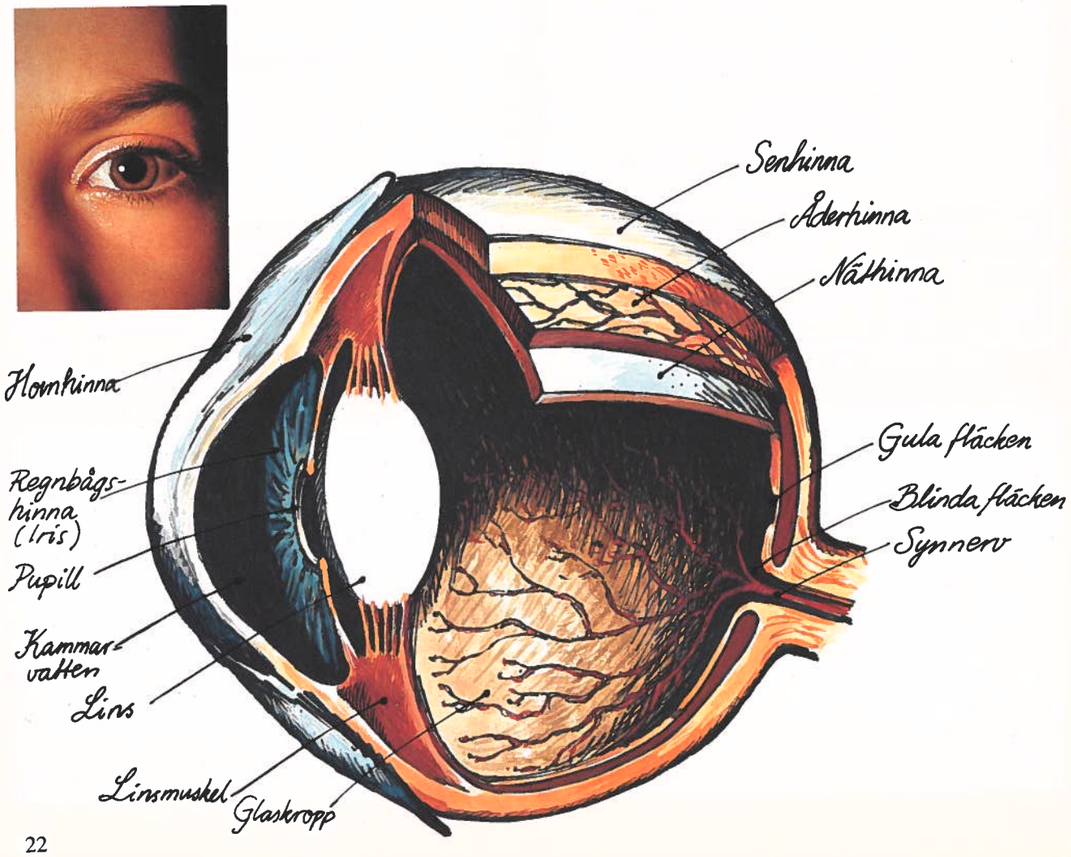
Kvalitetskrav på belysningen

När man utformar en belysning är det viktigt att inte bara tänka på de kvantitativa kraven – tillräckligt mycket ljus – utan även arbeta med belysningens kvalitet.

- ***Belysningen bör vara så fördelad i rummet att ljusvariationerna inte blir för stora. Färgsättningen i lokalen påverkar luminansfördelningen.***
- ***Belysningen bör inte ge någon störande bländning, varken direkt från ljuskällor eller indirekt genom reflexer i arbetsmaterial m m.***
- ***Belysningen bör ge god kontrast mellan synobjekt och dess bakgrund. Detta ställer krav på ljusinriktning, men även i viss mån på färgsättning av arbetsbord och maskiner.***
- ***Belysningens ljusfärg bör samverka med lokalens färgsättning, så att interiörer och föremål framträder i rätta färger. För färgbedömningsuppgifter måste speciella krav vara uppfyllda.***

Ögat och synen

Vi upplever vår omgivning med hjälp av alla våra sinnen, men framför allt med hjälp av ögat och synen. Vi uppfattar de föremål vi ser på tack vare att de är olika ljusa och har olika färger. Synintrycket vi får förs från ögat via synnerven till hjärnan, som tolkar det vi ser. Hela seendet är mycket komplicerat, och den psykologiska upplevelsen av ljuset spelar en viktig roll. Ljuset påverkar människan och hennes upplevelse av omgivningen.



Ögat

Människan har förmåga att se skarpt både på långt och kort håll. Ögats inställning på nära håll kallas för ackommodation. Även pupillen ställer automatiskt in sig till växlande ljusförhållanden. Är det ljust drar pupillen ihop sig, under mörker förstoras den.

Näthinnan ligger längst bak i ögat. Den ändrar känslighet om ljuset ökar eller minskar. Näthinnan är försedd med ljuskänsliga stavar och tappar. De har flera uppgifter. 7 miljoner tappar i näthinnan gör att vi kan se på dagen och vid god belysning. Tapparna kan urskilja färger. 130 miljoner (!) stavar används när vi ser då det är mörkt. De kan inte urskilja färger och därför ser man heller inte föremålens färger på natten. Omgivningen blir istället tämligen grå.

Näthinnan kan reglera ljuskänsligheten

Näthinnan är det ställe där synintrycken omformas till impulser som kan registreras av hjärnan. Dess ljuskänslighet kan regleras inom mycket vida gränser. Att det är nödvändigt förstår man när man vet att solljus kan vara 1 000 000 gånger starkare än månsken. Pupillen kan här bara klara en liten del av regleringen. Näthinnans känslighetsförändring – adaptation – är därför nödvändig för att ögat ska kunna klara alla sina uppgifter.

Från ögat går synnerven genom ögonhålan och vidare till hjärnan. Synnerven består av talrika nervtrådar, ca 1 miljon, som ligger förenade i buntar omgivna av bindväv. I hjärnan tolkas sedan det vi ser.

Ögat åldras

Ögat ändras när vi ser på kort eller långt avstånd. Denna förändring av linsens brännvidd kallar vi för ackommodation. Är belysningen svag eller kontrasten liten försvåras ögats möjligheter att snabbt ställa in synskärpan. Ackommodationsförmågan avtar med åldern p g a att linsen blir stelare. Denna synförändring startar faktiskt redan vid födseln och medför att man från 40- eller 50-årsåldern normalt måste använda glasögon vid läsning och andra synkrävande sysselsättningar. Det är ett faktum som sällan beaktas vid belysningsplanering!

Över huvud taget måste man ta hänsyn till att ögats möjligheter att ställa om minskar med stigande ålder. Det gäller inte bara omställning mellan när- och fjärrseende utan också omställning mellan ljus och mörker. En 50-åring behöver normalt 50% mer ljus än en 40-åring och en 60-åring minst dubbelt så mycket. De tabeller som finns med krav på vissa belysningsstyrkor för olika arbetsuppgifter utgår från en normalseende 40-åring.

Ljus och färger för äldre

Vid val av ljus och färger för äldre människor bör man beakta att dessa ser förhållandevis bra i glödljusbelysning. Detta beror på att ögats förmåga att släppa igenom kortvågig strålning (blått och grönt) minskar med stigande ålder, medan förmågan att släppa igenom långvågig strålning (gult och rött) förblir i stort sett oförändrad. Detta innebär att en ljuskälla med förhållandevis mer långvågig strålning (som glödljuset, vilket är ca 20 gånger starkare i det röda än i det blå) upplevs speciellt av äldre människor som mindre bländande och att de ser röda och gula färger väsentligt bättre än blå och gröna. Ur arbetsmiljösynpunkt har det dock sällan någon betydelse. Men man bör beakta detta vid val av färger på sjukhus, ålderdomshem och bostäder för äldre människor. I dessa fall måste man vid färgvalet ta mer hänsyn till de äldre än till personalens önskemål.

Färgseende

Vid färgbedömningsuppgifter är det viktigt att belysningen återger färger på ett riktigt sätt samt att avsynaren har ett fullgott färgseende.

Man måste räkna med att en del människor, 7- 8% bland männen och mindre än 1% bland kvinnorna, har sådana fel i färgseendet att färgbedömningen kraftigt försvåras eller omöjliggörs. Den vanligaste formen av färgblindhet är den röd-gröna, vilket innebär att den färgblinde ser rött och grönt som olika nyanser av grått. Om ett normalt färgseende är nödvändigt i yrket är det viktigt att färgseendet kontrolleras före yrkesvalet.

Undersökning av belysningen

När man ska undersöka belysningen är det viktigt att man går igenom och tar reda på vilka krav arbetet ställer på belysningen, vilka den anställdes förutsättningar är, t ex ålder, behov av glasögon, höger-vänsterhänthet.

Är det ett arbete där man behöver se små detaljer, där man behöver vara koncentrerad eller är det ett arbete som kan utföras med lägre krav på belysningen? Hur är avståndet till det man ska se, arbetsstyckets yta, armaturernas placering? Är det omväxlande synuppgifter etc?

En bedömning av belysningen kan ske med flera hjälpmedel:

1 **Intervjuer** med de anställda ger information om hur de upplever belysningen och synförhållandena och vilka förbättringar de önskar.

2 Vissa uppgifter, främst luminanser och belysningsstyrkor, kan kontrolleras med hjälp av **mätinstrument.**

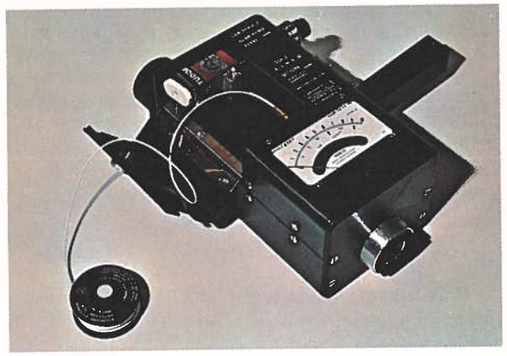
3 Belysningssituationen kan gås igenom med hjälp av **checklistor,** där olika frågor tas upp mer detaljerat och systematiskt.

Intervjuer

Ögat är kanske det bästa mätinstrument vi har. Uppenbara brister i omgivningen, t ex bländning från lampor och fönster eller reflexer, är lätta att upptäcka. Vid intervjuer med de anställda bör man inte bara göra en allmän bedömning om förhållandena är bra eller dåliga utan också gå in på konkreta detaljer. T ex allmän- och platsbelysning, färgsättning, värmeproblem, ljusets infallsvinkel, ev ögonbesvär, behov av glasögon. Man behöver också tänka på att flera människor – med olika förutsättningar – kan arbeta på samma arbetsplats, t ex vid deltidsarbete eller skiftarbete. För att åstadkomma individuella justeringar behöver samtliga anställda intervjuas.

Ljusmätning i praktiken

Med en universalljusmeter kan man mäta bl a luminanser i arbetslokaler, reflektansfaktorer från olika ytor och belysningsstyrkor. Enbart mätvärden ger ingen heltäckande bild, men tillsammans med intervjuer och kontroller med hjälp av checklistor ger de en värdefull information.

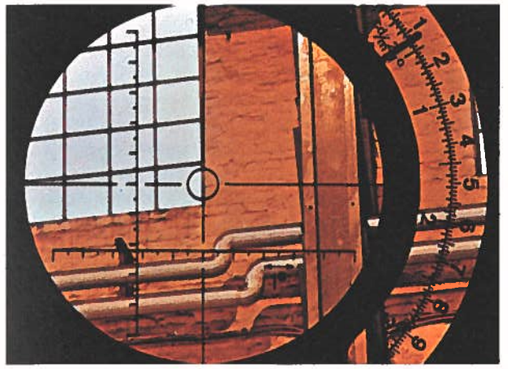


Bilden visar en universalljusmeter med den kabelanslutna mätcellen för luxmätning uttagen.

Så här mäter man luminanserna

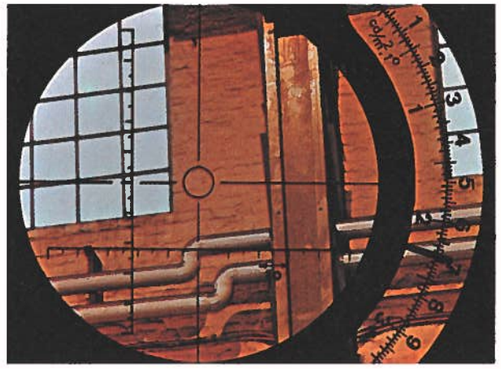
Vi ska här mäta fönstrens och väggens luminans. Inomhusbelysningen är en takmonterad högtrycksnatriumbelysning (ca 600 lux). Vädret utomhus är mulet.

Universalljusmätaren riktas mot den yta, vars luminans ska mätas.



Felaktig mätning

Genom instrumentet ser man det engradiga mätfältet, d v s den lilla cirkeln i mitten. Det är enbart ljuset från det området luminansmetern registrerar. Man ser också omgivningen. Vid sidan av synfältet visas instrumentutslaget. Observera att man alltid mäter medelluminansen inom mätområdet. Detta gör att en ljuskälla eller en reflex måste fylla ut hela det inringade området för att man ska få ett riktigt värde på den sökta luminansen. Ska man mäta en reflex får man ofta gå nära. En stor fördel är att man vid luminansmätning hela tiden kan se instrumentutslaget genom sökaren vilket underlättar mätningen väsentligt. Det inringade området på bilden upptar både fönster och vägg. Mätvärdet blir ett medelvärde av fönster- och väggluminansen 110 cd/m².) Men det var inte det värdet vi ville ha.



Rätt mätning

Nu upptas det inringade området enbart av väggen och då blir luminansvärdet för väggen riktigt (70 cd/m².).

Rätt mätning

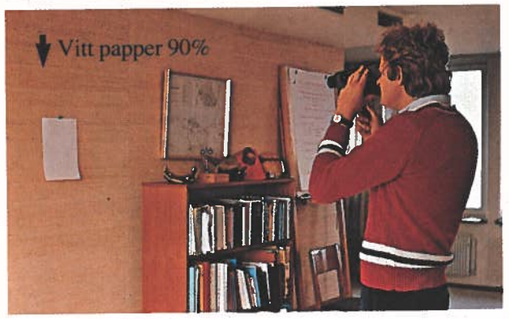
Nu upptas det inringade området enbart av fönster. Luminansen är 230 cd/m².

Så här mäter man belysningsstyrkan (lux)

Mätcellen är gjord så att instrumentet visar rätt oberoende av ljusets infallsriktning. Luxmetern har ungefär samma känslighet för dagsljus som ögat.

Man ska mäta under realistiska förhållanden. Den anställde ska vara kvar på sin arbetsplats eftersom den egna skuggan kan påverka resultatet. Mät på några olika ställen för att se om det är skillnader i belysningsstyrkan.

Så här mäter man reflektansfaktorn



Reflektansfaktorn avgör hur mycket ljus som reflekteras. Med luminansmetern är det lätt att bestämma en matt ytas reflektansfaktor. Man jämför luminansen hos den ytan med en provyta med känd reflektansfaktor (ett vitt papper har ca 90% reflektans).

Först mäts provytans luminans. Därefter placeras det vita papperet på provytans plats och luminansen mäts.

$$\text{Reflektansfaktorn} = \frac{\text{provytans luminans} \times 90}{\text{papperets luminans}}$$

Med denna metod kan man alltid arbeta under realistiska ljusförhållanden, vilket är värdefullt när man ska undersöka starkt färgade ytor.

Att mäta reflektansvärden kan vara bra när man vill kontrollera hur mycket ljus som reflekteras från väggar, tak och golv eller när en yta har blivit smutsig.

Kontrollera instrumentet vartannat år

Mätinstrumentet bör kalibreras vartannat år eftersom det kan förändras.

Mellan kalibreringarna är det bra att ha en löpande kontroll av instrumentet genom att jämföra mätvärden med ett annat instrument.

Med tanke på risken för mätfel ska man behandla mätresultaten med förnuft. Mätning av belysningen ska göras av kompetent personal, t ex personal från den tekniska företagshälsovården. Den som mäter ska vara med och utvärdera resultatet.

Tänk vid mätningen av belysningen på att:

- ***belysningsanläggningen arbetar under normala förhållanden. Den ska ha varit i gång minst en halv timme och temperaturen i lokalen ska vara normal.***
- ***dagsljusets inverkan och variationer mäts och tas med i bedömningen.***

Värdering med hjälp av checklista

I del III på sid. 58 finns en checklista som bygger på samspelet mellan ljuskällan, synobjektet och ögat. Med hjälp av den kan man punkt för punkt kontrollera viktiga faktorer och upptäcka fel.

Den checklistan kan både användas vid kontroll av belysningen och synförhållandena på en befintlig arbetsplats och vid planering av nya arbetsplatser.

I del III går vi i detalj igenom hur man utnyttjar checklistan för att upptäcka fel och brister.

Del II
Vanliga belysningsproblem och hur man kan åtgärda dem

Dåliga synförhållanden har normalt flera orsaker. När man åtgärdar belysningsproblem måste man därför angripa flera saker samtidigt. Här har vi sökt välja belysningssituationer där problemet i flertalet fall är koncentrerat till en eller ett par orsaker.

Problem med bländning

Bländning är ett av de svåraste belysningsproblemen i arbetslivet. Dels utsätts många för bländning, dels kan den vara svår att åtgärda effektivt. Bländning både försvårar och irriterar seendet. Den kan resultera i ögonbesvär och huvudvärk. Är bländningen intensiv kan den medföra en klar olycksfallsrisk.
Bländning orsakas av att ögonen utsätts för ett starkare ljus än de är inställda för. Orsak till bländning kan vara direktljus från lampor, solen eller enbart från himlen genom ett fönster. Ljuset kan också komma från reflexer i blanka ytor. Då talar man om indirekt bländning eller reflexbländning.

Samma ljus kan i olika situationer uppfattas helt olika beroende på vilken ljusnivå ögat är inställt för. Man bländas inte av billjus på dagen då omgivningen är ljus, men man gör det när det är mörkt.

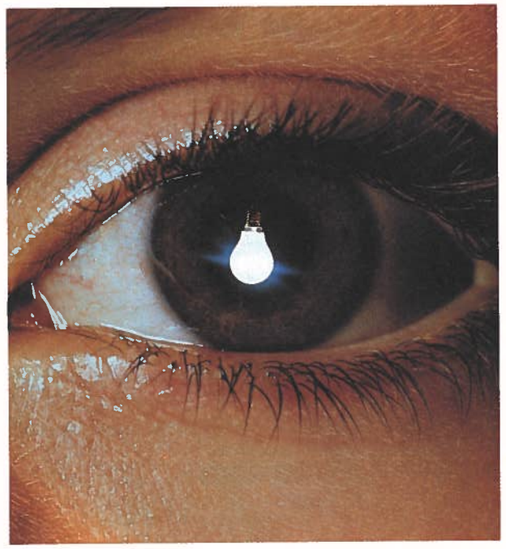
Om den bländande ljuskällan är mitt i synfältet blir man mer besvärad än om den förekommer i utkanten av synfältet. Minst besvär uppstår om ljuskällan befinner sig i synfältets övre del.

Direkt bländning

Direkt bländning från oskyddade lampor får inte accepteras. Men ändå är det ett vanligt fel att man använder t ex oskärmade lysrör i arbetslokaler.

Om en öppen ljusarmatur sitter under 30° vinkel faller ljuset direkt in i synfältet och ögat, och verkar på så sätt bländande. Antingen får man höja armaturen eller också förse lamporna med djupare reflektorer.

En annan form av direkt bländning uppstår när arbetsplatsen är fel placerad i förhållande till fönster.



Det är viktigt att skärma av lampor och armaturer som bländar.

Några exempel på direktbländning

På kontor, i affärer och i verkstadslokaler ser man då och då skräckexempel på direktbländning. Ljuskällan är placerad så att den anställde ser direkt på den. Ofta hänger ljusarmaturen lågt och har inget bländskydd alls. Ju mer ljus en ljuskälla ger desto viktigare blir kravet på god avbländning.

Placering och ljusriktning viktig

I den här skoaffären har man dels lysrör, dels ett stort antal spotlights för att rikta ljuset mot varorna. Biträdena klagar både på bländning och besvärande värme från punktlamporna. Att helt komma tillrätta med bländningsrisken är näst intill omöjligt, men en

omsorgsfull placering och inriktning av lamporna minskar i alla fall bländningen.

Värmeproblemet, som uppstår på grund av värmestrålningen, kan reduceras genom att begränsa antalet spotlights och justera belysningsanläggningen. Ett alternativ är att ersätta de vanliga glödlamporna med kall-ljuslampor. Kall-ljuslampor har den egenskapen att de släpper ut ljuset men inte strålningsvärmen. Värmen stannar kvar uppe vid lampan, där den kan ventileras bort. Kall-ljuslampan är en speciallampa som inte alla fabrikanter tillverkar och den passar inte alla armaturer.

En bra armatur avskärmar och riktar ljuset

Delikatessdisken. Inbjudande för kunden, men hur ser det ut på andra sidan?

Här är en bild från ett gjuteri. Bländningen blir så stark att den anställde har direkt svårt att se. Hur löser man problemet? Om man höjer armaturen och förser den med bländskydd minskar problemen. Men ännu bättre är att placera platsbelysning så att ljuset faller in snett bakifrån. För de flesta synuppgifterna är det den bästa ljusriktningen.

Har man placerat lysrören på det här sättet ovanför disken utan avskärmning får de anställda besvär. Även om lokalen är ljus liksom den närmaste omgivningen runt lysröret blir luminansskillnaderna för stora. Men det är enkelt och billigt att åtgärda genom att avskärma lysröret. Med hjälp av en armatur kan man rikta ljuset mot disken och varorna – då ser både kunder och anställda bättre.

Reflexbländning

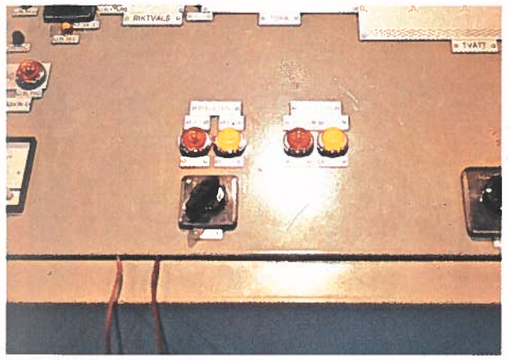
Reflexbländningen är den bländning som man kan drabbas av när ljuset återspeglas av mer eller mindre blanka ytor som t ex glas på mätapparatur, polerade maskindelar, blankt vitt papper etc. Man kan undvika reflexbländning i stor utsträckning om man placerar ljusarmaturerna lämpligt i förhållande till varje arbetsplats eller väljer mindre reflekterande material.

Några exempel på reflexbländning

Att helt komma tillrätta med reflexbländning kan vara svårt, men våra fyra exempel visar att man ibland på ett enkelt sätt kan ta bort irriterande reflexer.

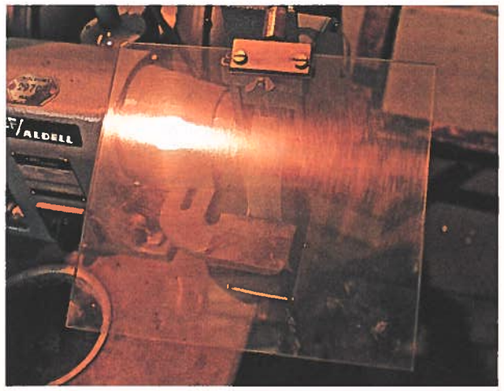
Snedställda fönster i kontrollrum och förarhytter m m

Det horisontella fönsterglaset ger upphov till kraftiga reflexer som försvårar sikten mellan kontrollrummet och verkstaden. Förarhytten till höger har snedställda rutor – ca 10 - 15° – vilket förbättrar siktförhållandena för kranföraren.



Matta paneler – reflexfritt glas

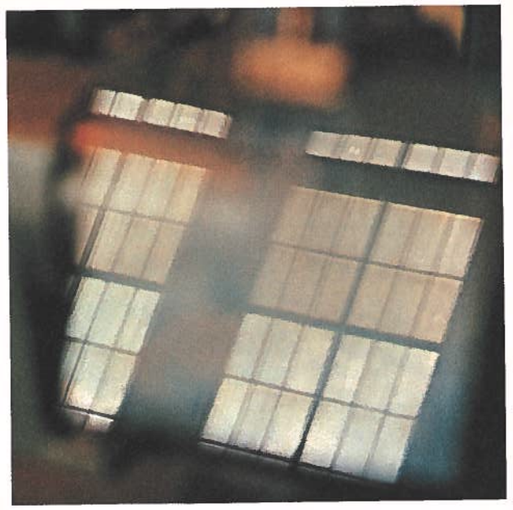
Manöverpaneler ger ofta reflexbländning. Om man använder reflexfritt glas till instrument och gör plåtpanelerna matta underlättas synarbetet väsentligt.



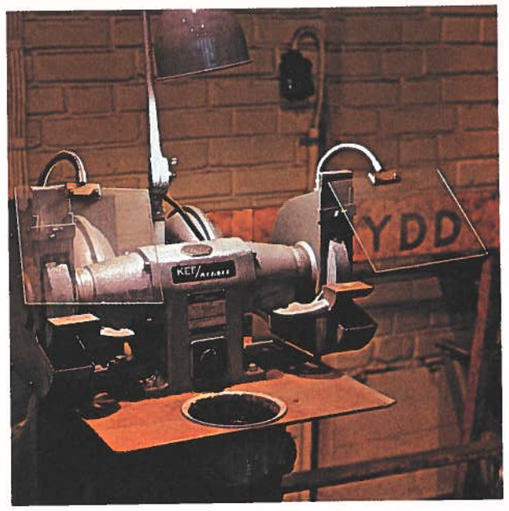
Spegling i skyddsglaset av takmonterade ljusarmaturer (högtrycksnatriumlampor).

Besvärande speglingar i skyddsglas

Vid slipning måste operatören skydda ögon och hud. Därför finns skyddsglas. Det är svårt att undvika speglingar i skyddsglaset från takfönster och takarmaturer i arbetslokalen. För att inte irriteras av speglingarna händer det att operatören står i obekväma arbetsställningar, vilket kan medföra t ex ryggbesvär. Dessa besvär kan man komma ifrån om man ändrar skyddsglasets läge.



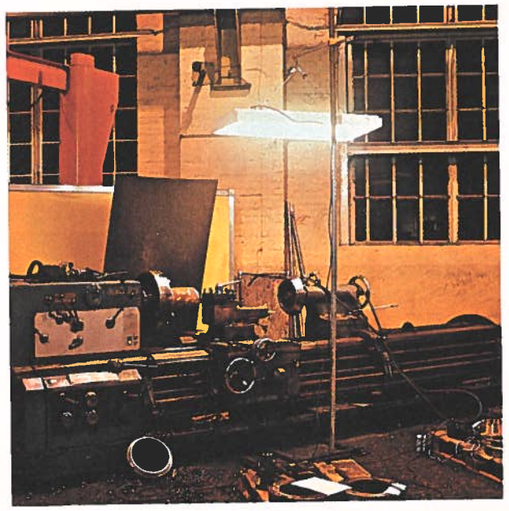
Vid detta läge på skyddsglaset får operatören spegelbild av takfönstret i skyddsglaset.



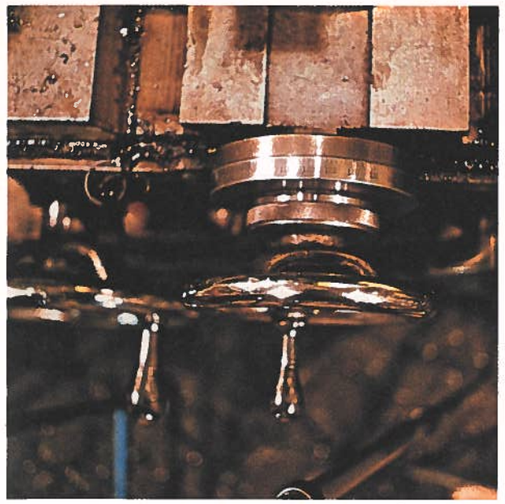
Vid detta läge på skyddsglaset ser operatören bra.

Spegelreflexer vid arbete där det krävs precision

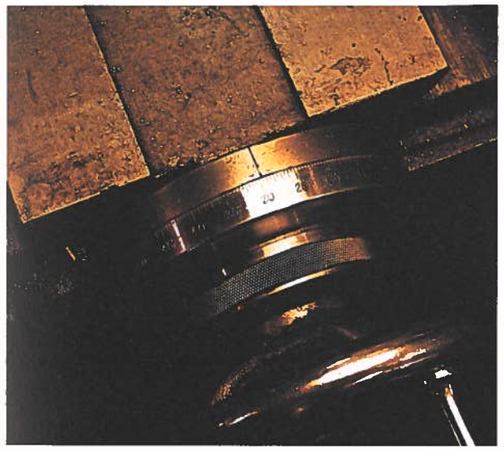
På många industriföretag finns maskiner som man ställer in med rattar och skalor. Vid t ex svarvning är det viktigt att både kunna se arbetsstycket och de rattar och skalor, som man manövrerar för olika arbetsmoment. Rattarna är oftast runda och blanka, vilket gör det nästan omöjligt att helt undvika spegelreflexer från ljusarmaturer i tak. Reflexerna gör det många gånger svårt att ställa in önskade skalvärden, speciellt om skalorna inte är tydligt markerade eller smutsiga/nedslitna.



1. På försök placerade vi en flyttbar lysrörsarmatur 3×40 W lysrör 2,3 m över golvet mitt ovan supportsvarven för att se om man kunde få bort reflexerna. Ljusarmaturen är avbländad med prisma bländskydd. Obs! Den typ av ställning vi använde vid försöket är inte lämpligt för permanent bruk och självklart måste armaturen hänga vågrätt.



2. För svarvaren såg skalorna ut så här innan vi började. Inte speciellt bra eller hur?



3. Med lysrören inkopplade förändras läget. Trots att skalan är blank syns skalstreck och siffror tydligt.

4. Det här är samma bild som den förra, men vi har sprayat den blanka ratten med matt klarplastlack

Denna klarplast tål stötar och slag bra. När plasten blir nedsliten är det bara att tvätta bort den med aceton och spraya på nytt. Säkert kan många blanka, reflekterande små ytor mattas ner på det här sättet.

Åtgärder mot bländning

- ***Placera armaturer så att ljusriktningen blir den rätta utan att arbetskamrater bländas.***
- ***Förse armaturerna med bländskydd.***
- ***Måla tak och fönsterväggar ljusa.***
- ***Placera arbetsplatser så att man drar nytta av dagsljus från fönster, men inte irriteras av det.***
- ***Matta ner blanka ytor.***

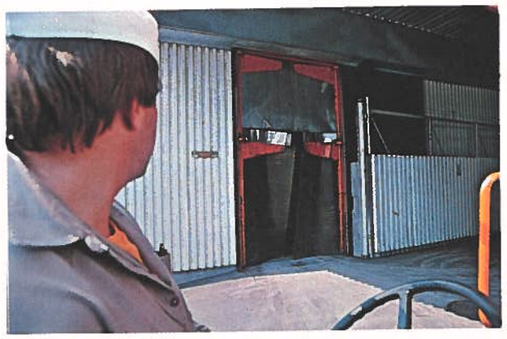
Problem med snabba skiftningar mellan ljus och mörker

Många rörliga arbeten innebär att man regelbundet rör sig mellan ljusa och mörka områden. Servitören som ideligen går mellan det ljusa köket och den mörka serveringslokalen, byggnadsarbetaren som ibland befinner sig ute i starkt solljus, ibland inne i mörka prång utan belysning alls, långtradarchauffören som möter bländande billjus på natten är tre exempel.

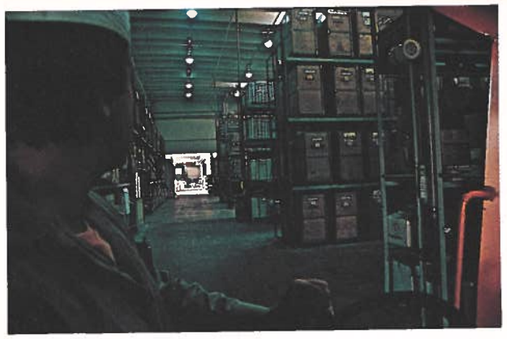
Om skillnaderna i ljushet är stora och övergången sker snabbt och ofta hinner inte ögat ställa om sig (adaptera sig). Man kan få adaptationsbesvär, t ex huvudvärk och ögontrötthet.

Det är framför allt övergången från ljus till mörker som ställer till problem. Även om den första omställningen går på någon sekund tar det upp till 1 timme för ögat att helt ställa om till nattseende.

En grupp som ofta utsätts för adaptationsbesvär är truckförare. Bilderna illustrerar hur truckförarens ögon måste anpassa sig till rådande ljusförhållanden, när han kör mellan lastplats och lager. Lagret har i vårt exempel en bra belysning med ljusa väggar, vilket gör att adaptationsbesvären i det här fallet inte blir alltför svåra.



1. Truckföraren är ute vid lastplatsen. Det är molnigt ute. Kameran är placerad på trucken i ögonhöjd ca 10 m från dörren till lagret, inställd efter de ljusförhållanden som råder på lastplatsen.



2. Kameran är flyttad innanför porten till lagerlokalen. Fotografiet är taget med samma ljusinställning som föregående utomhusbild.

3. När ögat ställt om sig, vilket går snabbt, ser det ut så här inne i lagerlokalen.

4. Truckföraren är på väg ut – ca 10 meter från porten. Kameran är inställd efter ljuset i lagerlokalen.

5. Ute i ljuset! Truckföraren har just kommit ut men kamerans ljusinställning är samma som för föregående bild.

6. Vi har ställt om kameran till utomhusljuset. Hur snabbt ögat ställer om sig beror på ljusförhållandena ute och inne på lagret och naturligtvis på människan. Med stigande ålder går omställningen långsammare.

Åtgärder mot adaptationsbesvär

- **Gör övergången mellan ljus och mörker så mjuk och långvarig som möjligt.**
- **Måla ljusa färger på och runt dörrar i riktning mot ljusa lokaler och dämpade färger i ljusa lokaler i riktning mot mörker.**
- **Placera inte ljusstarka lampor ovanför dörrar som leder ut i mörka lokaler, t ex i restaurangkök ut mot serveringslokaler.**
- **Truckföraren i vårt exempel kan vara hjälpt av belysta ljusa väggar runt porten och ett skärmtak på portens utsida. Då möts han inte direkt av solljus. På samma sätt skulle seendet kunna underlättas för lok- och tunnelbaneförare om tunnelmynningar målades vita.**

Problem med felaktiga luminansförhållanden

På fasta arbetsplatser, där man står eller sitter och arbetar längre perioder, är det viktigt att man upplever rummet och det man ser (synuppgiften) på ett harmoniskt sätt.

När förhållandena är som bäst är det man tittar på tre gånger ljusare än den närmaste omgivningen. Den är i sin tur tre gånger ljusare än de väggar och tak man ser när man lyfter blicken från synobjektet.

Det här är en bra belyst – och färgsatt – arbetsplats. Den är ljus men det finns ändå skillnader i ljushet mellan olika ytor, vilket underlättar rumsuppfattningen.

Ögat följer inte modesvängningarna

Det här är ett nytt påkostat kontor, där man gjort flera misstag. Svarta bord med svarta skrivunderlägg ger felaktiga luminansförhållanden. Det vita papperet nästan bländar. Det blir för stor skillnad mellan det vita och det svarta. Resultatet blir att många känner sig trötta i ögonen eller får andra synbesvär.

När den anställde höjer blicken ut mot kontorslandskapet ser han mörkbruna väggar och skåp, knallröda heltäckande mattor samt ett mörkt tak med i vissa synriktningar nakna lysrör.

Kontorsanställda klagar ofta över att de har besvär med ögontrötthet och känner ”grus” i ögonen när arbetsdagen är slut. En inte ovanlig orsak till detta är att luminansförhållandena är felaktiga.

På industrisidan – där arbetsobjekten ofta växlar – är det tyvärr svårare att tillgodose kraven på idealiska luminansförhållanden.

Åtgärder för god rumsuppfattning

- ***När man mäter luminanserna är idealet att det man direkt ser på är tre gånger ljusare än den närmaste omgivningen som i sin tur är tre gånger ljusare än det man ser när man tittar upp. Luminansförhållandet blir då 10:3:1.***
- ***Luminanserna avgörs av hur väggar, golv och tak samt större föremål reflekterar ljus, färgsättningen i lokalen samt ljusstyrkan/ljusriktningen.***
- ***Bäst är om det inte är för mörkt någonstans i lokalen, men heller inte för jämnt fördelat ljus.***

Problem med skiftande synavstånd

Ögats förmåga att växla mellan när- och fjärrseende kallas ackommodation. När vi t ex läser och plötsligt lyfter blicken för att se på ett föremål längre bort ställer ögat om sig från närseende till fjärrseende. Alltför täta växlingar mellan när- och fjärrseende kan bli ansträngande.

Många människor behöver skaffa sig läsglasögon i 40-årsåldern. Ögat kan inte längre ställa in sig för närseende. Den här naturliga processen fortsätter med stigande ålder. Från 60 års ålder har ögat förlorat möjligheten att ställa om sig. Närgränsen ligger runt 1 meter för 60-åringar.

Besvär med skiftande synavstånd (ackommodationsbesvär) är mest uppmärksammade på kontor och kanske främst vid dataterminalarbete. Men problemen finns också inom andra verksamheter. Snickare, målare, justerare, verktygsoperatörer har ofta ackommodationsbesvär.

Den som t ex arbetar med att övervaka en produktionsprocess måste ofta ha uppmärksamheten riktad på mätinstrument av olika slag, lampor och flödesscheman. Då bör instrument och manöverrattar befinna sig på nära avstånd från varandra för att inte anstränga ögonen. Belysningsstyrkan får inte heller vara för låg eller kontrasten för liten. Då försvåras ögats förmåga att ställa in synskärpan.

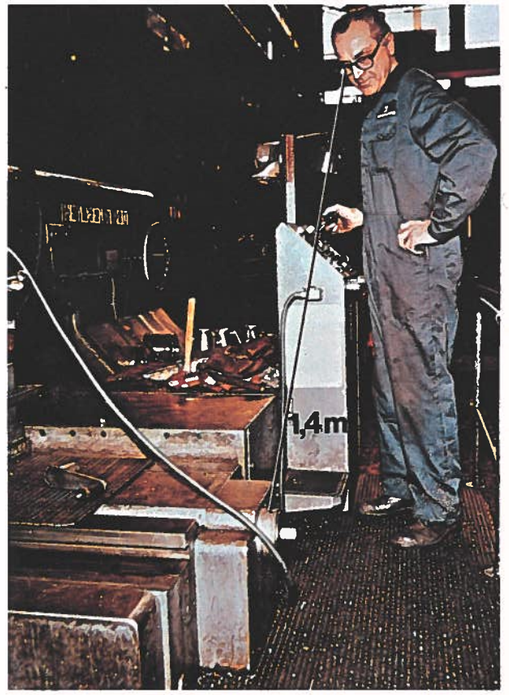
Bedömning av virkeskvalitet

Justeraren har ett synkrävande arbete. Han ska bedöma virket ur kvalitetssynpunkt och behöver därför bra ljusförhållanden. Bilden visar en bra lösning, där den jämna ljusfördelningen gör att han kan bedöma kvaliteten både på nära och på långt håll. Raster i armaturen minskar bländningsrisken.

Det här är ett arbete där man också bör ställa krav på lampans ljusfärger, så att ev kvalitetsfel i virket syns.

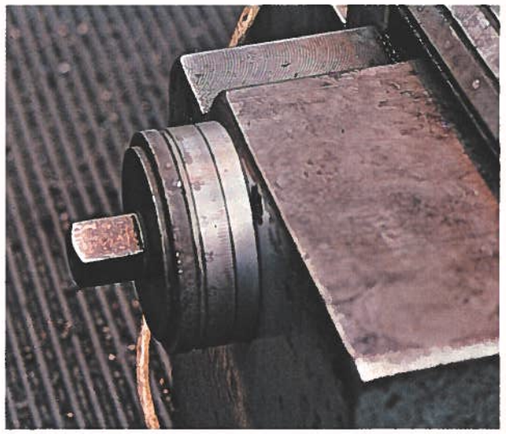
Glasögon utprovade för läsavstånd

Om du använder glasögon i arbetet bör dessa vara utprovade för de synavstånd som du har i arbetet. Speciellt viktigt är det om du arbetar med precisionsarbete eller arbetar vid maskiner där också en liten felbedömning av avståndet kan leda till arbetsolyckor och fel utförda jobb. Se också avsnittet om olycksfallsrisker.

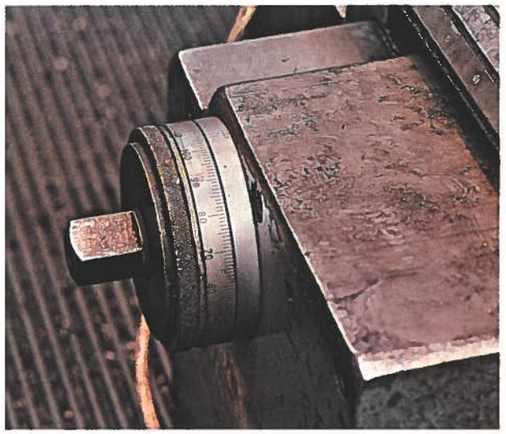


Operatören, som är i 60-årsåldern, i arbete vid en axelsvarv. Operatörens arbete består bl a av att efter flera graderade skalor ställa in svarven.

Synavståndet till dessa graderade skalor och manöverpulpet är olika. För manövrering måste operatören se den graderade skalan. Synavståndet är ca 1,4 m.



Denna bild ser operatören när han använder sina läsglasögon, som är utprovade för normalt läsavstånd.



Vad han borde se är det här! Med rätt utprovade arbetsglasögon och arbetsbelysningen rätt riktad hade det inte varit några svårigheter att läsa av skalan.

Har man återkommande synuppgifter på ett bestämt avstånd – och behöver glasögon – bör man ha glasögon utprovade efter detta avstånd.

Som ung klarar ögonen med lätthet av att växla mellan olika synavstånd.

När man blir äldre och behöver glasögon är det väsentligt att försöka minska antalet synavstånd så att glasögonen kan utprovas därefter. Att använda bifokalglas fungerar dåligt när man exempelvis har tre olika synavstånd.

Här på teckningen har vi minskat synavstånden till två olika avstånd.

Synkrav vid terminalarbete

Arbete vid dataterminaler skiljer sig både vad gäller synavstånd och blickriktning från traditionellt kontorsarbete. Flera belysningsproblem är förknippade med dataterminaler. Den vanliga regeln att synobjektet ska vara bäst belyst går inte att tillämpa. Dataskärmen är mörkare än omgivningen. Därför måste lokalens allmänbelysning vara relativt låg och med god avbländning. Men här ska vi inte ta upp synproblemen med dataterminaler i stort utan endast frågan om skiftande synavstånd. I branschhäftet om grafiska branschen går vi mer noggrant in på bildskärmar m m.

Arbete vid läsapparat och terminaler medför ofta varierande synavstånd. Ett näravstånd på 20–40 cm för läs- och skrivarbete, ett halvavstånd på 55–100 cm för läsning på bildskärmen eller läsapparaten och ett avstånd för seende på långt håll.

Utan läsglasögon förmår ögat hos personer runt 55 år och äldre inte ställa in sig på det kortare avståndet, och med läsglasögon förmår det inte ställa om sig till halvavståndet. Det är därför nödvändigt att använda speciella arbetsglasögon.

Vanliga bifokalglasögon (dubbelslipade glasögon) är ofta olämpliga för arbete vid bildskärmar/läsapparater. De tvingar fram en påfrestande arbetsställning för rygg och nacke.

Specialslipade bifokalglasögon kan vara ett bra alternativ förutsatt att arbetssituationen noggrant studerats och de aktuella synavstånden är individuellt uppmätta.

De höga synkrav som ställs medför att även personer med mindre brytningsfel, som inte är korrigerade, kan få olika former av ögonbesvär.

Enligt arbetarskyddsstyrelsens anvisning (136:78) ska arbetsgivaren tillhandahålla speciellt utprovade arbetsglasögon vid behov.

Åtgärder för att underlätta vid skiftande arbetsavstånd

- ***Se till att anställda vid behov har riktigt utprovade glasögon.***
- ***Rensa upp och söka minska antalet olika synavstånd.***
- ***Tänk på att ta speciell hänsyn till äldre vid planering.***

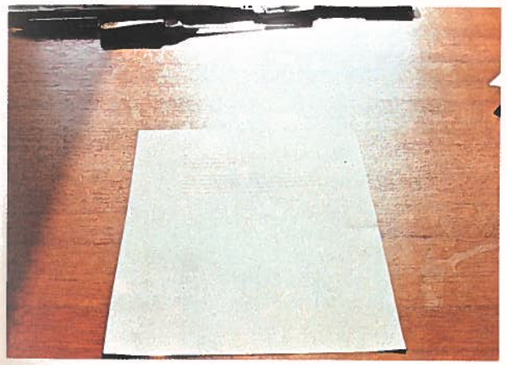
Problem att se små detaljer

Synkraven är höga vid arbete med små detaljer och ökar ytterligare om arbetet, t ex vid montering eller sömnad, måste göras snabbt.

Viktigt är bl a bra kontrast så att detaljerna man ska se går fram ordentligt. Redan en liten försämring av kontrasten försvårar seendet lika mycket som en betydande minskning av belysningsstyrkan.

Kontrasten beror på:

- ljusets infallsriktning och färg
- från vilken vinkel man ser föremålet
- föremålets form och förmåga att reflektera ljus
- bakgrunden

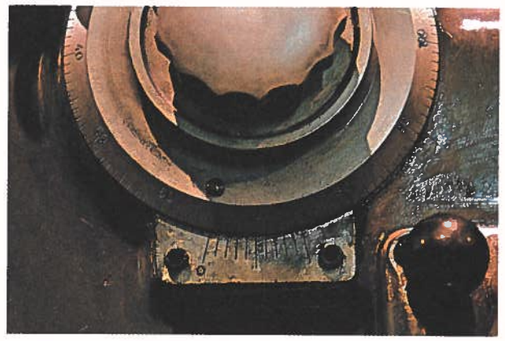


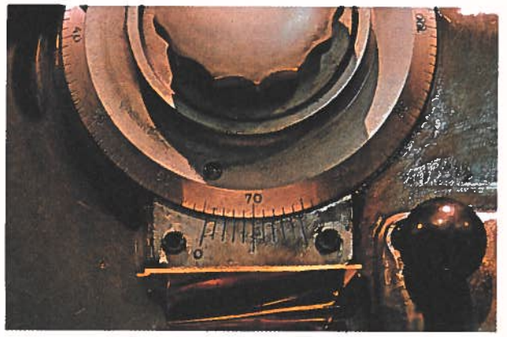
Blänk

Felaktig infallsvinkel kan leda till en effekt som kallas blänk. T ex blyertsskrift eller tryckt text på glättat papper blir svår att läsa på grund av att kontrasten mellan skriften och bakgrunden blir för liten.

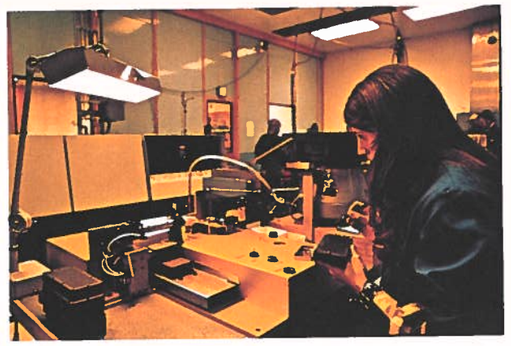
Svårt att se skalor

Att ställa in rattar mot skalor markerade med tunna streck och små siffror kan vara besvärligt. Med hjälp av olika färger på skalorna kan synuppgiften underlättas. Ett annat knep är att utnyttja takljuset och reflektera det mot skalorna, t ex med en ljus plåt.





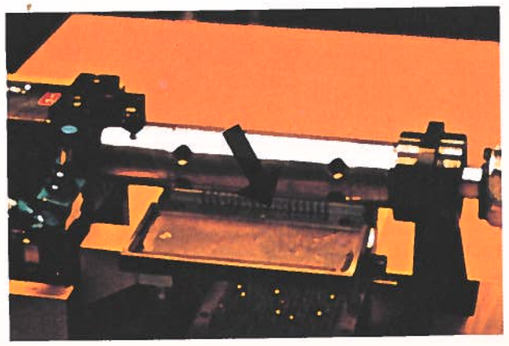
Enda skillnaden mellan dessa två bilder är att vi monterat en blank mässingsplåt framför den horisontella skalan, som gör att ljuset från takbelysningen reflekteras upp mot skalan.

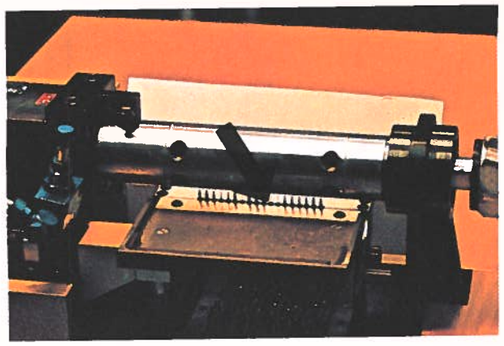


Ökad belysningsstyrka – ökade synsvårigheter

Det här exemplet är hämtat från en elektronikverkstad. Operatören står vid en maskin och ska ladda ett ”skepp” (det ställ operatören håller i handen) med kontakttungor. De är ca 15 mm långa.

Operatören ska kontrollera att kontakttungorna sitter rätt. (De små ”piggarna” som sticker upp under stålvalsen.) Operatören har svårt att kontrollera att tungorna sitter rätt. Speciellt mot slutet av arbetsdagen blir hon trött i ögonen och får huvudvärk. Man ökar belysningsstyrkan med hjälp av en platsbelysning. Men det ger inte avsedd verkan utan resulterar istället i ökade synsvårigheter p g a ökad bländning från den blanka stålvalsen.





Kontrasten förbättrades

För att minska bländningen prövar man med att förbättra kontrasten genom att placera en vit pappskiva bakom kontakttungorna. Operatören tycker att detta ger en klar förbättring av synförhållandena. Arbetet går lättare och med större tillförlitlighet utan att ögonen blir ansträngda.

Åtgärder för att se små detaljer bättre

- ***Pröva gärna med extra platsbelysning, men var medveten om att synförhållandena kan försämras, t ex genom bländning.***
- ***Ju mindre detaljerna är, desto högre kontrast krävs.***
- ***Bättre kontrast mellan synobjekt och bakgrund, borttagande av reflexer, en lugn bakgrund kan väsentligt minska eventuella synbesvär och förbättra synkoncentrationen.***
- ***Utnyttja reflekterande ljus.***
- ***Begär vid inköp av maskiner att de har tillfredsställande belysning om synuppgiften kräver det.***
- ***Förstoringsglas med inbyggd belysning kan ibland vara ett bra hjälpmedel vid arbete med små detaljer. Behövs arbetsglasögon?***
- ***Kontrasten blir ofta bäst om ljuset faller in i ungefär samma riktning som man ser, dvs i de flesta fall snett uppifrån/bakifrån.***

Problem med dålig kontrast

I förra avsnittet pekade vi på behovet av god kontrast vid arbete med små detaljer. Men även i andra sammanhang är det ur arbetsmiljösynpunkt viktigt att kontrasten är ordentlig mellan föremål och bakgrund.

Hur ofta irriteras vi inte av att det är svårt att läsa en text, en skylt, en etikett, en prislapp, en matsedel m m? Ibland beror det inte på att ljuset är för dåligt eller texten för liten, utan helt enkelt på att texten inte står fram mot bakgrunden. Svart text går inte fram speciellt bra mot blå, brun eller röd botten. Kontrasten blir inte tillräcklig.

Ett exempel från ett lager

Truckföraren hämtar och placerar in lastpallar i hyllfack. Varje lastpall har en viss markering. Vid besök på olika lager kan man konstatera att dessa markeringar inte alltid är gjorda med bästa kontrast.

Lösningen på truckförarens problem är inte att öka belysningsstyrkan, vilket skulle ge ökad bländning, utan att öka kontrasten på etiketterna.

Speciellt synansträngande blir det när truckföraren ska se högt upp, då han blir bländad av taklamporna. Arbetsställningen blir dessutom obekväm.

På det här lagret är numera all text svart och papperet vitt. Som jämförelse satte vi dit samma information på ett blått papper, som faktiskt används på andra lager.

Åtgärder för bättre kontrast

- ***Ljusriktningen är viktig för bra kontrast***
- ***Man kan öka både luminanskontrast och färgkontrast för att förbättra synförhållandena. Bra färgkontrast ger svart text mot gul bakgrund (varningsskyltar).***
- ***Storleken på texten kan ökas.***
- ***Vid höga belysningsstyrkor (som ökar kontrasten) är det nödvändigt att kontrollera om det finns risk för bländning.***

Problem med mörka lokaler

Flera gånger i boken har vi påpekat att det är samspelet mellan ljuskällan, det vi ser på och människan som är avgörande. I mörka lokaler hjälper det föga att öka belysningsstyrkan om inte reflektansen hos tak, väggar och golv samtidigt ökas. På sid. 21 finns en tabell med lämpliga reflektansvärden angivna.

Idén att måla väggarna för att underlätta synuppgiften, som exemplet visar, kan användas i många sammanhang.

”Personalingången”

Entrén till en av Televerkets ca 100 000 arbetsplatser under mark. Televerket, el-, vatten- och avloppsverk har många arbetsplatser under jord. Enbart Televerket har uppskattningsvis 100 000 brunnar. Dagens brunnar är av betong och utrymmet är speciellt vintertid fuktigt och smutsigt. Som belysning används ofta gasollyktor eller andra gaslyktor.

Målningen gjordes i maj 1979 och färgleverantören kommer att besiktiga brunnen var 6:e månad ett par år framåt och även testa nya färger.

Som tidigare nämnts är dessa brunnar många gånger fuktiga och vatten kan samlas i dem. Av detta skäl har färg av silikattyp använts vid försöket.

Ett alternativ till målning

I många befintliga brunnar är största delen av väggarna täckta med kablar, varför man ej kommer åt att måla väggarna. Endast tak och delar av väggarna går att måla.

Utrymmet under mark är 2 meter långt, 4 meter brett och takhöjden är 2,3 meter. På väggarna har man kabelhyllor. Oftast är det mycket mera kabel än i den här brunnen. Belysningen är en gasollykta.

Det är samma arbetsplats som på föregående bild, men i detta fall har tak och väggar målats med vit färg. Belysningen utgörs av samma gasollykta. Tack vare den vita färgen upplevs rummet som mycket ljusare. Den vita färgen har en hög reflektansfaktor.

Ett sätt att förbättra synförhållandena är då att ta med sig ett vitt plastskynke och hänga upp det på den vägg där man ej arbetar. Vid lödningsarbete o dyl kan man gärna placera en vit plåtskiva bakom/under kablarna, dels för att få en lugn bakgrund som ökar kontrasten, dels för att kunna reflektera upp ljuset.

Åtgärder för ökad reflektans

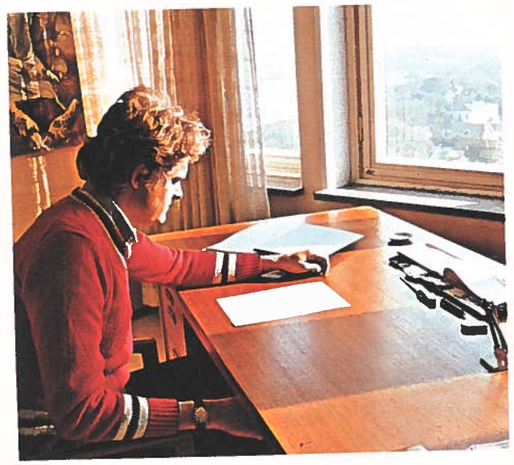
- ***Rengöring av nedsmutsade ytor ökar reflektansen.***
- ***Tabellen på sid. 21 visar lämpliga reflektanser för industrilokaler.***
- ***Begär vid ommålning att färgfabrikanten deklarerar färgens reflektansfaktor.***
- ***Även maskiner kan med fördel målas i ljusa matta färger som ger hög reflektans och som tål rengöring.***
- ***Mätning av reflektansen kan göras med universalljusmätare.***

Problem med dagsljus Olika fönsterlösningar

Dagsljus är ofta det bästa ljuset, men en belysningsanläggning måste alltid bestämmas utan hänsyn till dagsljuset. Det varierar allt för kraftigt med årstid och tid på dygnet.

Men självfallet bör man dra nytta av dagsljuset genom riktigt placerade fönster och arbetsplatser som är riktigt placerade i förhållande till fönstren. Man ska behålla kontakten med omgivningen utanför men inte bländas. Och naturligtvis ta vara på den gratis energi solen ger.

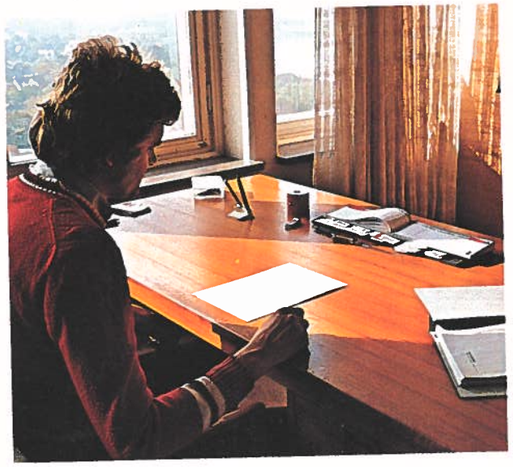
Här är tre exempel – ett på hur man bäst placerar en arbetsplats i förhållande till fönster, ett som visar irriterande dagsljusinsläpp och en lösning med utanpåliggande solavskärmning för att komma ifrån värmestrålning.

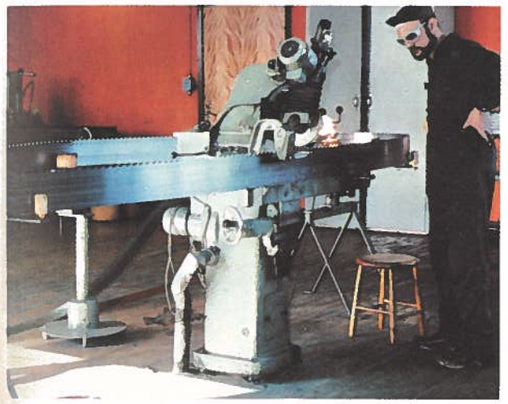


Placera inte mot fönster

Att placera en arbetsplats direkt mot fönster ger ofelbart besvär. Ljuset blir tidvis för starkt.

Men det räcker med att vrida arbetsplatsen så att ljuset kommer in från sidan för att situationen ska förbättras. Fönster bör kunna täckas av persienner eller gardiner. Ljuset bör komma från vänster för högerhänta och tvärtom för vänsterhänta.





Här måste solljuset kunna skärmas av

Sliparen har ett synkrävande arbete. Faller solen in direkt mot honom försvåras arbetet avsevärt. En gammal belysningsregel säger att arbetsplatser aldrig bör vara riktade direkt mot fönster p g a bländningsbesvär.

I den här lokalen får man dessutom problem med värme när solen lyser in.

Utanpåliggande solskydd

Solskydden är inte främst till för seendets skull utan för att slippa besvärande värme. En nackdel är dock att skydden tar bort så mycket ljus att man även dagtid kan behöva ha takbelysningen tänd.

Åtgärder för bra fönsterplacering

- ***Fönster bör normalt inte sitta högt upp på väggarna.***
- ***Vid placering av fönster i norrläge slipper man direkt solljus.***
- ***Fönsterväggar inomhus ska målas ljusa för att minska bländningsrisken.***
- ***Vid nybyggnation bör fönsterlösningar diskuteras i tidigt skede.***

Problem med arbetsplatsbelysningen

Många arbetsuppgifter fordrar särskild platsbelysning för att synförhållandena ska bli tillfredsställande. Allmänbelysningen från takarmaturerna räcker av olika skäl inte till. Speciellt svårt kan det vara när maskiner och maskindelar är i vägen och hindrar ljuset att nå just dit där det behövs. Platsbelysningen hjälper till att göra luminansfördelningen bättre och därmed blir rumsupplevelsen behagligare. Platsbelysningen är också det främsta hjälpmedlet för att få belysningen att passa den enskildes arbetssituation. På samma sätt som takarmaturerna ska också platsbelysningen vara väl avbländad.

Det här är en vanlig situation, som ger oacceptabel belysning för rörläggaren.

Stolparmaturen är försedd med eluttag för anslutning av t ex borrmaskiner. Den utprovas på olika arbetsplatser. Kraven på hur armaturen ska fungera har diskuterats fram tillsammans med byggnadsarbetare, arbetsledare och belysningskonsult.

En lätt flyttbar armatur för byggarbetsplatser

Belysningen inomhus på byggen är ofta svår att klara av på ett bra sätt. Arbetsplatsen ändras ju dag för dag, timme för timme. Vanligt är att man använder strålkastare och s k sladdrankor. De ger stundtals svår synnedsättande bländning och belysningen på själva arbetsstället blir heller inte tillfredsställande.

Nu pågår emellertid praktiska försök inom Statens Råd för Byggnadsforskning. Även om undersökningarna inte är klara kan vi här visa ett exempel på en som det verkar fint fungerande armatur. Den är lätt att flytta, men ändå stabil. Jämfört med vanliga armaturer är bländningen väsentligt mindre och den ger ett bra ljus vid normala takhöjder.

Belysningsstyrkan 10-dubblades

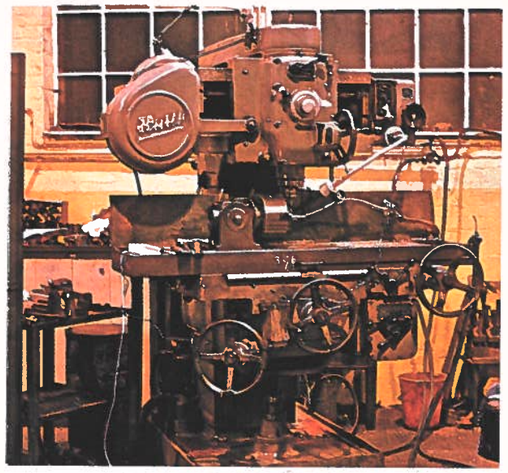
Det är naturligtvis en fördel om utrustning (t ex maskiner) redan vid leverans från fabrik är försedd med bra belysning och goda förutsättningar att se synuppgiften. Vid beställning av maskiner bör man ställa krav också på belysningen.

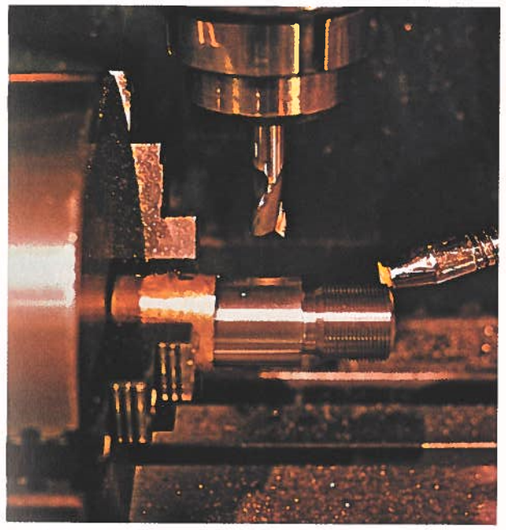
I avsnittet Planering sid. 60 går vi noga igenom hur belysningssituationen vid en maskin kan förbättras med hjälp av platsbelysning.

Här ett annat exempel med en kilspårfräsmaskin, där vi i efterhand monterade en ställbar armatur.

Det är viktigt att man ser bearbetningsområdet bra. Denna maskin saknade arbetsbelysning vid leverans från fabrik.

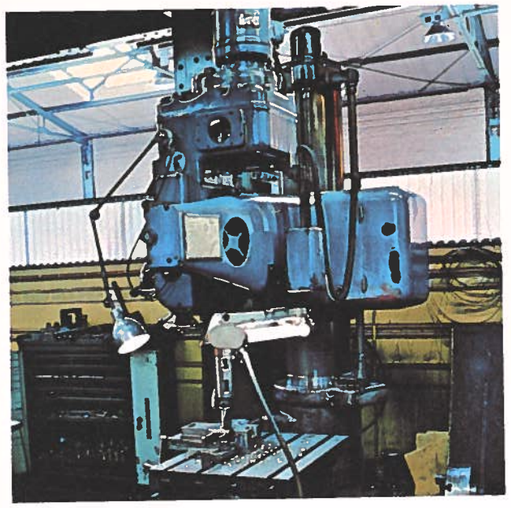
Operatören sade att han såg dåligt och måste böja sig onödigt mycket. På kilspårfräsmaskinen monterade vi en ställbar glödljusarmatur med 12 V/20 W halogenlampa.





Arbetsstycket är placerat i den s k delningsapparaten. Belysningen är den i verkstaden monterade takbelysningen (högtrycksnatriumlampor). Belysningsstyrkan på arbetsstycket är 120 lux.

Samma bild som föregående men med den ställbara glödljusarmaturen inkopplad. Belysningsstyrkan på arbetsstycket är ca 1 200 lux. Bearbetningsområdet syns väsentligt bättre.

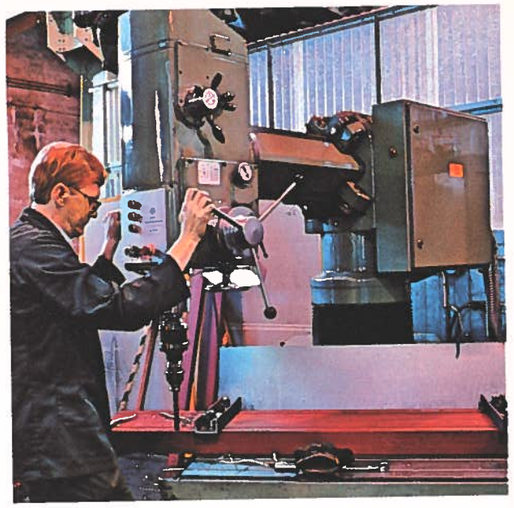


Personsäkerheten viktig

Att sedan en maskin installerats söka montera armaturer är förenat med problem. Denna borrmaskin levererades utan arbetsbelysning. I efterhand monterade man en ställbar glödljusarmatur och en 2 × 20 W lysrörsarmatur med nakna, helt oskyddade lysrör. Det är lätt hänt att man i arbetet stöter till lysrören med något arbetsstycke så att de går sönder. Om lysrören går sönder sprids glassplitter och ljuspulver över arbetsplatsen.

Det nakna lysröret ger dessutom synnedsättande bländning. Den ställbara glödljusarmaturen är ansluten med en lös sladd. Alla elsladdar som hänger lösa är en personsäkerhetsrisk, som ska undvikas.

Det borde vara en självklarhet för maskinkonstruktörer och -leverantörer att också utrusta sina maskiner med bra belysning.



Ett bra exempel på fabriksmonterad platsbelysning

Här har maskintillverkaren levererat och monterat en bra arbetsbelysning. Den är rätt placerad för att ge ljus på synuppgiften. Den bländar inte och är försedd med slagtålig kupa. Inga lösa elsladdar utan alla ledningar är förlagda i rör innanför plåtkåpan.

Åtgärder för bra arbetsplatsbelysning

- ***Platsbelysningen ska vara enkel att ställa in och flytta om den ej kan vara fast monterad.***
- ***Platsbelysningen ska vara lätt att rengöra och lampor ska gå lätt att byta.***
- ***Platsbelysningen ska vara försedd med bländskydd. Den ska fördela ljuset så att ljus och skuggor underlättar synuppgiften.***
- ***Diskutera igenom belysningen redan på inköpsstadiet.***
- ***Rätt skyddsklass ur personsäkerhetssynpunkt. (Se även sid. 87.)***

Problem med att korrekt bedöma färger

Att ha en belysning vars ljus visar färgerna i omgivningen på ett naturligt sätt är betydelsefullt i alla arbeten. Ljuset ska upplevas som varmt och ombonat för att man ska trivas.

I en del arbetsuppgifter ingår emellertid att mer exakt avgöra färgnyanser och då måste man ha lampor av dagsljustyp.

Undersökningsrum och operationssalar på sjukhus t ex har behov av dagsljusbelysning för att personalen ska kunna registrera förändringar i hudfärgen hos patienten eller bedöma sjukdomstillstånd. Inom den grafiska branschen finns flera arbetsmoment där färgbedömningen är viktig.

Tyger i dagsljusliknande belysning

I kläd- och sybehörsaffärer bör det finnas möjlighet att se färger i ”dagsljusbelysning”. Det gör det lättare att avgöra de rätta nyanserna och man minskar antalet byten.

Att enbart använda lysrör av dagsljustyp i konfektionsaffärer är inte nödvändigt. Men något provutrymme kan vara bra att ha just för färgbedömning av kläder. Provutrymmet ska vara målat med gråvit färg på insidorna och väl avskärmat så att bara ljuset från lysrören av dagsljustyp belyser tygerna.

Garnerna på bilden får sitt ljus från några takarmaturer med lysrör av universalvit typ. Dessutom är spotlights med glödljus riktade mot garnerna. Eftersom glödlampan har ca 20 gånger starkare strålning inom det röda färgområdet än i det blå framhävs garnernas röda och gula färger.

Med lysrör av dagsljustyp ser man färgerna i sina rätta proportioner. Då får man nästan samma intryck som i normalt dagsljus.

Åtgärder för korrekt färgbedömning

- ***Lysrör av dagsljustyp (Ra-index över 90, korrelerad färgtemperatur över 5 000°K) ger ljus som liknar vanligt dagsljus.***
- ***Andra ljuskällor – som kan påverka bedömningen – bör skärmas av.***
- ***Personal som har att göra färgbedömningar bör kontrollera färgseende. 8% av alla män och mindre än 1% av alla kvinnor har fel på färgseendet.***

Problem med olycksfallsrisker

Många olyckor i arbetslivet hänger direkt eller indirekt samman med belysning – eller brist på god belysning! Även om det inte gjorts särskilda undersökningar vet man av erfarenhet att felaktiga ljusförhållanden tillsammans med andra orsaker kan utlösa olyckor. Fall och snubbelolyckor t ex beror inte sällan på att den anställde inte sett var han satt foten, inte observerat ett hinder i vägen.

De sex exemplen nedan utgör ingen fullständig provkarta, men kanske kan de öka förståelsen för att belysning och färgsättning är viktigt för personlig säkerhet.

När blir det lika självklart att använda skyddsglasögon som skyddshjälm?

Varje år råkar tusentals människor ut för allvarliga ögonskador p g a olycksfall i arbetet. Det är uppenbart inte lika självklart att använda skyddsglasögon som att använda skyddshjälm. Det borde vara det så länge man inte kan planera verksamheten på ett sådant sätt att personlig skyddsutrustning inte behövs. Lämpliga ögonskydd ska finnas på aktuella arbetsplatser och personer med riskfyllda arbeten måste dessutom få en grundlig information om riskerna och hur man kan förebygga skador.

Ögonskydden kan vara avsedda att skydda mot olika typer av skadlig ljus- eller värmestrålning eller att skydda mot kringflygande damm eller metallspån. Vissa ögonskydd har dessa funktioner samtidigt.

Av erfarenhet vet vi att det ofta är tillfälliga besökare som råkar ut för skador. Varför inte diskutera om man kan införa någon form av anslag med krav på användning av ögonskydd inom utsatta delar av lokalen? På samma sätt som man kräver skyddshjälm?

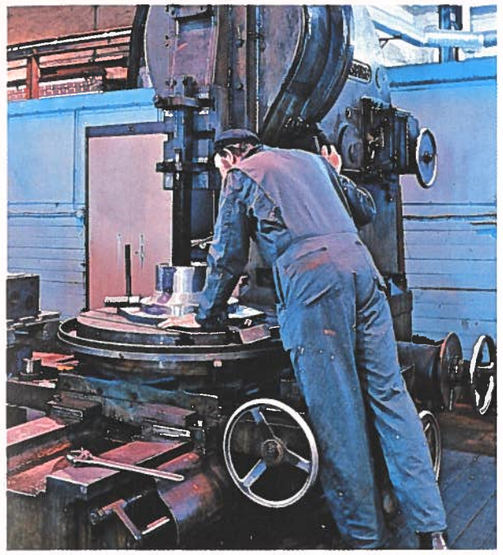
En orange overall syns ju inte!

Utearbetare, t ex väg- och bangårdsarbetare, televerkets montörer, har gulorange overaller. Färgen har valts för att den syns så bra. I dagsljus vill säga.

På bangårdar, i hamnar och på vägar används vanligen lågtrycksnatriumlampor. Dessa lampor har strålningen koncentrerad till den gula natriumlinjen. Ljuset ger inga möjligheter att urskilja färger. Detta betyder att overallerna inte uppfattas som orange. Ljuskällan är helt felaktig ur färggivningssynpunkt.

Bangårdsarbetaren som arbetar på den snötäckta bangården (belysning – lågtrycksnatriumlampor) blir svår att upptäcka. Färgkontrasten är dålig mellan bangårdsarbetaren och snön, vilket kan innebära olycksrisker.

Lågtrycksnatriumlampor har tidigare varit mest ekonomiska, men dagens högtrycksnatriumlampor, som har väsentligt bättre färggivningsegenskaper, har hämtat in avståndet och finns nu för olika effekter.



Vi gjorde ett experiment. Kan du se vilka delar på den här maskinen som rör sig? Allt har samma svarta färg utom arbetsstycket. Dessutom är det svårt att se ner i arbetsstycket varför arbetaren lutar sig framåt.

Gult betyder fara

När vi talar om kontrast menar vi inte bara skillnader i ljusstyrka utan också färgkontrast.

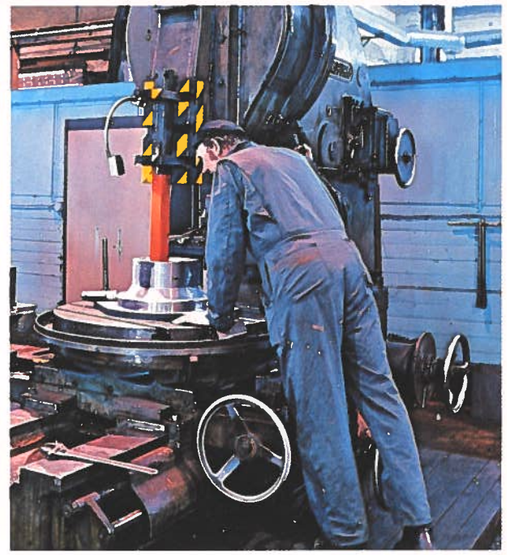
Genom att måla golvytor, pelare men också rörliga maskindelar etc med varningsfärger ökar ögats möjlighet att upptäcka faror. Svart/gult är den vanliga skyddsfärgen. Orange förekommer också.

Ett tips

En god regel är att måla pelare, åtminstone till 2 m höjd, med en signalfärg.

Läsglasögon i jobbet kan ge fel bild

Personer med dubbelslipade glasögon kan riskera olycksfall om deras glasögon inte är slipade så att de passar arbetsavståndet.



Vi målade den rörliga bommen med svart/gul varningsfärg, och stålhållaren med orange färg. Vidare utrustade vi maskinen med en ställbar arbetsbelysning. (12V/20W halogenlampa.) Arbetaren kan nu med lätthet följa arbetet utan att komma i farlig närhet av den rörliga maskindelen.

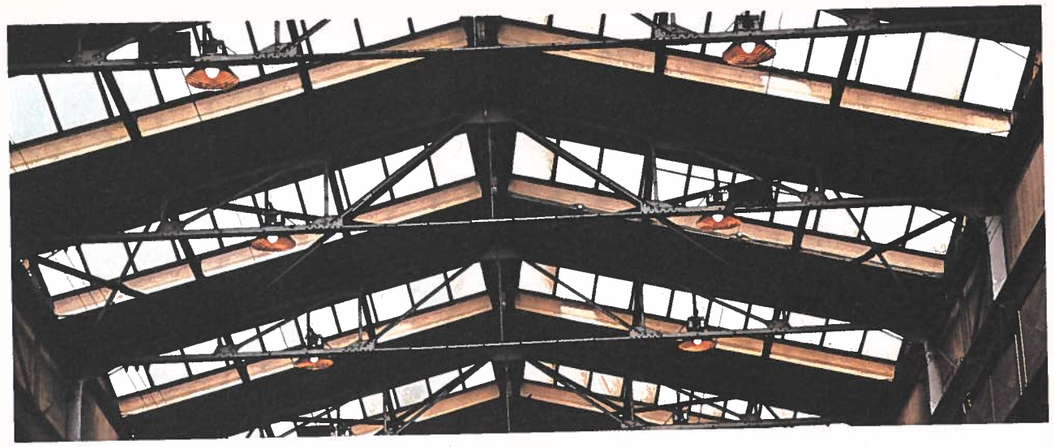
Finns det liknande risker på ditt jobb som du kan minska med ett par burkar färg?

Risken ligger i att man kan få en bild som ligger ett par centimeter vid sidan om verkligheten. Det kan vara farligt för personer som t ex gör precisionsarbeten i farliga maskiner.

Det vanliga är att dubbelslipade glas har en slipning för långt avstånd (mer än fem meter) och en slipning för läsavstånd (33 centimeter). När man arbetar – t ex vid en såg – passar ingen av dessa slipningar. Arbetsavståndet är kanske 50 centimeter.

Det är då man riskerar att se fel. Synbilden kan förskjutas upp till 3 centimeter.

Om man använder dubbelslipade glas ska dessa därför vara inställda för rätt distans.



Skyddsnät

Ibland händer det att glaskolven på högtryckslampor lossnar och faller ner på golvet. För att undvika olyckor, t ex glassplitter i ögonen, bör dessa ljusarmaturer förses med skyddsnät.

Utomhus i det starka solskenet är det ca 100 000 lux. I det rum den här ventilationstrumman ska placeras, är belysningsstyrkan 1 lux. Belysningen inomhus utgörs endast av glest placerade halogenlampor på golvstativ.

Armaturerna är placerade i en korridor. Sidoutrymmena, som är ca 40 m djupa, är nästan helt mörka.

Urladdningslampor som fortsätter att brinna trots att den yttre glaskolven gått sönder ska bytas omedelbart p g a den ultravioletta (UV) strålningen.

Nu är de två byggnadsarbetarna inne i det mörka sidoutrymmet. Den vita hjälmen syns bra, vilket beror på att den är målad med en självlysande färg. Om hjälmen målas 3 gånger med denna färg lyser hjälmen i mörka rum ca 30 min.

Färgen kan också användas i t ex korridorer utan fönster och trappor för att vägleda vid strömavbrott.

Del III
Hur man kan undvika problem genom planering av belysningen och effektivt underhåll

När det gäller planering är det viktigaste att söka bestämma synuppgiften. Till hjälp finns en checklista, som vi med fyra exempel visar hur man kan utnyttja.

Belysningsunderhåll är på många håll eftersatt idag. Genom att inte underhålla belysningsanläggningen får man inte ut den planerade effekten.

Belysningsplanering och kontroll

Vad vi i belysningsplaneringen praktiskt kan påverka är ljuskällan och synobjektet. Den tredje faktorn i samspelet – människan – förutsätter vi i detta sammanhang har fullgod synförmåga. Om hon ej har det bör ögon- eller företagsläkare kopplas in för att vid behov utprova synhjälpmedel.

Det viktiga i all planering är att försöka ta reda på synuppgiften vid varje arbetsplats. Att komma fram till vad synuppgiften verkligen är kan i många situationer vara besvärligt och kräver därför erfarenhet.

Längre fram i detta avsnitt presenteras en checklista som kan underlätta genomgången. I fyra exempel går vi igenom lika många arbetsplatser och söker redovisa synuppgifter och hur man kan planera för bättre synförhållanden.

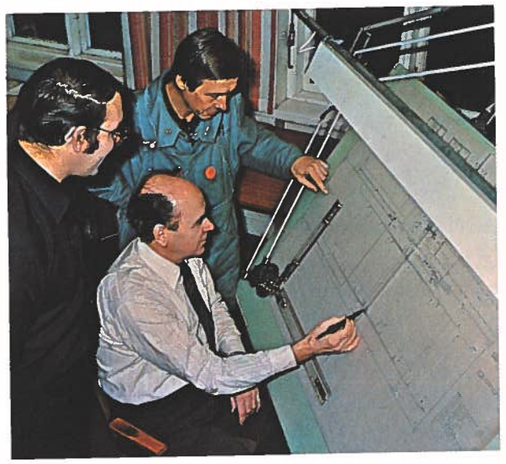
Oavsett om man planerar

1 ***ny verksamhet i nya lokaler***
2 ***ny verksamhet i gamla lokaler***
3 ***oförändrad verksamhet i nya lokaler eller***
4 ***höjning av belysningsstandarden i gamla lokaler med oförändrad verksamhet***

gäller det att försöka ta reda på synuppgiften. Det är A och O vid all belysningsplanering.

Ej tekniska beräkningar

I samband med planering och projektering av nya lokaler görs regelmässigt beräkningar av belysningsstyrka, bländtal m m av el- eller belysningskonsult. Vi kommer inte att ta upp dessa tekniska beräkningar här, utan hänvisar bl a till arbetarskyddsstyrelsens bok ”Belysning och belysningsplanering”, som kan beställas gratis från arbetarskyddsstyrelsen, Publikationsservice, 171 84 Solna.



Planering av belysningen påverkar arbetsmiljön. På sid. 9 tog vi upp en del synpunkter på skyddsombudens och skyddskommittéernas medverkan i planeringsarbetet.

Planering – justering

Vid planering av en arbetslokal finner man i allmänhet att flera arbetsuppgifter har olika belysningskrav, men att de flesta är likartade. Av ekonomiska skäl planerar man en belysning som täcker de flesta arbetsplatserna. Då kan ingå såväl takbelysning som arbetsplatsbelysning. Arbetsplatser som behöver ses över extra noga, åtgärdas först sedan arbetsplatsen tagits i bruk. Detta gäller även de förändringar som brukar uppstå mellan projektering och till dess anläggningen är klar.

Planeringen består alltså av dels en allmän planeringsfas, dels en individuell justeringsfas.

Vilka är synuppgifterna?

Det första steget i planeringen är att ta reda på vad det är den anställde behöver se för att kunna fullgöra sin arbetsuppgift. Med andra ord måste man noggrant gå igenom arbetet och se vilka synuppgifter som är aktuella, vad de kräver av ögat samt vilka speciella krav och begränsningar som finns för de tekniska belysningsåtgärder man planerar införa. Observera att synuppgiften inte behöver vara densamma som arbetsuppgiften. T ex kan kontoristens arbetsuppgift vara att skriva maskin, medan synuppgiften är att läsa manuskript.

Förslag till tekniska och andra åtgärder tas fram, kontrolleras med berörda personer samt justeras och godkänns.

Efter det att åtgärderna genomförts sker en kontroll av att uppsatta mål uppnåtts och att individuella justeringar genomförts.

Själva belysningsplaneringen kan genomföras på olika sätt, allitfrån ett rent experimentellt prövande av olika tekniska lösningar till en systematisk genomgång av olika faktorer som kan påverka seendet. Ofta använder man båda dessa medel.

Hur man experimentellt prövar sig fram har vi sett flera exempel på i Del II. Ibland står man emellertid i den situationen att man inte kan pröva sig fram, t ex vid en ny verksamhet då inga arbetsplatser finns, vilket ställer högre krav på förutseende och kunskaper.

Fabriksmonterad belysning

Det är naturligtvis en fördel om man i planeringsskedet kan bestämma om maskiner ska vara utrustade med anpassade arbetsbelysningar redan vid leverans. Då kan man kräva att armaturerna ska ha rätt skyddsklass, att ledningar placeras på ett säkert sätt, att armaturen är lättåtkomlig både för rengöring och lampbyte.

Checklistan

Oavsett vilken av de fyra planeringssituationerna man befinner sig i kan det vara bra att ha någon form av minneslista, checklista, ordnad på ett systematiskt sätt. När man diskuterar igenom synuppgiften för ett arbete går man punkt för punkt igenom de viktigaste momenten. Checklistan hjälper till att komma ihåg de vanligaste faktorerna man behöver ta ställning till. Men checklistan ersätter inte kunskap och erfarenhet. Den är bara ett verktyg, men ofta ett mycket användbart sådant.

En checklista kan göras på många sätt. Vi har här tagit de nyckelord som använts tidigare i detta informationsmaterial och sorterat in dem under våra ”samspelsfaktorer”.

A Öga
B Synobjekt
C Närfält/Omfält
D Ljuskälla

Enbart dessa fyra nyckelord är i sig en checklista. Om man i varje planeringssituation tänker på dessa fyra begrepp har man kommit en bra bit på väg mot ett bättre seende.

Vill man arbeta sig igenom en arbetsplats mer noggrant måste man ta hänsyn till betydligt flera orsaker, vilket framgår av checklistan på nästa sida.

Checklistan är avsedd att användas för att beskriva synuppgiften samt ange de speciella krav och begränsningar som gäller för arbetet. Den kan också vara till god hjälp bl a för skyddsombuden, när de vill fråga ut belysningsplaneraren om det förslag som denne lämnar till företaget.

Checklistan kan också användas för att kontrollera den gjorda anläggningen. Man kan föreslå nödvändiga individuella justeringar och kompletteringar. Vi ska med några exempel visa hur blanketten kan användas.

Obs: Nyckelorden i checklistan (t ex Skydd, Färgseende) inrymmer ofta fler betydelser än de som anges i frågan inom parantes.

Checklista för belysningsplanering / kontroll / individuell justering

Datum	Utförd av	Arbetsställe	Arbetsplats	
Arbetsuppgift – viktigare synuppgifter			Glasögon	Ålder

Nyckelord (Exempel på fråga)	Anteckningar	Vid kontroll åtgärdas av
Ögat:		
A 1 **Skydd** (Behövs skyddsglasögon eller annat skydd?)		
A 2 **Färgseende** (Kräver arbetet fullgott färgseende?)		
A 3 **Adaptation** (Finns ljusa/mörka ytor i synfältet eller innebär arbetet ofta förflyttningar mellan ljusa och mörka lokaler?)		
A 4 **Ackommodation** (Förekommer skiftande synavstånd?)		
A 5 **Ögonrörelser** (Förekommer snabba ögonrörelser (ping-pong) ?)		
A 6 **Förstoring** (Behövs synhjälpmedel, t ex glasögon, förstoringsglas?)		
A 7 **Övriga synpunkter**		
Synobjektet – det man ser på:		
B 1 **Färgkontrast** (Hur är färgkontrasten mellan olika delar av synobjeket och/eller omgivningen?)		
B 2 **Luminanskontrast** (Hur är skillnaderna i ljushet mellan olika delar av synobjektet och/eller omgivningen?)		
B 3 **Reflektanser** (Hur mycket av det mot ytan infallande ljuset reflekteras?)		
B 4 **Ljusinfallsmöjligheter** (Når tillräckligt mycket ljus dit man ska se?)		
B 5 **Reflexbländning** (Finns risk för reflexbländning, t ex i blanka material?)		
B 6 **Skuggor** (Hur kan skuggor påverka – positivt eller negativt?)		
B 7 **Betraktningstid** (Hur lång tid har man på sig att se t ex vid avsyning eller montering?)		
B 8 **Nedsmutsning** (Påverkar nedsmutsning belysningsnivån och därmed synuppgiften? Rengöring?)		
B 9 **Övriga synpunkter.**		
Närfältet/omfältet:		
C 1 **Reflektanser** (Är reflektansfaktorerna lämpliga?)		
C 2 **Ljusinfallsmöjlighet** (Finns hinder för ljuset att nå fram?)		
C 3 **Synkoncentration** (Kräver synuppgiften koncentration och därmed en lugn bakgrund och omgivning?)		
C 4 **Ytegenskaper** (Matt - blank - färg?)		
C 5 **Nedsmutsning** (Påverkar nedsmutsning synobjektet? Rengöring?)		
C 6 **Övriga synpunkter**		
Ljuskällan:		
D 1 **Belysningsstyrka** (Krav på belysningsstyrka?)		
D 2 **Ljusriktning** (Krav på ljusriktning?)		
D 3 **Bländning** (Från fönster/ljuskälla?)		
D 4 **Färggivning** (Ställs speciella krav på ljuskällans färggivningsförmåga?)		
D 5 **Värmestrålning** (Finns risk för besvärande värmestrålning?)		
D 6 **Ljusfördelning/rumsupplevelse** (Ger ljuset en god rumsupplevelse?)		
D 7 **Nedsmutsning** (Risk för nedsmutsning av lampa/armatur? Rengöring?)		
D 8 **Åtkomlighet/elsäkerhet/mekaniskt skydd**		
D 9 **Övriga synpunkter**		

Observera att frågorna efter nyckelorden endast är exempel och att orden kan ha fler betydelser.

Har bedömningen/mätningen påverkats av dagsljus? ☐ Ja ☐ Nej

Om Ja – hur? .....

Arbetarskyddsfonden, Tunnelgatan 31, Box 1122, 111 81 Stockholm.
Tel. 08-14 32 00.

Bra belysning på jobbet

Checklista för belysningsplanering / kontroll / individuell justering

Datum	Utförd av	Arbetsställe	Arbetsplats	
Arbetsuppgift – viktigare synuppgifter			Glasögon	Ålder

Nyckelord (Exempel på fråga)	Anteckningar	Vid kontroll åtgärdas av

Ögat:

A 1 **Skydd** (Behövs skyddsglasögon eller annat skydd?)

A 2 **Färgseende** (Kräver arbetet fullgott färgseende?)

A 3 **Adaptation** (Finns ljusa/mörka ytor i synfältet eller innebär arbetet ofta förflyttningar mellan ljusa och mörka lokaler?)

A 4 **Ackommodation** (Förekommer skiftande synavstånd?)

A 5 **Ögonrörelser** (Förekommer snabba ögonrörelser (ping-pong) ?)

A 6 **Förstoring** (Behövs synhjälpmedel, t ex glasögon, förstoringsglas?)

A 7 **Övriga synpunkter.**

Synobjektet – det man ser på:

B 1 **Färgkontrast** (Hur är färgkontrasten mellan olika delar av synobjeket och/eller omgivningen?)

B 2 **Luminanskontrast** (Hur är skillnaderna i ljushet mellan olika delar av synobjektet och/eller omgivningen?)

B 3 **Reflektanser** (Hur mycket av det mot ytan infallande ljuset reflekteras?)

B 4 **Ljusinfallsmöjligheter** (Når tillräckligt mycket ljus dit man ska se?)

B 5 **Reflexbländning** (Finns risk för reflexbländning, t ex i blanka material?)

B 6 **Skuggor** (Hur kan skuggor påverka – positivt eller negativt?)

B 7 **Betraktningstid** (Hur lång tid har man på sig att se t ex vid avsyning eller montering?)

B 8 **Nedsmutsning** (Påverkar nedsmutsning belysningsnivån och därmed synuppgiften? Rengöring?)

B 9 **Övriga synpunkter.**

Närfältet/omfältet:

C 1 **Reflektanser** (Är reflektansfaktorerna lämpliga?)

C 2 **Ljusinfallsmöjlighet** (Finns hinder för ljuset att nå fram?)

C 3 **Synkoncentration** (Kräver synuppgiften koncentration och därmed en lugn bakgrund och omgivning?)

C 4 **Ytegenskaper** (Matt - blank - färg?)

C 5 **Nedsmutsning** (Påverkar nedsmutsning synobjektet? Rengöring?)

C 6 **Övriga synpunkter.**

Ljuskällan:

D 1 **Belysningsstyrka** (Krav på belysningsstyrka?)

D 2 **Ljusriktning** (Krav på ljusriktning?)

D 3 **Bländning** (Från fönster/ljuskälla?)

D 4 **Färggivning** (Ställs speciella krav på ljuskällans färggivningsförmåga?)

D 5 **Värmestrålning** (Finns risk för besvärande värmestrålning?)

D 6 **Ljusfördelning/rumsupplevelse** (Ger ljuset en god rumsupplevelse?)

D 7 **Nedsmutsning** (Risk för nedsmutsning av lampa/armatur? Rengöring?)

D 8 **Åtkomlighet/elsäkerhet/mekaniskt skydd.**

D 9 **Övriga synpunkter.**

Har bedömningen/mätningen påverkats av dagsljus? ☐ Ja ☐ Nej

Om Ja – hur? .....

Observera att frågorna efter nyckelorden endast är exempel och att orden kan ha fler betydelser.

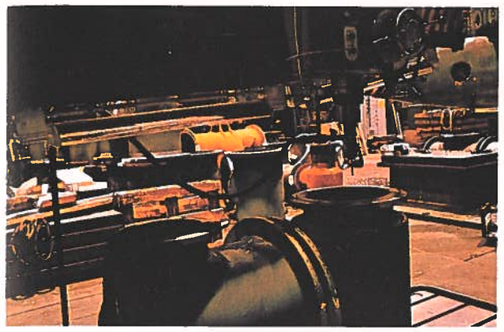
Exempel 1: Radialborrmaskin

Vid arbete med radialborrmaskin utförs arbetet dels på arbetsstyckenas ovansidor dels djupt nere i arbetsstyckena.

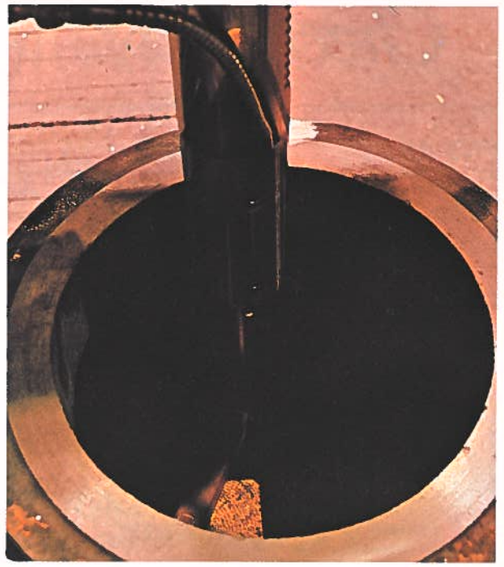
Flertalet radialborrmaskiner, som används inom mekanisk industri, saknar vid leverans från fabrik inbyggd arbetsbelysning.

Om man bara har takmonterad allmänbelysning kommer radialborrmaskinens bom och support att vara i vägen för ljuset, så att arbetsstället kommer i skugga, vilket medför att det är mycket svårt att se ritsar och körnslag.

Operatörerna på maskinverkstaden påpekar att man behöver bra ljus på det aktuella arbetsstället, men ogillar att använda ljusarmaturer som man själv ska ställa in. Man är oljig och smutsig om händerna av kylvätskan, som används vid borrningsarbetet.

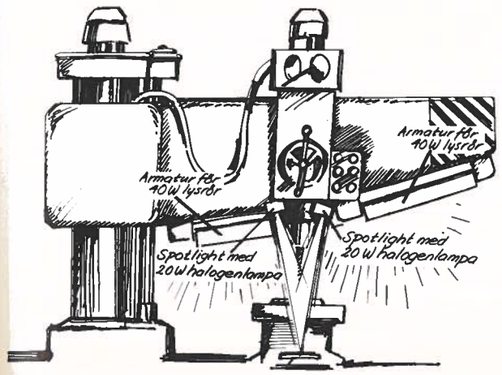


Arbetsstycket är placerat under bommen i läge för borrning. Belysningen utgörs endast av den allmänbelysning (högtrycksnatrium) som är monterad i verkstadens tak. Syn- och belysningsförhållandena vid arbetsstället är helt otillfredsställande.



När man arbetar nere i arbetsstyckena blir det än svårare att se. I det här fallet är borrstället en stålbit belägen ca 50 cm ner i arbetsstycket. På stålbiten finns ett körnslag. Runt körnslaget har ritats en ring. Vid detta tillfälle användes endast den takmonterade allmänbelysningen. Man har ingen möjlighet att se borrstället.

Med hjälp av checklistan går nu belysningsplaneraren igenom arbetssituationen och gör noteringar på de kritiska punkterna.



Teckningen visar radialborrmaskinen försedd med de platsanpassade armaturerna.

Checklista för belysningsplanering/kontroll/individuell justering

Datum	Utförd av	Arbetsställe	Arbetsplats
1980-02-05	Sven H	C-Hallen	Radialborrmaskinen

Arbetsuppgift – viktigare synuppgifter	Glasögon	Ålder
Utföra borrning på arbetsstyckets ovansidor eller djupt ner i arbetsstycket. Att se ritsar och körnslag i blanka el. svarta arb.st.		

Nyckelord (Exempel på fråga)	Anteckningar	Vid kontroll åtgärdas av
Ögat:		
A 1 **Skydd** (Behövs skyddsglasögon eller annat skydd?)	A1 Ögonskydd måste användas (spån)	
A 2 **Färgseende** (Kräver arbetet fullgott färgseende?)		
A 3 **Adaptation** (Finns ljusa/mörka ytor i synfältet eller innebär arbetet ofta förflyttningar mellan ljusa och mörka lokaler?)		
A 4 **Ackommodation** (Förekommer skiftande synavstånd?)		
A 5 **Ögonrörelser** (Förekommer snabba ögonrörelser (ping-pong) ?)		
A 6 **Förstoring** (Behövs synhjälpmedel, t ex glasögon, förstoringsglas?)		
A 7 **Övriga synpunkter**		
Synobjektet – det man ser på:		
B 1 **Färgkontrast** (Hur är färgkontrasten mellan olika delar av synobjeket och/eller omgivningen?)	B2 Svårt att se ritsar och körnslag i blanka ytor	
B 2 **Luminanskontrast** (Hur är skillnaderna i ljushet mellan olika delar av synobjektet och/eller omgivningen?)	B3 Både låga och höga reflektanser	
B 3 **Reflektanser** (Hur mycket av det mot ytan infallande ljuset reflekteras?)		
B 4 **Ljusinfallsmöjligheter** (Når tillräckligt mycket ljus dit man ska se?)	B4 Ljuset måste komma ner genom borrhålet	
B 5 **Reflexbländning** (Finns risk för reflexbländning, t ex i blanka material?)		
B 6 **Skuggor** (Hur kan skuggor påverka – positivt eller negativt?)		
B 7 **Betraktningstid** (Hur lång tid har man på sig att se t ex vid avsyning eller montering?)		
B 8 **Nedsmutsning** (Påverkar nedsmutsning belysningsnivån och därmed synuppgiften? Rengöring?)	B8 Kylvätska stänker. Oljeemulsion.	
B 9 **Övriga synpunkter.**		
Närfältet/omfältet:		
C 1 **Reflektanser** (Är reflektansfaktorerna lämpliga?)		
C 2 **Ljusinfallsmöjlighet** (Finns hinder för ljuset att nå fram?)	C2 Maskinens bom och support skuggar.	
C 3 **Synkoncentration** (Kräver synuppgiften koncentration och därmed en lugn bakgrund och omgivning?)		
C 4 **Ytegenskaper** (Matt - blank - färg?)		
C 5 **Nedsmutsning** (Påverkar nedsmutsning synobjektet? Rengöring?)		
C 6 **Övriga synpunkter**		
Ljuskällan:		
D 1 **Belysningsstyrka** (Krav på belysningsstyrka?)	D1 Ca 600 lux	
D 2 **Ljusriktning** (Krav på ljusriktning?)	D2 Ljuset måste lysa rakt ner längs bom och vid support.	
D 3 **Bländning** (Från fönster/ljuskälla?)	D3 Höga krav på avbländning.	
D 4 **Färggivning** (Ställs speciella krav på ljuskällans färggivningsförmåga?)		
D 5 **Värmestrålning** (Finns risk för besvärande värmestrålning?)		
D 6 **Ljusfördelning/rumsupplevelse** (Ger ljuset en god rumsupplevelse?)		
D 7 **Nedsmutsning** (Risk för nedsmutsning av lampa/armatur? Rengöring?)	D7 Stänk o dimma från skäremulsion på armatur.	
D 8 **Åtkomlighet/elsäkerhet/mekaniskt skydd**	D8 Armaturerna skall vara fast monterade och manövreras med strömbrytare som plac. vid maskinens reglage. Om armaturer matas med 220 volt måste elsäkerhetsåtgärder vidtagas. Skyddskåpa på ev. lysrörsarmatur bör vara kraftig och beständig mot oljeemulsion.	
D 9 **Övriga synpunkter**		

Observera att frågorna efter nyckelorden endast är exempel och att orden kan ha fler betydelser.

Har bedömningen/mätningen påverkats av dagsljus? ☐ Ja ☐ Nej

Om Ja – hur? .....

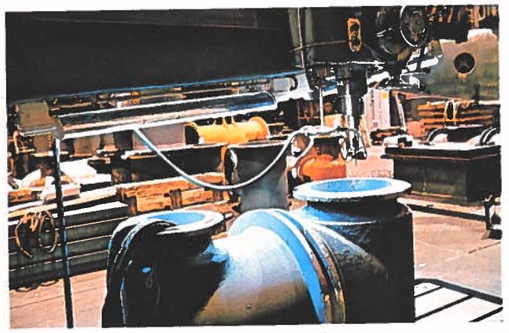
Belysningsplanerarens åtgärdsförslag

När checklistan är genomgången gör belysningsplaneraren ett förslag till förbättringar. I vissa fall kan den erfarne planeraren direkt se vad som behöver göras, i andra fall kan man prova sig fram.

Synuppgiften för operatören är att se ritsar och körnslag i arbetsstycket. Belysning behöver ge minst en belysningsstyrka på 600 lux. För att få erforderlig belysningsstyrka i de olika arbetslägen som supporten får vid förflyttning längs bommens sida monteras 2 st 1 × 40 W lysrörsarmaturer på bommens undersida. Armaturens lysrör skyddas med klar slagtålig plastkupa och förses med inbyggd reflektor.

För borrningsarbete djupt nere i arbetsstycket monteras på supporten 2 st spotlights – halogenlampa 12 V/20 W.

För att lättare kunna se ritsar och körnslag speciellt i blanka stålytor bör området där sådana anbringas målas med t ex röd eller blå snabbtorkande färg – ökad kontrast!



På bommens undersida har två lysrörsarmaturer monterats. Ljusarmaturerna, som är monterade i ramp, täcker hela den sträcka som borrdelen kan förflyttas i bommens längdriktning.

Vid arbete på arbetsstyckenas ovansidor ger de monterade lysrörsarmaturerna bra syn- och belysningsförhållanden.

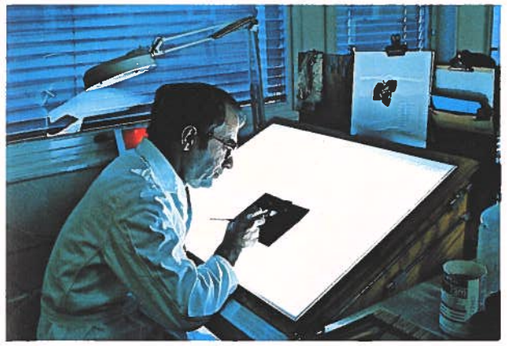
Två spotlights och lysrörsarmaturen är tänd. Man ser arbetsstället mycket bra. Vid arbete djupt nere i ett arbetsstycke krävs belysning som både är kraftig och väl riktad. Annars syns inte ritsar och körnslag som finns på arbetsstycket. För att ljuset ska kunna nå borrcentrum på olika djup bör ljusarmaturerna placeras på motsatta sidor om borren. Avståndet mellan ljusarmatur och borrets centrum bör vara ca 30 – 40 cm (mellan ljusarmaturer ca 60 – 80 cm).

Lysrörsarmaturer på bommen manövreras med kapslad strömställare som placeras vid radialborrmaskinens manöverrattar. Detsamma gäller strömställare för spotlights. Strömställaren för armaturerna förses med tydliga etsade skyltar.

Lysrörsarmaturer matas med 220 V växelström. Ledningen till och på maskin ska vara skyddad mot mekanisk åverkan. För att öka elsäkerheten och personsäkerheten förses belysningsledningen vid elcentral med jordfelsbrytare.

För rengöring av armaturer och support som smutsas ner av kylvätskan (oljeemulsion) används T-sprit. Vid radialborrmaskinen ska finnas T-sprit i plastflaskor samt trasor eller trassel.

Exempel 2: Filmmontage och retuscharbete på ljusbord



På reklambyråer, arkitektkontor men framför allt inom den grafiska branschen utnyttjas ljusbord. När man arbetar med filmmaterial för montering, retuschering m m, utförs det för det mesta på ljusbord. Materialet man arbetar med är blankt och det innebär att man måste ställa särskilda krav på belysningen i arbetslokalen. Takarmaturen ger i regel kraftigt störande reflexer i arbetsmaterialet och det gör att man rätt ofta släcker takbelysningen i dessa typer av arbetslokaler. I dessa fall lyses lokalen upp från själva ljusborden och ljuset reflekteras mot tak och väggar. Belysningen blir diffus och ger i regel stora kontraster i den arbetandes synfält.

Det starka ljuset i ljusbordet gör att man har svårt att se de små prickarna i filmmaterialet.

Kan resultera i synbesvär

Vid retuscharbete (bättringsarbete – t ex fylla i prickar i film) varierar ofta arbetsmaterialets storlek. Ofta täcker det endast en liten del av arbetsbordets lysande yta. Att koncentrera sig på arbetsuppgiften under sådana omständigheter är ansträngande och kan resultera i synbesvär.

Checklista för belysningsplanering/kontroll/individuell justering

Datum	Utförd av	Arbetsställe	Arbetsplats
1980-02-05	Sven H	Tryckeriets Retuschavdelning	Ljusbord

Arbetsuppgift – viktigare synuppgifter: Retuschera bort små prickar i filmen. Se små prickar i det mörka filmmaterialet

Glasögon:

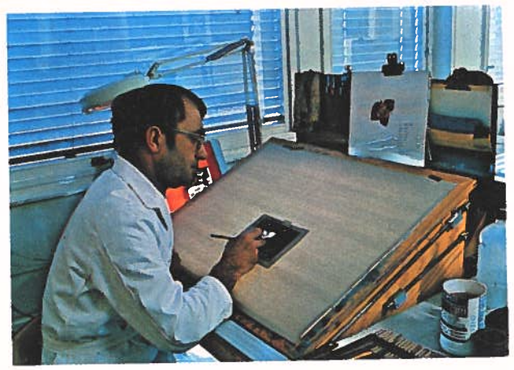
Ålder:

Nyckelord (Exempel på fråga)	Anteckningar	Vid kontroll åtgärdas av
Ögat:		
A 1 **Skydd** (Behövs skyddsglasögon eller annat skydd?)		
A 2 **Färgseende** (Kräver arbetet fullgott färgseende?)		
(A 3) **Adaptation** (Finns ljusa/mörka ytor i synfältet eller innebär arbetet ofta förflyttningar mellan ljusa och mörka lokaler?)	A 3 Vid arbete med film på ljusbord adapterar ögat sig till för hög medel-luminans, som gör det svårt att se små prickar i filmen.	
A 4 **Ackommodation** (Förekommer skiftande synavstånd?)		
A 5 **Ögonrörelser** (Förekommer snabba ögonrörelser (ping-pong)?)		
(A 6) **Förstoring** (Behövs synhjälpmedel, t ex glasögon, förstoringsglas?)	A 6 Förstoringsglas erfodras ibland.	
A 7 **Övriga synpunkter**		
Synobjektet – det man ser på:		
B 1 **Färgkontrast** (Hur är färgkontrasten mellan olika delar av synobjeket och/eller omgivningen?)		
(B 2) **Luminanskontrast** (Hur är skillnaderna i ljushet mellan olika delar av synobjektet och/eller omgivningen?)	B 2 För stora luminans-kontraster mellan ljusbord och filmmaterial.	
B 3 **Reflektanser** (Hur mycket av det mot ytan infallande ljuset reflekteras?)		
B 4 **Ljusinfallsmöjligheter** (Når tillräckligt mycket ljus dit man ska se?)		
(B 5) **Reflexbländning** (Finns risk för reflexbländning, t ex i blanka material?)	B 5 Ljusarmaturer i tak m.m. ger spegelreflexer i den blanka filmen.	
B 6 **Skuggor** (Hur kan skuggor påverka – positivt eller negativt?)		
B 7 **Betraktningstid** (Hur lång tid har man på sig att se t ex vid avsyning eller montering?)		
B 8 **Nedsmutsning** (Påverkar nedsmutsning belysningsnivån och därmed synuppgiften? Rengöring?)		
B 9 **Övriga synpunkter.**		
Närfältet/omfältet:		
C 1 **Reflektanser** (Är reflektansfaktorerna lämpliga?)		
C 2 **Ljusinfallsmöjlighet** (Finns hinder för ljuset att nå fram?)		
C 3 **Synkoncentration** (Kräver synuppgiften koncentration och därmed en lugn bakgrund och omgivning?)		
C 4 **Ytegenskaper** (Matt - blank - färg?)		
C 5 **Nedsmutsning** (Påverkar nedsmutsning synobjektet? Rengöring?)		
C 6 **Övriga synpunkter**		
Ljuskällan:		
(D 1) **Belysningsstyrka** (Krav på belysningsstyrka?)	D 1 300 lux D 3 Bländtal 13 från takarmatur. D 5 Ljusbordet ger värme som ibland förorsakar huvudvärk D 9 Besvärande flimmer bör undvikas (t. ex från äldre lysrör.)	
D 2 **Ljusriktning** (Krav på ljusriktning?)		
(D 3) **Bländning** (Från fönster/ljuskälla?)		
D 4 **Färggivning** (Ställs speciella krav på ljuskällans färggivningsförmåga?)		
(D 5) **Värmestrålning** (Finns risk för besvärande värmestrålning?)		
D 6 **Ljusfördelning/rumsupplevelse** (Ger ljuset en god rumsupplevelse?)		
D 7 **Nedsmutsning** (Risk för nedsmutsning av lampa/armatur? Rengöring?)		
D 8 **Åtkomlighet/elsäkerhet/mekaniskt skydd**		
(D 9) **Övriga synpunkter**		

Observera att frågorna efter nyckelorden endast är exempel och att orden kan ha fler betydelser.

Har bedömningen/mätningen påverkats av dagsljus? ☐ Ja ☒ Nej

Om Ja – hur? .....



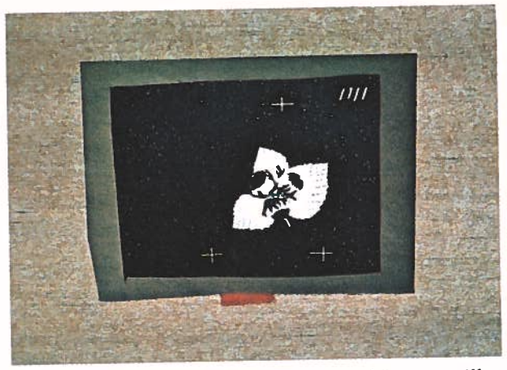
Belysningsplanerarens åtgärdsförslag

Belysningsplaneraren, som gick igenom arbetsplatsen, fann med hjälp av nyckelorden lättare och säkrare felen och kunde föreslå denna lösning.

Att se alla småprickar i filmmaterialet är inte lätt när det i synfältet omges av en starkt lysande ljus bordsyta. Ögat blir mer adapterat (anpassat) till ljusbordets lysande yta än till det mörka filmmaterialet.

För olika storlekar på arbetsmaterialet kan man göra avskärmningsskivor med passande ljusöppningar.

Vid nyinköp av ljusbord bör bord där man kan tända och släcka olika delar särskilt studeras.



Här har ljusbordets lysande yta avskärmats, vilket gör att den anställde ej behöver anstränga ögonen för att se prickarna i filmen.

Utrusta alla takarmaturer med dragströmbrytare så att man lätt kan släcka armaturer som ger spegelreflexer i arbetsmaterialet. Takbelysningens avbländning bör utgöras av optiskt spegelraster.

Lysrörsflimmer tilltar med drifttiden och börjar bli märkbart efter några tusen timmar och då bör lysrören i ljusbordet bytas ut.

På grund av värmeutvecklingen från lysrören bör ljusborden förses med stora ventilationshål och fläkt om så är nödvändigt.

Exempel 3: Telefonister ofta utsatta

Telefonisten kopplar telefonsamtal med hjälp av en s k förmedlingsapparat. Frontplattan i det här fallet är gråsvart och ytan är blank. Därför uppstår lätt spegelreflexer från takbelysning och fönster. På frontplattan sitter lysande, blinkande lampor. Tryckknapparna är välvda och ger även de reflexer.

Telefonister, som arbetar med den här typen av tangentbord kan få ögonbesvär och ibland ont i nacke och rygg. Man sitter snett för att undvika reflexer. Synuppgiften är att se när lampor lyser i tryckknappar, då samtalen tagits emot.

Här syns takreflexerna tydligt. Luminansförhållandet mellan de ljusa knapparna och den svarta ytan är 250:1. Idealet är 3:1.

Checklista för belysningsplanering / kontroll / individuell justering

Datum	Utförd av	Arbetsställe	Arbetsplats
1980-02-05	Sven H.	Kontoret	Arbete i telefonväxel

Arbetsuppgift – viktigare synuppgifter	Glasögon	Ålder
Koppla inkommande telefonsamtal till sökt person. Att se när lampor lyser i tryckknappar o signaltabå		

Nyckelord (Exempel på fråga)	Anteckningar	Vid kontroll åtgärdas av
Ögat:		
A 1 **Skydd** (Behövs skyddsglasögon eller annat skydd?)		
A 2 **Färgseende** (Kräver arbetet fullgott färgseende?)	A2 Att se blå, röda, gröna och vita signallampor	
A 3 **Adaptation** (Finns ljusa/mörka ytor i synfältet eller innebär arbetet ofta förflyttningar mellan ljusa och mörka lokaler?)		
A 4 **Ackommodation** (Förekommer skiftande synavstånd?)		
A 5 **Ögonrörelser** (Förekommer snabba ögonrörelser (ping-pong) ?)		
A 6 **Förstoring** (Behövs synhjälpmedel, t ex glasögon, förstoringsglas?)		
A 7 **Övriga synpunkter**		
Synobjektet – det man ser på:		
B 1 **Färgkontrast** (Hur är färgkontrasten mellan olika delar av synobjeket och/eller omgivningen?)		
B 2 **Luminanskontrast** (Hur är skillnaderna i ljushet mellan olika delar av synobjektet och/eller omgivningen?)	B2 Stora luminanskontraster mellan lysande knappar och blank, mörkgrå frontplatta	
B 3 **Reflektanser** (Hur mycket av det mot ytan infallande ljuset reflekteras?)		
B 4 **Ljusinfallsmöjligheter** (Når tillräckligt mycket ljus dit man ska se?)		
B 5 **Reflexbländning** (Finns risk för reflexbländning, t ex i blanka material?)	B5 Lysrörsarmatur i tak ger reflex i frontplatta	
B 6 **Skuggor** (Hur kan skuggor påverka – positivt eller negativt?)		
B 7 **Betraktningstid** (Hur lång tid har man på sig att se t ex vid avsyning eller montering?)	B7 Ibland 6-8 samtal/minut	
B 8 **Nedsmutsning** (Påverkar nedsmutsning belysningsnivån och därmed synuppgiften? Rengöring?)		
B 9 **Övriga synpunkter.**		
Närfältet/omfältet:		
C 1 **Reflektanser** (Är reflektansfaktorerna lämpliga?)		
C 2 **Ljusinfallsmöjlighet** (Finns hinder för ljuset att nå fram?)		
C 3 **Synkoncentration** (Kräver synuppgiften koncentration och därmed en lugn bakgrund och omgivning?)		
C 4 **Ytegenskaper** (Matt - blank - färg?)	C4 Frontplatta för blank	
C 5 **Nedsmutsning** (Påverkar nedsmutsning synobjektet? Rengöring?)		
C 6 **Övriga synpunkter**		
Ljuskällan:		
D 1 **Belysningsstyrka** (Krav på belysningsstyrka?)	D1 För att kunna göra anteckningar krävs ca 300 lux.	
D 2 **Ljusriktning** (Krav på ljusriktning?)		
D 3 **Bländning** (Från fönster/ljuskälla?)		
D 4 **Färggivning** (Ställs speciella krav på ljuskällans färggivningsförmåga?)		
D 5 **Värmestrålning** (Finns risk för besvärande värmestrålning?)		
D 6 **Ljusfördelning/rumsupplevelse** (Ger ljuset en god rumsupplevelse?)		
D 7 **Nedsmutsning** (Risk för nedsmutsning av lampa/armatur? Rengöring?)		
D 8 **Åtkomlighet/elsäkerhet/mekaniskt skydd**		
D 9 **Övriga synpunkter**		

Observera att frågorna efter nyckelorden endast är exempel och att orden kan ha fler betydelser.

Har bedömningen/mätningen påverkats av dagsljus? ☐ Ja ☒ Nej

Om Ja – hur? .....

Belysningsplanerarens åtgärdsförslag

Telefonisternas synbesvär beror till största delen på de stora kontrasterna mellan den blanka mörka frontplattan och de lysande vita tryckknapparna. Spegelreflexerna från takbelysningen i frontplattan och de blanka, välvda tryckknapparna irriterar också.

För att avhjälpa dessa olägenheter har tangentbordet målats med ljusgrå matt färg och tryckknapparna bytts till halvmatta plana tryckknappar. Luminansförhållandena förbättras väsentligt.

Exempel 4: Maskin för kontroll av kontakttungor till tungelement

Det här exemplet är hämtat från en elektronikindustri.

En ny verksamhet ska starta och i lokalen kommer en ytbehandlingsutrustning att placeras samt fyra s k skeppsladdare och en glödgugn. Utrustningen köps från USA och avdelningschefen har varit där på studiebesök. Som underlag finns hans minnesintryck, broschyrer samt layout (ritning med maskiner m m inplacerade).

Den som ska planera belysningen får så småningom fram följande uppgifter, vilka kan föras in i checklistan.

Allmänna villkor

Fönsterlöst rum, mellanväggar med glasfönster, plastmatta på golv, målade väggytor, höga krav på rent och dammfritt undertak med ljudabsorberande material.

Ytbehandlingen

Arbetsuppgift: Placera färdigmonterade ställ i en transportör. Lyfta av stället efter ytbehandlingen. Avläsa instrument (temperatur, pH etc). Dosera kemikalier. Rengöra kar.

Synuppgift: Se infästning för stället. Se väggar och botten vid rengöring. Se nödströmbrytare.

Från skisser framgår att maskinen byggs in med plexiglas.

Glödgugn

Arbetsuppgift: Placera skepp på transportband genom ugn. Ta bort skepp. Avläsa temperatur.

Synuppgift: Ingen kritisk synuppgift.

Skeppsladdare

Arbetsuppgift: Övervakning av helautomatisk maskin. Ladda med magasin. Ta bort felaktiga detaljer.

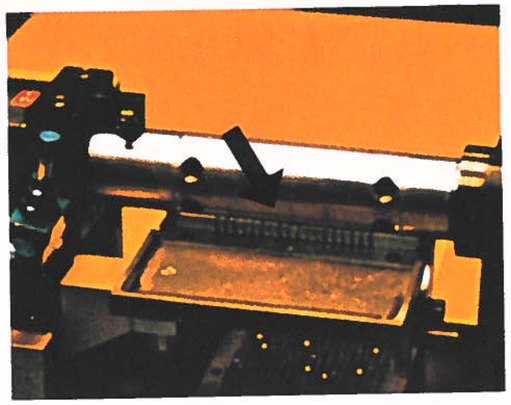
Synuppgift: Kontrollera att tungorna sitter rätt och har den breda delen uppåt.

Ur en broschyr från maskinleverantören framgår att skeppet som laddas är placerat under en blank stålvals. Detta innebär att

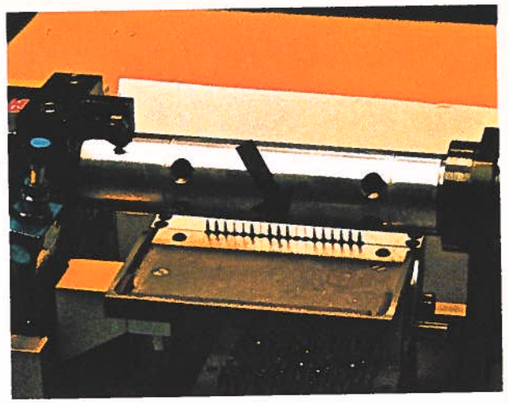
a) ljuset har begränsad möjlighet att nå fram
b) den blanka valsen kan ge besvärande reflexer.

Lösning

Lösningen sker i två steg: grovplanering och slutjustering (när utrustningen är på plats).



Före justering.



Efter justering.

1 Grovplanering

Liksom övriga lokaler förses lokalen med regelbundet placerade infällda lysrörsarmaturer i taket. Armaturerna har prismaraster. Allmänbelysningen planeras för en belysningsstyrka på 800 lux.

Efter samråd mellan arkitekt och belysningsplanerare har tak, tre väggar och golv höga reflektansfaktorer (90, 65 resp 35%). En vägg är målad i något mörkare färg.

Över ytbehandlingskaren (ca 2,3 meter över golvytan) placeras en rad med lysrörsarmaturer som är väl avbländade.

Skeppsladdaren förses med ställbar platsbelysning (2×20 W lysrör), beräknad belysningsstyrka ca 1 500 lux.

2 Kontroll

Sedan den inköpta utrustningen kommit på plats kan belysningsplaneraren i detalj kontrollera om de tidigare gjorda bedömningarna av syn- och belysningsförhållandena är riktiga eller om de behöver korrigeras.

Syn- och belysningsförhållandena kontrolleras enligt checklistan. Inget framkommer som förorsakar ytterligare åtgärder vad gäller ytbehandlingen och glödgugnen. Däremot behöver skeppsladdaren åtgärdas. Av utrymmesskäl fyller vi inte i checklistan på samma sätt som vi gjort i de tre tidigare exemplen, utan noterar bara de aktuella punkterna.

B2 Luminanskontrast: Tungorna och plattan (se bild) har i stort sett samma metallgrå färg, vilket ger dålig kontrast mellan synobjekt och bakgrund.

B4 Ljusinfallsmöjlighet: Platsbelysningen går ej att placera (kommer i vägen) så att ljuset når det kritiska synobjektet.

B5 Reflexbländning: Stålvalsen ger irriterande reflexer från både plats- och takbelysning.

D1 Belysningsstyrka: Ca 800 lux.

D3 Bländning: Tre av takarmaturerna som är placerade intill en mörkmålad vägg ovanför den mörkmålade maskinen upplevs av personalen som besvärande.

3 Slutjustering

1 Med hjälp av en vitmålad skiva bakom tungorna förstärks kontrasten samtidigt som ljus reflekteras in.

2 Tre lysrörsarmaturer med prismaraster utbyts till raster av typ ”Silvertint”. Belysningsstyrkan under dessa armaturer kommer då att bli något lägre än 800 lux, vilket vid nuvarande maskinuppställning kan accepteras.

Kontroll och individuell injustering

Förändringar i verksamheten som vidtagits efter det att belysningsanläggningen färdigplanerats medför ofta att belysningen behöver justeras med tanke på den person som ska arbeta på den aktuella arbetsplatsen. Dessa förändringar kan vara:

att äldre arbetstagare eller handikappade människor har beretts arbetsmöjligheter och de behöver mera ljus eller kanske nya arbetsglasögon

att armaturer har flyttats därför att ventilationstrummor eller rörledningar omöjliggör den planerade placeringen. I dessa fall måste man justera för att undvika t ex fel ljusinfall, för låg belysningsstyrka m m

att den planerade belysningsanläggningen vid inköp blev alldeles för dyr, varför man köpte en billigare anläggning, som ej hade så bra optik och avbländning. Undersök vilka följder detta medför

att man behöver kontrollera belysning p g a ändrad verksamhet, annan layout, ny teknik eller ändrade produktionsmetoder etc.

Vid planering av ny verksamhet bör pengar avsättas för individuell injustering av belysningen. Anläggningen måste kontrolleras.

Kontroll av radialborrmaskinen

Som exempel har vi valt att kontrollera radialborrmaskinen i det tidigare redovisade exemplet en tid efter det att vi monterade lysrörsarmaturer och spotlights.

Checklista för belysningsplanering / kontroll / individuell justering

Datum	Utförd av	Arbetsställe	Arbetsplats
1980-02-05	Sven H	C-Hallen	Radialborrmaskinen

Arbetsuppgift – viktigare synuppgifter	Glasögon	Ålder
Kontroll av att föreslagna åtgärder är genomförda	Arbetsglasögon	59 år

Nyckelord (Exempel på fråga)	Anteckningar	Vid kontroll åtgärdas av
Ögat:		
(A 1) **Skydd** (Behövs skyddsglasögon eller annat skydd?)	A1 Bra skyddsglasögon OK	
A 2 **Färgseende** (Kräver arbetet fullgott färgseende?)		
A 3 **Adaptation** (Finns ljusa/mörka ytor i synfältet eller innebär arbetet ofta förflyttningar mellan ljusa och mörka lokaler?)		
A 4 **Ackommodation** (Förekommer skiftande synavstånd?)		
A 5 **Ögonrörelser** (Förekommer snabba ögonrörelser (ping-pong) ?)		
A 6 **Förstoring** (Behövs synhjälpmedel, t ex glasögon, förstoringsglas?)	A7 Behöver arbetsglasögon Synavstånd ca 1m.	
(A 7) **Övriga synpunkter**		
Synobjektet – det man ser på:		
(B 1) **Färgkontrast** (Hur är färgkontrasten mellan olika delar av synobjeket och/eller omgivningen?)	B1 Blå eller röd färg på - målas innan ritsar och körnslag görs OK	
B 2 **Luminanskontrast** (Hur är skillnaderna i ljushet mellan olika delar av synobjektet och/eller omgivningen?)	B3 OK	
(B 3) **Reflektanser** (Hur mycket av det mot ytan infallande ljuset reflekteras?)		
(B 4) **Ljusinfallsmöjligheter** (Når tillräckligt mycket ljus dit man ska se?)	B4 Spotlights bra OK	
B 5 **Reflexbländning** (Finns risk för reflexbländning, t ex i blanka material?)		
B 6 **Skuggor** (Hur kan skuggor påverka – positivt eller negativt?)		

Observera att frågorna efter nyckelorden endast är exempel och att orden kan ha fler betydelser.

B 7 **Betraktningstid** (Hur lång tid har man på sig att se t ex vid avsyning eller montering?)		
(B 8) **Nedsmutsning** (Påverkar nedsmutsning belysningsnivån och därmed synuppgiften? Rengöring?)	B8 Trassel + T-sprit i plastflaska. OK	
B 9 **Övriga synpunkter.**		
Närfältet/omfältet:		
C 1 **Reflektanser** (Är reflektansfaktorerna lämpliga?)		
(C 2) **Ljusinfallsmöjlighet** (Finns hinder för ljuset att nå fram?)	C2 Lysrören bra. OK	
C 3 **Synkoncentration** (Kräver synuppgiften koncentration och därmed en lugn bakgrund och omgivning?)		
C 4 **Ytegenskaper** (Matt - blank - färg?)		
C 5 **Nedsmutsning** (Påverkar nedsmutsning synobjektet? Rengöring?)		
C 6 **Övriga synpunkter**		
Ljuskällan:		
(D 1) **Belysningsstyrka** (Krav på belysningsstyrka?)	D1 800 - 1.400 lux. OK	
(D 2) **Ljusriktning** (Krav på ljusriktning?)	D2 OK	
(D 3) **Bländning** (Från fönster/ljuskälla?)	D3 Acceptabel.	
D 4 **Färggivning** (Ställs speciella krav på ljuskällans färggivningsförmåga?)	D7 T-sprit OK	
D 5 **Värmestrålning** (Finns risk för besvärande värmestrålning?)	D8 Ledningar på maskin beröringsskyddade. Kabel till lysrörsarmatur 220 V utrustad med jordfelsbrytare	
D 6 **Ljusfördelning/rumsupplevelse** (Ger ljuset en god rumsupplevelse?)	Lysrörskupa acceptabel OK	
(D 7) **Nedsmutsning** (Risk för nedsmutsning av lampa/armatur? Rengöring?)		
(D 8) **Åtkomlighet/elsäkerhet/mekaniskt skydd**		
D 9 **Övriga synpunkter**		

Har bedömningen/mätningen påverkats av dagsljus? ☒ Ja ☐ Nej

Om Ja – hur? ..... Vid mörkt väder .....

Val av belysning

I det här avsnittet ger vi några allmänna synpunkter på dagsljus och allmänbelysning, val av ljuskälla, armaturer och rengöringsmöjligheter.

För och emot dagsljus

Att få in dagsljus i en arbetslokal genom rätt placerade fönster, är mestadels en stor fördel. I Svensk Byggnorm finns regler för hur stor yta av olika byggnader som bör utgöras av fönster. Ur psykologisk synpunkt är det trevligt att kunna titta ut och hålla kontakten med omgivningen, se hur vädret är m m. Dessutom ger dagsljuset ett gratis ljustillskott. Om fönster däremot är felplacerade och feldimensionerade ger det ofta upphov till värme- och bländningsproblem när solen ligger på. Under molniga dagar kan dagsljuset växla mycket snabbt, vilket kan innebära påtagliga adaptationsbesvär för de anställda, framför allt i lokaler som har takfönster, högt belägna fönster eller fönster mot solsidan.

Dessa problem är speciellt besvärliga om den anställde för att utföra sitt arbete tvingas ha ett eller flera bländande fönster i synfältet. I sådana fall måste man många gånger vända arbetsplatsen eller förse fönstren med persienner eller markiser för att undvika besvär. Vid nybyggnad eller större ombyggnad måste man komma ihåg att problemet med dagsljus är invecklat och behöver behandlas med stor omsorg.

Oavsett hur man ställer sig i valet mellan dagsljus och elektriskt ljus, måste en belysningsanläggning dimensioneras utan hänsyn till dagsljuset, eftersom detta endast är tillräckligt under en mindre del av dagen/arbetsåret.

Kan enbart allmänbelysningen ge bra synförhållanden?

Innan belysningsstyrkan för allmänbelysningen bestäms bör man först undersöka om allmänbelysningen har möjlighet att ge bra synförhållanden för resp synuppgift. Om så ej är fallet bör platsanpassad belysning användas. Med hjälp av platsanpassad belysning kan säkerligen nivån på allmänbelysningen väljas väsentligt lägre än om man ej tänkt använda dessa platsbelysningar.

Om takmonterad allmänbelysning ger tillräckligt bra synförhållanden bör givetvis den belysningsnivå väljas som synuppgiften kräver. Om synuppgifterna är flera och kräver olika belysningsnivåer bör man välja den nivå som är mest förekommande. Är det ett fåtal synuppgifter som kräver högre belysningsstyrkor än den valda får dessa ordnas med extra platsbelysning.

Grupplösning av belysning för arbetsplatser med likartade synkrav

I många arbetslokaler har man kanske olika arbetsuppgifter men själva synuppgiften är ganska likartad. Ett exempel härpå är montering av komponenter till ljusarmaturer.

Här krävs en belysningsstyrka över arbetsområdet av ca 1 000 lux. Beroende på arbetsuppgiftens art och arbetstagarens individuella önskningar är det också önskvärt att ha en belysning som ger möjlighet till individuell anpassning.

Valet av ljuskälla påverkar både belysningens kvalitet och ekonomi.

Att i en sådan arbetslokal planera en allmänbelysning som ger ca 1 000 lux är fel ur energisynpunkt och kan dessutom ge dåliga synförhållanden. I detta fall kan man använda en lysrörsarmatur som placeras på ställning vid varje arbetsplats som bilden visar. Denna armatur är ställbar i olika lägen över arbetsområdet.

Val av armatur

Alla ljuskällor har hög luminans och olämplig ljusfördelning, varför det är ett absolut krav att de placeras i rätt armatur med rätt optik.

Armaturen ska dirigera lampans ljus inom avsett område, samtidigt som armaturen hålls tillräckligt bländfri.

Luminanserna varierar kraftigt mellan olika ljuskällor. Varmvita lysrör t ex har luminansen 7 000 cd/m² och 400 W högtrycksnatriumlampor av matt typ har 5,5 millioner cd/m². Andra typer av högtrycksnatriumlampor och kvicksilvermetallhalogenlampor har ännu högre luminanser. Se tabellen med tekniska data om ljuskällor på sid. 86.

Arbetarskyddsstyrelsen skriver i boken ”Belysning och belysningsplanering”:

”För att undvika bländning kan följande regler tillämpas för ljuskällor med luminanser över 5 000 cd/m². Ljuskälla bör vara monterad i armatur på sådant sätt att såväl det direkta ljuset som reflekterat ljus med samma luminans från armaturens reflektor inte är synligt ovanför ett plan i 30° vinkel mot horisontalplanet genom armaturens underkant.

Vid låga monteringshöjder kommer armaturen att befinna sig mer centralt i synfältet än vid höga monteringshöjder. Med hänsyn till detta bör armaturer monterade på höjder under ca tre meter inte ha luminanser överstigande 2 500 cd/m² ovanför ett plan i 30° vinkel mot horisontalplanet genom armaturens underkant.”

När man använder ljuskällor med höga luminanser gäller det verkligen att med stor omsorg välja rätt armatur. Bländningen från en armatur för högtrycks-lampor kan minskas avsevärt om man väljer en armatur med djup reflektor.

Val av ljuskälla

Då man väljer ljuskälla måste flera faktorer beaktas. Valet påverkar både belysningens kvalitet och ekonomi.

Bilden visar en arbetslokal där ljusarmaturerna är placerade på ca 10 m avstånd från vägg. Belysningsstyrkan en meter över golvytan är ca 500 lux.

En annan verkstadslokal där belysningen också utgöres av högtrycksnatriumlampor som i arbetsplanet ger belysningsstyrkan 500 lux. I denna lokal är ljusarmaturerna i tak placerade nära väggarna, vilket gör att väggarna blir belysta och rummet upplevs ljusare än på föregående bild.

Vissa arbetsuppgifter ställer speciella krav när det gäller att bedöma färger rätt. Läkaren som undersöker patienten, tryckaren som granskar färgåtergivningen är två exempel på synuppgifter med höga krav. Här kan endast vissa typer av ljuskällor komma ifråga.

Men de flesta arbetsplatser har inte dessa krav. Däremot är det alltid viktigt att belysningen blir så trivsam som möjligt. I kontorslokaler och andra lokaler med lägre takhöjder kan man välja lysrör som har en ”varm” färg istället för dagsljusliknande ”kallare” lysrör.

I industrilokaler med högt till tak och där man inte har speciella krav på färgseende kan t ex högtrycksnatriumlampor användas.

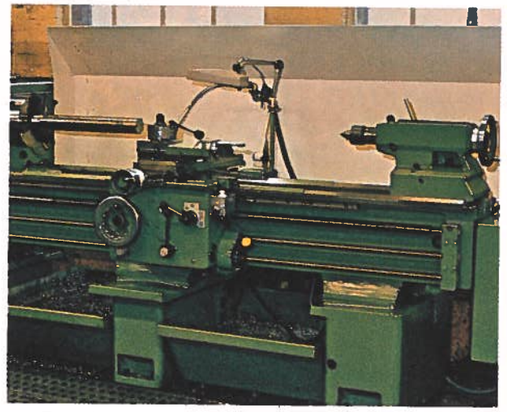
I tabellen med tekniska lampdata finns alla väsentliga data, utom lamppriser, som behövs för att planera en belysningsanläggning.

Armaturernas placering påverkar rumsuppfattningen

Vid belysningsplanering placeras ljusarmaturer i tak oftast symmetriskt, vilket innebär att ljusarmaturerna närmast väggarna placeras på halva lampavståndet. Om exempelvis belysningen utgörs av högtrycksnatriumlampor är avståndet många gånger 10 – 20 m mellan armaturerna och då kommer en stor del av väggarna att ej bli belysta. Rummet upplevs som mörkt och dystert trots att man kanske väljer ljusa väggfärger.

Rengöringsmöjligheter än en gång

Rengöring och underhåll av belysningsarmaturer har vi tagit upp tidigare. Men vi vill ändå påpeka en gång till att den som planerar belysningsanläggningar också verkar för att det finns lämpliga, arbetssäkra



Rengöring av armaturer och ljuskällor är viktigt. Men också maskiner och väggytor behöver rengöras. Det tog c:a ½ timma att tvätta av maskinen ordentligt. Den vita skivan gör bakgrunden lugn och underlättar synkoncentrationen.

ställningar och plattformar för belysningsunderhåll. Således bör t ex traverser förses med arbetssäkra räcken om de används som plattform för belysningsunderhåll

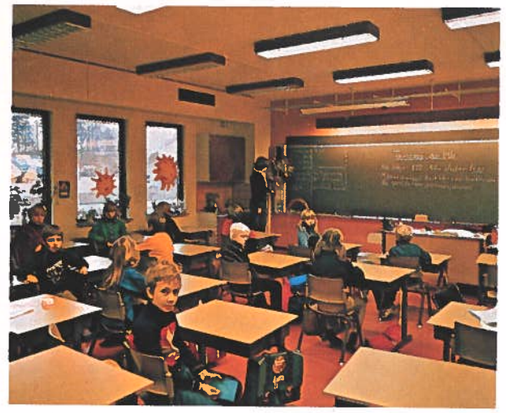
Planera för förändring av belysningsinstallation

Vid planering av belysning för exempelvis storrumskontor, lager eller fabrikslokaler m m där man ändrar bordsplacering, maskiner och produktion behövs en belysning som är flexibel. Därför bör man i dessa fall diskutera att montera armaturer i skenor i taket eller förse resp takarmatur med extra lång lampsladd, så att belysningen kan anpassas till den nya arbetssituationen.

Några åtgärder för minskad energiförbrukning

Den viktigaste åtgärden för att minska energiförbrukningen är att se till att man kan släcka och tända i olika delar av lokalen, allt efter behov. Strömställarna ska vara placerade så att man lätt kan se och nå dem. I stora rum bör belysningen vara uppdelad för skilda tändningar. Armaturer som är placerade nära fönstervägg behöver som regel ej vara tända under dagtid.

Det är en vanlig missuppfattning, att det inte lönar sig att släcka lysrör för kortare perioder. Med de priser och den kvalitet som dagens lysrör håller kan man bortse från den förkortade livslängden hos ett lysrör som tänds och släcks ofta.



Den här skolklassen spar energi genom att släcka lamporna närmast fönstret.Bilden är tagen en regnig novemberdag.

Åtgärder som minskar energiförbrukningen är

- ***att välja ljusa färger på golv, väggar och tak samt inredningar***
- ***att undvika bländande ljusarmaturer***
- ***att hålla ljusarmaturerna rena***
- ***att byta ljuskällor i rätt tid***
- ***att använda lysrörsarmaturer istället för glödljusarmaturer där så är möjligt***
- ***att använda ljusarmaturer med god optik och hög verkningsgrad***
- ***att använda glödlampor med rätt märkspänning.***

Underhåll av belysningen

''Det lönar sig inte att göra rent, det blir snart smutsigt igen'', '' . . .det går inte att göra rent, armaturerna är för svåra att komma åt'', '' . . .underhåll kostar för mycket pengar.''

Tyvärr är det så att man inte alltid har klart för sig hur stora ljusförlusterna är och hur mycket mindre ljus man får ut. De anställda tvingas utföra sina arbetsuppgifter i olämplig belysning.

Ljuskällor och armaturer

Livslängden hos olika ljuskällor är begränsad. Yttre faktorer som temperatur, spänningsvariationer och skakningar påverkar livslängden.

Ljusflödet från själva ljuskällan minskar med ca 20% de första hundra timmarna, men går sedan ner långsamt.

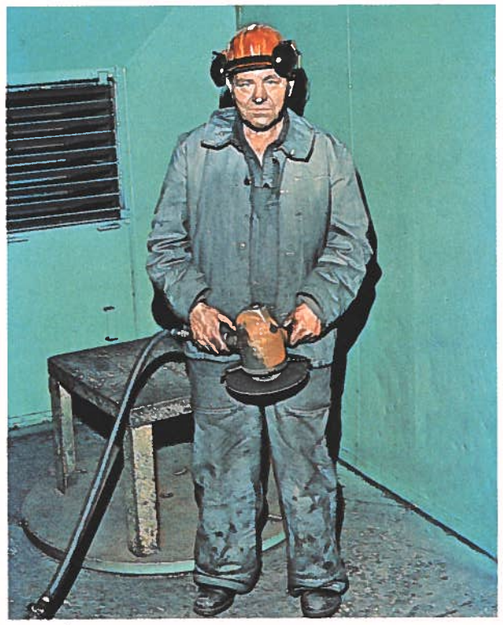
Armaturernas hållbarhet påverkas främst av:

- ***Temperaturförhållandena omkring ljuskällan.***
- ***Nedsmutsningen på reflektor och bländskydd.***
- ***Plast som åldras.***
- ***Mekanisk påfrestning på material och på ytbehandling vid hantering, montering och skötsel.***

Ljusnedgångens storlek beror på:

- ***Smutshalten i den aktuella miljön.***
- ***Byggnadens belägenhet (t ex smutsigt industriområde eller rent landsbygdsområde).***
- ***Åtkomligheten till armaturerna.***
- ***Belysningsunderhållet.***

Dessutom påverkas ljusnedgången mycket av armaturernas konstruktion och vilket material reflektorn består av.

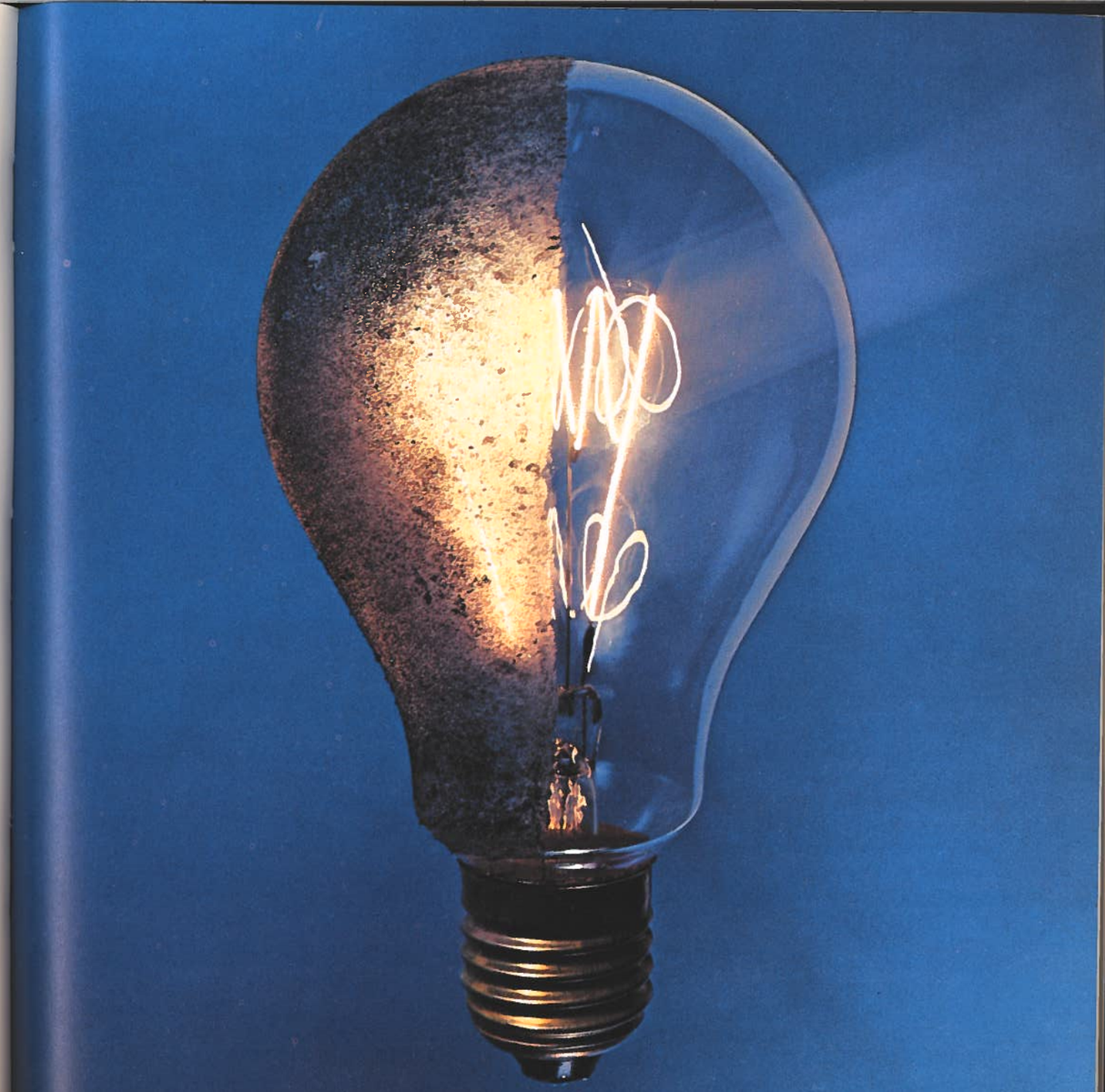


Många industriprocesser är starkt smutsande, men även ''ren'' verksamhet kräver belysningsunderhåll.

Undersökningar bl a från gjuterier har visat mycket stora skillnader. För vissa armaturer konstaterade man ljusförluster på hela 80% efter 7 000 brinntimmar. Bara 20% av ljuset återstod.

Även om ljusförlusterna naturligtvis är störst i smutsig arbetsmiljö ska man inte glömma bort ''ren'' verksamhet. Armaturens verkningsgrad i kontor minskar t ex 10–15% på ett år.

Hur stor minskning av ljusflödet kan godtas innan man sätter in åtgärder? Ett riktvärde är 30%. Med hjälp av det riktvärdet kan man bestämma hur lång tid det bör gå mellan underhållstillfällena.



Planerat underhåll

Istället för ett planerat belysningsunderhåll byter man på många håll lampor och försöker rengöra reflektorerna när någon lampa går sönder. Speciellt i höga lokaler är det problematiskt. Den som projekterar en belysningsanläggning bör också se till att det finns lämpliga ställningar för belysningsunderhåll eller att traverser förses med säkra skyddsanordningar. Detta är speciellt väsentligt i industrilokaler där man använder smalstrålande 1000 W högtrycksnatriumlampor, vilka p g a sitt stora ljusflöde är ganska glest placerade i jämförelse med andra lamptyper. När en sådan ljuskälla slocknar kan det betyda att belysningsnivån lokalt sjunker högst avsevärt.

Planerat underhåll kräver viss specialutrustning för själva rengöringen, lätta flyttbara ställningar och rengöringsmedel som tar bort smutsen utan att förstöra reflektorn.

Gruppbyten av lampor ofta fördelaktigt

I belysningsunderhållet ingår lampbyten, rengöring och reparationer. Lampbyte kan ske efter olika metoder:

- ***Varja lampa som blir obrukbar byts omgående. I större lokaler kräver sådana byten mycket tid. Byteskostnaden blir hög. I vissa fall, där t ex en lampa står och blinkar, är det alltid nödvändigt att snarast åtgärda felet.***
- ***I många företag finns program för förebyggande underhåll.***
- ***Samtliga lampor – även hela – i en anläggning byts samtidigt. Vid lampbytet får man en kraftig höjning av belysningsnivån. Lampor som gått sönder före bytestillfället byts inte ut i förtid.***
- ***Lamporna byts ut gruppvis i anläggningen. Denna metod har fördelen framför den föregående att man får mindre variationer i belysningsnivån. Efter två à tre gruppbyten har samtliga lampor bytts ut. Gruppbytesmetoden är fördelaktig trots att man accepterar att slänga fungerande lampor. Lampkostnaden för t ex lysrör är låg medan arbetskostnaden är hög.***

Lampbyten och rengöring av armaturer och ljuskällor bör samordnas. Vid lysrörsbyten är det många gånger en fördel att även byta glimtändare. Ytterligare positiva effekter får man om man samordnar arbetet med en rengöring av lokalerna.

Nedsmutsning av olika reflektortyper

Har man i samma lokal aluminiumreflektorer för lysrör resp högtryckslampor får man den svåraste nedsmutsningen i armaturerna för högtryckslampor. Det beror på att lysrörets yttemperatur är avsevärt lägre än högtryckslampornas.

Den starka hettan i högtryckslampor bränner fast smutsen i aluminiumreflektorn. Många industrielektriker hävdar att det inte är någon idé att rengöra ljusreflektorerna då reflektionen försämras med följd att ljuset sprids åt alla håll. Vid rengöring av aluminiumreflektorer med skarpa rengöringsmedel är risken att den från början blanka reflekterande ytan blir diffus och skrovlig.

Vid armaturrengöring är det lämpligt att använda alkaliska tvättmedel med pH-värde 8 – 10. Vid rengöring av eloxerade aluminiumytor finns risk för att kemiska reaktioner kan uppstå. Rengöringen bör därför utföras så snabbt som möjligt och den rengjorda reflektorn bör sköljas av med ytspänningsnedsatt vatten.

Tiden mellan rengöringsåtgärderna har också stor betydelse. Ju längre tidsintervall desto svårare blir det att få reflektorn ren. Alltför lång drifttid utan rengöring kan betyda att det överhuvudtaget inte går att göra reflektorn ren.

Jämförelser som gjorts mellan aluminium- och glasreflektorer i kemisk, smutsig miljö visar att glasreflektorerna klarar sig bättre.

Armaturer med öppna aluminiumreflektorer utan ventilationsöppningar uppåt bör ej användas i smutsig industrimiljö. För att fungera ska ventilationshålen vara minst 15% av reflektorns yta.

Svetsröken förstör aluminium

Det här är speciellt intressant i lokaler där man svetsar. Elektrodröken innehåller alkaliska ämnen som tillsammans med fuktigheten i luften bildar lut. Och

Så här kan en reflektor se ut efter att ha brunnit 7 000 timmar i ett gjuteri. Mycket lite ljus reflekteras och reflektorytan av aluminium är svår att rengöra.

lut angriper även i små mängder aluminium. Reflektorn blir omöjlig att göra ren. Med glasreflektorer kommer man ifrån problemet. Glasreflektorer är dock dyrare. Ett alternativ kan vara att placera en glasskiva under reflektorn för att på så sätt utestänga svetsröken. Med den senare lösningen minskar dock lampans livslängd med 20 - 30%.

Om man vid svetsning använder punktutsugning så att svetsrök inte kommer ut i lokalen och därmed inte heller kan smutsa ner ljusarmaturerna kan man givetvis välja aluminiumreflektorer.

Analysera smutsen

Innan man köper belysningsarmaturer till en arbetslokal bör man försöka ta reda på vilka kemiska ämnen som finns i luften och med hjälp av den analysen välja material till reflektorerna.

”Billigaste” anläggningen blir dyr

Ekonomiska jämförelser visar att de armaturtyper som är de billigaste i inköp ofta ger de dyraste belysningsanläggningarna i form av höga årliga kostnader för bl a energi och underhåll.

Val av rätt armaturtyp, planering av anläggningarna från underhållssynpunkt och ett regelbundet belysningsunderhåll ger de lägsta årskostnaderna.

Fakta om lampor

Lamptyp	Egenskaper				Ekonomi			Användningsområde
	Effekt W	Färg-temp. K	Färgrenderings-index Rd	Ljuskällans luminans cd/m² ***)	Ljus-flöde lm	Ljus-utbyte lm/W *)	Livs-längd tim. **)	
Glödlampa 220 V	25	2400	99	För klara glödlampor	230	9	1 000	Maskinbelysningar och sladdrankor.
Glödlampa 220 V	40	2600	99	varierar luminansen	430	11	1 000	Bör vara skaksäkra.
Glödlampa 220 V	60	2700	99	från	730	12	1 000	Kontor. Platsbelysning.
Glödlampa 220 V	75	2800	99	1000000 cd/m²	960	13	1 000	
Glödlampa 220 V	100	2800	99	till	1380	14	1 000	
Glödlampa 220 V	150	2800	99	20000000 cd/m²	2220	15	1 000	
				För matta varierar luminansen från 50000 cd/m² till 500000 cd/m²				
Lysrör, varmvit	40	2900	52	7 000	3100	77	7 500	I arbetslokaler med takhöjd,
Lysrör, varmvit de Luxe	40	3000	85	4 500	1950	48	7 500	som ej överstiger ca 3 m.
Lysrör, vit	40	4100	66	7 000	3100	77	7 500	
Lysrör, dagsljus	40	5000	98	4 000	1850	46	7 500	
Lysrör, dagsljus	40	7400	94	4 000	1800	45	7 500	
Lysrör, varmvit	36	3000	86	10 900	3300	92	7 500	
Lysrör, vit	36	4000	86	10 900	3300	92	7 500	
Lysrör, varmvit	65	2900	52	9 000	4950	76	7 500	I arbetslokaler med takhöjd,
Lysrör, vit	65	4100	66	9 000	4950	76	7 500	som ej överstiger ca 6 m.
Lysrör, varmvit	58	3000	86	13 500	5300	91	7 500	I lager mellan hyllfack med
Lysrör, vit	58	4000	86	13 500	5300	91	7 500	takhöjd som ej överstiger 10-12 m.
Metallhalogen	400 Matt	4100	70	150 000	29 000	72	6 000	Tryckhallar med större
	Klar	4100	70	7 700 000	32 500	81	8 000	takhöjd än 6 m.
Metallhalogen	1000 Klar	4200	70	9 500 000	90 000	90	2 000	Idrottsplatser, sporthallar,
Metallhalogen	2000 Klar 220 V	4200	70	11 000 000	190 000	85	4 000	fotbollsplaner och travbanor där TV gör inspelningar.
Metallhalogen	2000 Klar 380 V	4200	70	8 700 000	184 000	92	6 000	
Vit kvicksilver	50	3800	45	45 000	2 000	40	9 000	Park-, gatu-, väg- och
Vit kvicksilver	80	3800	45	50 000	3 800	48	9 000	industribelysning. Kan
Vit kvicksilver	125	3800	45	90 000	6 300	50	9 000	användas i lokaler med
Vit kvicksilver	250	3800	45	100 000	13 500	54	9 000	ca 3 m takhöjd och högre.
Vit kvicksilver	400	3800	45	115 000	23 000	57	9 000	
Vit kvicksilver	700	3800	45	150 000	42 000	60	9 000	
Vit kvicksilver	1000	3800	45	180 000	60 000	60	9 000	
Vit kvicksilver	2000	3800	45	260 000	125 000	62	3 000	

Lamptyp	Egenskaper				Ekonomi			Användningsområde
Högtrycksnatrium	70	2200	25	70 000	5 800	82	6 000	Industri-, gatu- och
Högtrycksnatrium	150 Matt	2200	25	110 000	15 700	105	9 000	vägbelysning samt hamnar
	Klar			3 400 000	16 500	110		och bangårdar.
Högtrycksnatrium	250 Matt	2200	25	190 000	25 000	100	9 000	Kan användas i lokaler med
	Klar			3 600 000	26 000	104		ca 3 m takhöjd och högre.
Högtrycksnatrium	400 Matt	2200	25	240 000	47 000	117	9 000	
	Klar			5 500 000	48 000	120		
Högtrycksnatrium	1000 Matt	2200	25	360 000	120 000	120	6 000	
	Klar			6 500 000	130 000	130		
Lågtrycksnatrium	35	–	–	100 000	4 800	137	9 000	Motorleder, broar,
Lågtrycksnatrium	55	–	–	100 000	8 000	145	9 000	tunnlar och hamnar
Lågtrycksnatrium	90	–	–	100 000	13 500	150	9 000	
Lågtrycksnatrium	135	–	–	100 000	22 500	166	9 000	
Lågtrycksnatrium	180	–	–	100 000	33 000	183	9 000	
Blandljus	160	3600	60	30 000	3 150	19	6 000	
Blandljus	250	3500	60	50 000	5 700	22	6 000	
Blandljus	500	3700	60	70 000	14 000	28	6 000	

*) Exklusive reaktorförluster.

**) Den angivna ekonomiska livslängden är när belysningsstyrkan sjunkit ca 20% av nyvärdet (när ljuskällan brunnit ca 100 tim). Nedsmutsning ej inräknad.

***) Metallhalogenlampor med dysprosium har väsentligt högre luminanser cd/m²än de som finns angivna i tabellen. Detta beror på den kortare ljusbågen som finns i denna typ av lampor. Ju kortare en ljusbåge är desto lättare är det att med god optik dirigera ljuset.

Armaturens skyddsklass

Svenska	Engelska	CEE symbol	Nya DIN 40050 och IEC	Vanligaste förekommande användningsområde
Normal-utförande	Ordinary	–	IP 20	Torra utrymmen, icke brand eller explosionsfarliga
Droppskyddad	Dripproof		IP 22	Fuktiga utrymmen
Strilsäker	Rainproof		IP 23	Våta utrymmen, utomhus
Sköljtät	Splashproof		IP 34	Fuktiga, våta, brandfarliga utrymmen
Spolsäker	Jetproof		IP 55	Våta utrymmen
Vattentät	Watertight		IP 67	Våta utrymmen med frätande ämnen
Tryckvattentät	–	h	IP 68	Under vatten
Dammsäker	Dustproof		IP 54	Dammigt utrymme
Dammtät	Dusttight		IP 67	Dammigt, vanligtvis brandfarligt utrymme

Liten belysningsordlista

Ljusstyrka

Ljusstyrka är den fysikaliska grundstorheten för ljus. Grundenheten för ljusstyrka är candela (cd).

Ljusflöde

Ljusflöde är en ljuskällas "ljuseffekt" och mäts i lumen (lm).

Luminans

Luminansen hos en (lysande eller ljusreflekterande) yta kan uttryckas som förhållandet mellan ytans ljusstyrka i riktning mot betraktaren och ytans projektion på ett plan vinkelrätt mot betraktningsriktningen. Enheten för luminans är candela per kvadratmeter (cd/m^2).

Belysningsstyrka

Förhållandet mellan det ljusflöde som infaller på en yta och denna ytas storlek. Enheten för belysningsstyrka är lux (lx).

Ljusreflektansfaktor

Förhållandet mellan det från en yta reflekterande ljusflödet och det ljusflöde som reflekteras från en på exakt samma sätt placerad perfekt mattvit yta.

Färgtemperatur

Med färgtemperatur avses temperaturen i en svart kropp som upphettats så att den utsänder strålning med en bestämd spektral sammansättning (ljusfärg). Färgtemperaturbegreppet gäller strikt för den svarta kroppen men för vissa artificiella ljuskällor kan man ange ett närmevärde på färgtemperaturen. Detta närmevärde kallas korrelerad färgtemperatur. Enheterna för såväl färgtemperatur som korrelerad färgtemperatur är kelvin (K).

Färggivningsindex

Färggivningsindex hos en ljuskälla är ett mått på en ljuskällas färggivningsegenskaper. Indexskalan är dimensionslös och går från 0 till 100 där index 100 motsvarar den svarta kroppens färggivningsegenskaper.

Bländning

Ett tillstånd hos seendet som medför obehag och/eller nedsättning i förmågan att se föremål. Bländning beror på en ogynnsam luminansfördelning, för höga luminanser eller alltför stora luminanskontraster i rum eller tid.

Bländtal

Bländtal är ett mått på en belysningsanläggnings grad av bländning. Bländtalsskalan är 13, 16, 19, 22 och 25, där 25 ger den största bländningen.

Beställningskupong

Härmed beställer jag kostnadsfritt följande material:

Bra belysning på jobbet (92 sid.) .... st

Bra belysning på jobbet – Restaurangbranschen .... st
Bra belysning på jobbet – Verkstadsindustrin .... st
Bra belysning på jobbet – Gjuteriindustrin .... st
Bra belysning på jobbet – Grafiska branschen .... st

Affisch om bländning .... st
Affisch om nedsmutsning .... st
Informationsfolder (4 sid.) .... st

Vi reserverar oss om materialet tagit slut.

Namn _____

Företag _____

Adress _____

Postnummer / Postadress _____

Frankeras
ej
ASF
betalar
portot

Arbetarskyddsfonden

Svarsförsändelse
Kontonummer 1466
172 80 Sundbyberg

Några litteraturtips

Belysning.
Arbetarskyddsnämndens vidareutbildningsmaterial.

Belysning och belysningsplanering.
Arbetarskyddsstyrelsen.

Belysning inomhus – riktlinjer och rekommendationer.
Ljuskultur, Stockholm.

Arbete och belysning.
Gösta V Hultgren & Allan Ottosson.

Industribelysning. Undersökningar på en finmekanisk verkstadsindustri och gjuteri/smältverk.
Bengt Knave, Lars Carlsson, Roger Wibom, Walter Ruuth, Allan Ottosson, Bertil Mattson, Maud Werner och Gösta V Hultgren.
10 rapporter publicerade i tidskriften Ljuskultur.

Belysning och färgsättning. Maskinbelysningar.
Projekt vid Kockums Varv 1977.
Sven R Hökfelt.

Ljus och belysningskrav vid arbete med textskärmar på tidningsföretag.
Lars Carlsson.

Belysning inom grafisk industri.
Allan Ottosson, Sven R Hökfelt.

Syn- och belysningsundersökning vid Kockums Mekaniska Verkstads AB.
Kjell Dyster-Aas och Sven R Hökfelt.
Rapport till Styrelsen för Teknisk Utveckling, STU, 1974.

Synfysiologi och belysning. Några yrkeshygieniska konsekvenser.
Bengt Knave. Ljuskultur nr 5/1977.

Arbetsmiljö på verkstaden.
Koncernföretagshälsovården inom LM Ericsson 1977.

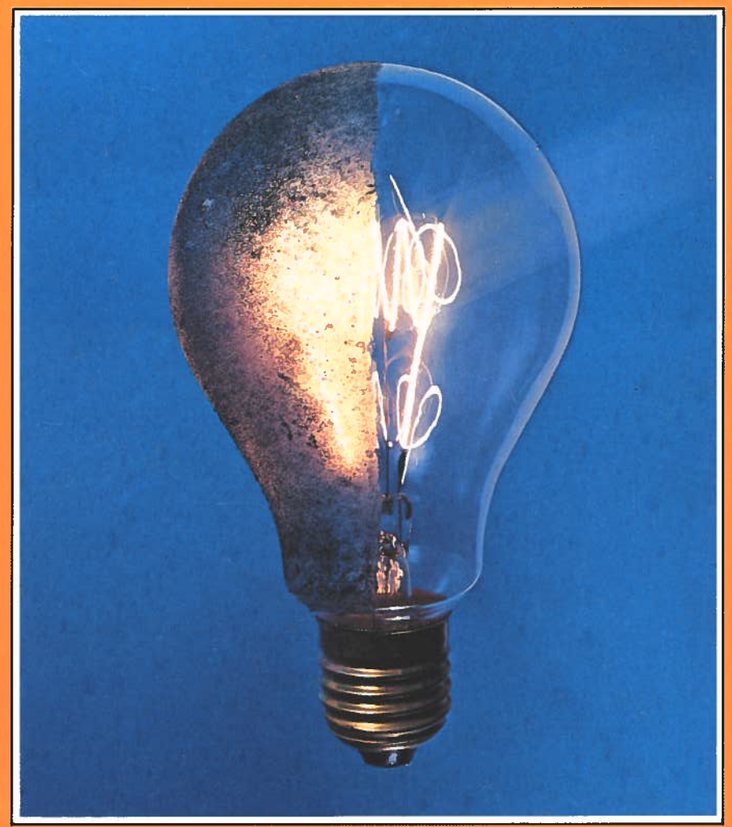
Ljus och färg på våra arbetsplatser.
Sven R Hökfelt. Färg och Fernissa nr 3, 1975.

Enkla åtgärder för bättre avsyning.
Sven R Hökfelt, Mats Johansson.
Teknisk Tidskrift.

Belysning i sjukvårdslokaler.
SPRI-råd 5:14. Andra utgåvan.

Arbejdspladsbelysning. En undersökning av belysningsförhållandena på industriella arbetsplatser.
Erwin Petersen, Wibeke Clauson och Peder Öbro.
Lystekniskt laboratorium i Köpenhamn 1976.

The Ergonomics of Lighting.
Hopkinson, R G & Collins, J B,
Macdonald, London 1969.



Smuts äter ljus.

Arbetarskyddsfonden, Tunnelgatan 31, Box 1122, 111 81 Stockholm.
Tel. 08-14 32 00.

PROGRAMME OF ACTIVITIES AND BUDGET 1981/82—1983/84

SWEDISH WORK ENVIRONMENT FUND ASF

SWEDISH WORK ENVIRONMENT FUND (ASF)

PROGRAMME OF ACTIVITIES AND BUDGET

1981/82 - 1983/84

DNR 081-27

LF/ALLF 532 82 003
Graphic Systems Angered 1982

FOREWORD

The Swedish Work Environment Fund, (Arbetarskyddsfonden) was established in 1972. The task of the Fund is to support research and development, training and information to improve the working environment in a wide sense. Therefore the field of activity includes also research and information on co-determination. The Fund has more than 400 million Skr annually at its disposal - financed by a special work environment fee paid by all employers.

The last comprehensive programme of activities issued by the Swedish Work Environment Fund (ASF) was published two years ago. This present programme is the result of a complete revision of the earlier versions. Investigations commissioned by the Fund, programmes published by the labour market partners etc. were used as the planning basis. In addition, during the planning stage, the secretariat of the Fund contacted the labour market partners, researchers etc. directly. The planning basis may be regarded as complete in most sub-areas and the results of activities in the 1981/82 budget year should not deviate appreciably from the targets laid down in the programme, either in orientation or extent. Although the forecasts for the following two budget years are obviously somewhat less accurate, they should still provide a good indication as to the main thrust of the activity. However, the scope may need to be re-assessed in the light of economic circumstances. Only minor adjustments will be made to the present plan next year, while a more thorough review of plans for the future activities of the Fund will be carried out the following year.

The structure of the programme is such that the introductory summary of costs is followed by a review of the main elements of the projected activities and a number of associated problems of an important nature. The following chapter deals with the assistance provided by the Fund for research and development work. This is followed by a report on the Fund's contribution to training and information, the Fund's international contacts and its information activities. A separate chapter is devoted to the resources normally allocated directly by the Swedish government for special purposes, while the final chapter deals with the Fund's secretariat.

Most of the chapters conclude with an itemised statement of planned activities. In the case of support provided by the Fund for research and development work, these are based on more detailed documents relating to the various problem areas. This material (which is available only in Swedish) may be ordered from the secretariat.

A list on all current projects, supported by the Fund, is published separately in english and can be ordered from the secretariat.

Stockholm , 1981

CONTENTS

ABBREVIATIONS

ASS	National Swedish Board of Occupational Safety and Health
BFR	Swedish Council for Building Research
DSF	Swedish Social Research Commission
FRN	Swedish Council for planning and Coordination of Research
HSFR	Swedish Council for Research in the Humanities and Social Sciences
IAH	Institute of Occupational Health Helsinki (Finland)
ILO	International Labour Organisation
INRA	Commission on information relating to environmental hazards at work
IVF	Swedish Institute of Workshop Engineering Research
KTH	Royal Institute of Technology, Stockholm
MFR	Swedish Medical Research Council
NE	National Swedish Board for Energy Source development
NFR	Swedish Natural Science Research Council
OSHA	Occupational Safety and Health Administration (U.S.A.)
RJ	Bank of Sweden Jubilee Fund
SCB	Swedish Central Bureau of Statistics
SIND	National Swedish Industrial Board
SNV	National Swedish Environment Protection Board
SPRI	Swedish Planning and Rationalisation Institute of the Health and Social Services
STU	National Swedish Board for Technical Development
SU	Stockholm University
SO	National Swedish Board of Education
TFK	Swedish Transport Research Commission
UHA	The National Board of Universities and Colleges

BUDGET PROPOSAL

Budget proposal (SKr thousand)

Items of expenditure and income	Cost outturn	Estimated expend./ income	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
A. EXPENDITURE					
1. Research and development (R&D) grants	79 100	89 100	107 200	122 600	140 200
2. Training and information grants	50 700	63 800	79 000	94 600	99 300
3. International activities	750	3 570	4 850	5 600	6 400
4. ASF information activities	4 832	5 770	6 325	7 250	7 620
5. Grants for special purposes	205 850	212 200	224 000	240 500	260 500
6. Working groups and specialists	1 955	1 904	2 485	2 600	2 700
7. ASF secretariat	6 659	9 896	9 767	9 946	10 450
TOTAL EXPENDITURE	349 846	386 240	433 627	483 096	527 170
B. INCOME					
1. Occupational safety and health contributions	164 748	264 000	346 000	375 000	414 000
2. Interest	28 176	40 000	35 000	30 000	25 000
3. Subscriptions to ASF	145 000	80 000	-	-	-
4. Result (shortfall)	11 922	2 240	52 627	78 096	88 170
TOTAL INCOME	349 846	386 240	433 627	483 096	527 170

Note. As of 1 January 1981, the activities of the Fund have been financed solely by occupational safety and health contributions. (83.5% of these contributions, which represent 0.155% of wages and salaries, is allocated to ASF). The original grant from central funds via the state Budget ceased with effect from the same date.

Estimated cost of research and development (R&D) grants (SKr thousand)

Main area/ problem area	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
TOTAL P&D	79 100	89 100	107 200	122 600	140 200
CHEMICAL WORKING ENVIRONMENT PROBLEMS	27 200	35 100	41 700	49 400	57 700
10. Chemical problem areas, general	6 600	9 000	12 100	14 600	16 900
11. Solvents, fuels	4 400	7 000	7 500	8 000	8 500
12. Lubricating oils and cutting fluids	600	1 300	1 800	2 500	3 000
13. Plastic and rubber materials	1 200	2 000	2 400	2 900	3 500
14. Paints, varnishes and glues	1 600	1 800	2 500	3 000	3 500
15. Pesticides	100	200	400	500	600
16. Welding and cutting, products of	2 400	2 600	2 800	3 000	3 200
17. Minerals and mineral products	2 300	2 000	2 000	2 500	3 500
18. Metals and metallic compounds	2 800	2 000	2 500	3 500	4 500
19. Microorganisms	800	900	1 500	2 000	2 500
25. Investigation of chemical environments by area	1 700	2 000	2 300	2 600	3 000
26. Investigations of individual chemical substances	1 300	1 700	400	-	-
29. Chemical problem areas, miscellaneous	1 400	2 600	3 500	4 300	5 000

Main area/ problem area	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
PHYSICAL WORKING ENVIRONMENT PROBLEMS	13 600	14 900	18 300	17 800	19 100
30. Physical problem areas, general	1 700	2 000	2 300	2 600	2 900
31. Radiation	1 400	1 600	1 600	1 700	1 700
32. Noise	8 400	8 500	11 000	9 500	10 000
33. Vibration	1 300	1 000	1 300	1 600	2 000
34. Climate	500	900	1 100	1 300	1 400
35. Lighting	300	900	900	1 000	1 000
39. Physical problem areas, miscellaneous	0	0	100	100	100
WORKING POSTURE/ WORK LOAD	5 300	5 500	6 500	8 000	9 500
40. Working posture/ work load	5 300	5 500	6 500	8 000	9 500
ACCIDENTS AT WORK	4 000	5 200	6 400	7 300	8 300
45. Accidents, general	1 600	700	1 500	2 000	2 500
46. Accidents, technical corrective measures	1 100	2 700	2 800	3 000	3 500
- Working accident group	1 300	1 800	2 100	2 300	2 300
WORKPLACE AND MACHINE DESIGN. VENTILATION. SAFETY EQUIPMENT	8 400	6 900	9 400	11 600	14 100
50. General workplace design	400	800	1 200	1 600	2 000
51. Premises	1 500	500	700	900	1 200
52. Layout	0	300	600	800	1 100
53. Design of working area	1 000	1 300	1 800	2 400	3 000

Main area/ problem area	Cost outturn	Estimated costs/ income	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
54. Machinery	1 700	1 200	2 000	2 500	3 000
55. Tools/equipment	500	500	600	700	800
56. Ventilation	2 100	1 300	1 500	1 700	2 000
57. Safety devices - personal safety equipment	1 200	1 000	1 000	1 000	1 000
PSYCHOSOCIAL WORKING ENVIRONMENT PROBLEMS. WORK ORGANISATION. CO-DETERMINATION	17 800	19 000	22 700	25 900	28 500
60. Research into working life, psychosocial problem areas, general	3 200	5 500	6 000	6 500	7 000
61. Working schedules	1 600	2 300	2 600	2 800	3 000
62. Working environment and absenteeism/ personel turnover	900	1 100	1 400	1 600	1 800
63. Work organisation, technical changes	3 000	3 200	4 000	4 600	5 000
64. Work organisation, miscellaneous	2 300	1 200	2 300	3 100	3 600
65. Planning & development	2 400	1 000	1 400	1 800	2 000
66. Co-determination/ problems of influence	4 400	4 600	4 400	4 500	4 600
69. Research into working life, psychosocial problem areas, miscellaneous	0	100	600	1 000	1 500

Main area/ problem area	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
LOCAL SAFETY ACTIVITIES. COMPANY HEALTH AND WELFARE	2 800	2 500	2 200	2 600	3 000
70. Local safety activities. Occupational Health Services	2 800	2 500	2 200	2 600	3 000

Estimated cost of training and information (T&I) grants (SKr thousand)

Main area/ problem area	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
TOTAL T&I	50 700	63 800	79 000	94 600	99 300
TRAINING	38 100	49 900	64 300	77 800	81 800
80. Preparation of training materials	8 100	17 500	11 000	12 000	12 000
81. Basic training, residential	10 300	10 700	15 000	25 000	25 000
82. Basic training, study circles	3 400	3 700	6 000	7 000	8 000
83. Further training, residential	8 500	10 500	17 500	17 500	20 500
84. Further training, study circles	1 800	2 500	2 000	3 000	3 000
85. Discussion leader training	4 400	3 000	8 300	8 300	8 300
89. Training, miscellaneous	1 600	2 000	4 500	5 000	5 000
INFORMATION	12 600	13 900	14 700	16 800	17 500
90. Preparation of informational material	900	1 800	2 000	2 500	2 500
91. Conferences/ campaigns	1 900	1 600	2 500	3 000	3 000
92. Information systems	300	1 100	500	500	500
93. Information grants to employee organisations	3 800	4 300	4 800	5 300	6 000
94. Publications	3 400	3 600	3 900	4 500	4 500
99. Information, miscellaneous	2 300	1 500	1 000	1 000	1 000

Note. As a result of the decision of the Swedish parliament to introduce a new system of government grants for adult education, the Fund has decided to increase study circle grants. This means that certain aspects of the budget will require to be reviewed at a later date.

Estimated cost of grants for special purposes (SKr thousand)

Purpose of grant	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
TOTAL	205 850	212 200	224 000	240 500	260 500
Information and training regarding Co-determination Act	115 000	121 900	125 000	135 000	148 000
Training of employee representatives on company boards	9 800	10 000	12 000	13 000	13 000
Regional safety officers	28 200	35 000	40 000	45 000	50 000
National Board of Occupational Safety and Health	30 200	19 300	20 000	19 000	19 500
Centre for Working Life	17 650	21 000	22 000	23 500	25 000
Research promoting-activities	5 000	5 000	5 000	(5 000)	(5 000)

GENERAL DEVELOPMENT TRENDS IN THE FUND'S ACTIVITIES

INTRODUCTION

The Swedish Work Environment Fund has been in existence for nearly ten years - a period which has been marked by intense activity. The research and development activities of the Fund in Sweden are now many times greater in scope than when the Fund commenced work at the beginning of the 1970s. Similar expansion has taken place in the field of training.During the 1970s , the resources devoted to training in the area of the working environment were of an order unparalleled in Swedish working life. These developments were accompanied by the establishment (with the support of the Fund) of a broadly-based information programme designed to disseminate research findings and technological knowhow to workplaces throughout the country.

The experience of these years has been that working life is an area in which there is an enormous need for research and development, as well as training and information programmes. At times, the Fund has experienced difficulties in meeting this need (for example, in the area of R&D) while satisfying the requirements of quality and a fresh, practical approach. Neither have the requirements of working life in these areas yet been satisfied despite the allocation of substantial additional resources during the 1970s and, in fact, it is impossible to forecast when this goal may be achieved in future. Life in productive industry is constantly being renewed. Although research, development, training and information can contribute to clarifying and, to some extent, solving the related environmental problems, new aspects which must be taken into account arise regularly. Even now, it is likely that we are overlooking a number of problems which will ultimately need to be solved with support from the Fund.

During the period of expansion which has taken place, it has been possible to extend Fund support to new areas without having to modify, to any appreciable extent, assistance already allocated to other areas. In this respect, however, we are now entering a new phase in the activities of the Fund. Economic circumstances are now vastly different and it is unlikely that any major expansion into a new area will be possible without reviewing the level of support provided to other areas. In fact, it is assumed that the Fund will, in future years, be obliged to draw substantially on the capital reserves accumulated during the 1970s. (This is dealt with in further detail under "Economic conditions" on page 25.)

The foregoing also changes the basic conditions underlying

discussion of the content of the programme. Some of the guidelines used in planning the coming 3-year period are stated below.

With regard to research and development, the programme of activities may be discussed roughly in terms of the following three sets of circumstances:

1) There continues to be a major need for increased support in certain areas. To some extent, this applies to areas which, in fact, have already been identified but in which conditions have not yet warranted the allocation of greater resources. This applies, for example, to the field of ergonomics in the widest sense, research into working life with particular reference to work organisation, the introduction of new technology (especially in the area of data processing) and certain areas of activity concerning chemical health hazards. Areas of activity with a practical orientation, such as workplace design, are assigned high priority. In other cases, it is assumed that the increase in the level of support will be moderate.

2) In the case of certain areas to which the Fund is already contributing substantial support, there is a need to concentrate and co-ordinate efforts. To be precise, this is a matter of summarising the results of projects carried out to date and trying out new forms of support to ensure that knowhow development, continuity and quality continue to be features of the research effort. The problems of chemical health hazards provide examples of such areas. However, other examples can be found in the fields of psychosocial and working life/co-determination research. In this instance, it is intended to carry out a detailed review of strategies and forms relating to the continued support for research and development work by the Fund, no appreciable increase in the level of resources allocated being envisaged.

3) The need for monitoring and evaluation in a range of other areas is obvious. At present, the scope of research findings in certain fields is such that future efforts should be concentrated on practical development work designed to produce concrete measures. This is, perhaps, particularly applicable to R&D to which the Fund has contributed substantial support with the aim of creating an improved working environment in certain industrial areas. However, it also applies to individual areas of research which overlap the boundaries of several industries.

Some of the problems which have only been touched on above are dealt with in a later section entitled "Some viewpoints on strategies and forms".

The rapid dissemination of research findings to interested parties in the workplaces is an essential element of the effort to ensure that research and development financed by the Fund is of practical interest to those in working life. Furthermore, the problem of achieving this aim in a form which enables those engaged in practical work to apply the findings to the everyday situation is an important and difficult one. Therefore, this problem is also receiving attention as part of a number of research and development activities now incorporated in the programme. In addition, it is assumed that increased and somewhat different forms of efforts will have to be devoted to information and training.

At present, information activities in the area of the working environment are dealt with by a government commission which is scheduled to issue its report in 1981. The likelihood is that the commission will recommend proposals and guidelines which will affect both the extent and nature of the Fund's information activities, as well as the scope of support provided by the Fund for this type of work, for example, within the labour market organisations and their co-operative bodies.

Training was probably one of the most valuable elements of the reforms carried out during the 1970s in the working environment field. However, the production of the training materials needed to meet the demand for basic and further training of safety officers, supervisors and other such categories in a number of important areas of knowhow, has now largely been completed. Therefore, the content and nature of future training material will be a matter of importance during the coming planning period. It is likely that the demand for more specialised training materials will increase. Similarly, greater attention will be paid to groups other than safety officers and supervisors.

There is much to suggest that training procedures will also have to be reviewed during the years immediately ahead. Following the vast expansion which took place in the middle of the 1970s, the volume of training has now slackened somewhat. To some extent, this was expected. However, it also revealed deficiencies in the training programme which must be corrected. At present, intensive work aimed at stimulating training is under way in practically all sectors of the labour market. The experimental adoption of partially new methods of training various groups will probably be one aspect of this work during the 1980s.

In summary, therefore, it may be concluded that a high level of activity will continue to characterise all aspects of the Fund's programme. In addition, it will be necessary to try out new methods of working, partly as a result of the expansion which occurred during the 1970s. This should be carried to fullfil the aim of utilising the resources of the Fund in the most efficient manner so that working life will ultimately benefit to the maximum possible extent.

ECONOMIC CONDITIONS

Since its establishment in 1972, the economic circumstances of the Fund have been relatively good. This is due to a number of different factors.

The financial basis of the Fund, which is derived mainly from occupational health and safety contributions, has increased steadily due to the general rise in the levels of employment, wages and salaries in Sweden. In addition, the contribution was increased a couple of years later in 1974, at which time the state employers also became contributors. From 1976 on, the Fund has also been allocated finance for research in the area of co-determination and the problems of working life in general.

Originally, the overall potential for research in the field of the working environment was limited in comparison with the resources available for financing research which, however, were built up rapidly. Quite naturally, the programme of work initiated by the Fund at an early stage for the purpose of developing bases and guidelines for research activities began to produce the desired results only gradually and at a later stage.

In addition to this, the personnel resources available to the Fund for undertaking more active forms of initiative efforts in various fields of activity during the formative phase were limited - a factor which inhibited the rate of expansion to some extent.

The circumstances described above may be regarded as the explanation for the fact that, throughout practically the entire 1970s, the Fund had at its disposal resources which could not be fully utilised. An additional factor was the restrictive approach adopted by the board of the Fund in dealing with applications, which was designed to maintain a high standard in the fields of research, training and information alike.

In recent years, however, this operating surplus has fallen gradually as the following chart shows. In fact, from budget year 1979/80 on, annual costs will exceed income and this trend will be further accentuated during this planning period. The net result is that the financial and economic circumstances of the Fund have been altered decisively.

The increased grants for various purposes which the Fund has been delegated to administer by special government decisions provide one obvious reason for the altered cost structure. The scope and distribution of these grants are shown in the budget summary and report in a special section of this report. During the coming budget year, these grants will total approx. SKr 220 million, or a little less than half of the total assets for the year. Furthermore, recent statements, including that made in last year's "retrenchment" bill, indicate that the Fund may be used, in future, to provide operating finance for various activities not directly associated with the functions of the Fund as defined by its terms of reference.

At the beginning of 1981, the disposable capital reserves of the Fund amounted to approximately SKr 220 million following the deduction of outstanding debts in the form of project financing approved but not yet paid out and other grants paid but not yet taken up.

The forecasts shown for the coming 3-year period indicate that nearly all of the disposable capital reserves may be expended for purposes already known or planned. The additional costs which may be incurred as a result of government decisions or because of major grants to future projects as yet unforeseen, must also be included.

An extremely important factor which must be taken into account is the uncertainty in the estimates of income on which planning has had to be based. The income figures, based on occupational safety and health contributions, shown in the present budget have been calculated by the National Swedish Social Insurance Board and are based on available official forecasts relating to trends in wage and salary levels during the period. However, changes in the levels of employment, wages or salaries may indirectly influence the economic circumstances of the Fund to an appreciable extent.

The economic conditions described briefly above will, in future, necessitate a very detailed review of the Fund's commitments, continuous monitoring of costs and close supervision of the current liquidity of the Fund.

Trends in ASF income and expenditure, 1972-1983/84

SKr million

600

500

400

300

200

100

72/73 73/74 74/75 75/76 76/77 77/78 78/79 79/80 80/81 81/82 82/83 83/84

Net income = ---------

Net expenditure = ———

SOME VIEWPOINTS ON STRATEGIES AND FORMS

The financial situation of the Fund has already been dealt with. In this context, it was indicated that the available resources will, in future, be barely sufficient to meet the needs and requirements of the Fund's activities. Faced with the careful ordering of priorities between various activities - an absolute necessity in this situation - it is obviously essential that these be structured and analysed. This section will deal with a number of problems considered to be important in this regard.

In this section, the discussion will be seen mainly from the R&D viewpoint. Quite obviously, R&D activities must not be regarded as a separate entity. In fact, it is particularly important that R&D, training and information be integrated as the programme continues. Furthermore, it will eventually be necessary to allocate priorities also at this overriding level, as well as between different types of R&D measures.

Support for research

There is general agreement that ASF should assign first priority to development work with a practical orientation. However, in the period covered by the present programme, the Fund should allocate substantial support to research since there is still an insufficient basis of knowhow in many areas to enable practical solutions to be applied systematically and purposefully. It is obvious that the Fund should use the means which best promote the overall objective. In some cases, the accumulation of basic knowledge or the performance of specific research is an effective means whereas in other cases, it may be preferable to concentrate on technical development or practical experimental work.

Furthermore, it would probably be advisable to refrain from an excessively standardised categorisation of the efforts taken at various levels from basic research to development work based on elimination techniques and practical experimental activities. A research project often touches on several levels simultaneously and, sometimes, fundamental methods may provide rapid means of achieving practical goals.

Even though there is a considerable demand for further research, a great deal has already been accomplished with the support of the Fund. In several areas, the research effort was split into different aspects and based on many different premises, which naturally offered some advantages and was an obvious result of the development phase through which the Fund was going. However, there is now a major need to coordinate and synthesize the knowledge which has been gained and also, in many cases, to develop general methods based on the splintered and many-faceted experience of project activities to date. Setting the right priorities with regard to future R&D projects is one of the important reasons which make this type of effort a necessity.

The foregoing discussion impinges on the more general problem of evaluating the activities of the Fund which will be dealt with at a later stage.

Longer term research support in certain cases

With certain exceptions, ASF support for research has been allocated to established research institutions, mainly within the technilogical institutes, and projects financed by the Fund have represented only a small proportion of the particular institution's total activities. However, there are cases in which the Fund contributes a substantial proportion of the institution's funding.

In many cases, support by the Fund has been of short duration while, in other cases, it has extended over several years. However, in instances such as the latter, support has been approved only in stages and for limited periods of time. To the research institutions, the disadvantages of this system were that the time scale for forward planning was inadequate, and that the systematic quest for knowledge and gradual creation of skills was made more difficult. However, the system enabled ASF to utilise the short-term work carried out by senior researchers, the writing of degree and doctoral theses etc. to achieve many results of value to developments in the field of the working environment and working life.

The system just described is not, of course, unique to ASF, but is the method normally employed by interested bodies when using the technological institutes. To the body making a grant, it offers the advantage that discontinuing the activity does not normally create problems. For example, if the Fund withdraws its support, senior researchers will resume their ordinary activities and the doctors will revert to their ordinary working lives. The disadvantage is that the involvement of the institution in the field of the working environment often comes to an end.

In future, ASF will probably have to continue operating in this manner in many cases. However, whenever there is sufficient basis for setting priorities, the grants to the institutions should not be split unnecessarily into too many limited periods of time. ASF may reasonably expect to achieve better results if the institutions can be guaranteed the support of the Fund for somewhat longer periods than hitherto, thereby enabling them to plan their activities in a more rational manner. Obviously, this must not preclude ASF from exerting any desirable influence on the project during the term of the grant e.g. through reference groups of appropriate composition.

Co-ordinated research programmes

The time should now be ripe for ASF to allocate priorities, in a more conscious way, regarding which research assignments to support on a broad, continuous basis. The support by the Fund of a project package already being carried out by the Department of Psychology at Stockholm University may be said to represent a beginning. In addition, finance provided by ASF will be used during the 1981/82 budget year to initiate a basic programme of research into the working environment in relation to the needs of the engineering industry. This programme will be

operated jointly with the Swedish Institute of Workshop Engineering Research (IVF). Joint R&D programmes are also being carried out under the direction of working environment committees in a number of industries. Better returns should reasonably be expected from the finance invested in joint efforts of this type. It is also likely that there are some existing fields of research and, possibly, some others not yet established, which might conceivably benefit from a similar approach. For example, the former type might include medically-orientated research into noise levels, research dealing with stress problems, toxicological research, and work organisation and co-determination problems. In the latter case, it is conceivable that agreement could be reached with technical institutions regarding the performance of development work using elimination techniques for investigating certain groups of machines, types of workplaces etc.

The criteria used in selecting areas of joint effort should be the relevance of the particular field to the working environment and, by no means least, the expertise of the research group. At present, ASF has several working groups capable of providing a forum for discussing the criteria to be applied, and making proposals as to suitable research programmes.

A period of up to five years would be a suitable duration for a research programme carried out by an institution. The detailed planning must obviously be carried out in co-operation between ASF and the institution in question. In order to prevent the occurrence of problem situations resulting from the responsibility for the security of the research groups established with ASF finance, the Fund should not embark on this type of research programme without a thorough discussion of how the programme is to be terminated. It should, moreover, be easier to plan the termination of research programmes in a manner acceptable to both the researchers and the Fund if the activity can be viewed as an integral programme rather than one split into a number of projects.

It would naturally be desirable if there were alternatives to the termination of a research programme established by ASF other than the withdrawal of support by the Fund. It is highly unlikely, for example, that the responsibility for funding would be assumed by UHA. However, ASF should not overlook any possibilities of exerting influence which may be present in such a case. Improved career opportunities for working environment researchers in the technological institutes, as well as in commercial life and administration, would facilitate both the recruitment of researchers and the discontinuation of research groups.

The direction of a research programme should be capable of variation as to form. However, the basic premise should be the avoidance of unnecessary detailed intervention in the activity, influence being exerted only to modify the overall objective. One of the other advantages of providing finance, as far as possible, to joint research programmes is the fact that neither the board of the Fund, its secretariat nor those responsible for working environment problems within the labour market organisations will need to devote too much time to a variety of individual projects. In this case, the time saved should not be wasted in the

detailed direction of programmes but should, instead, be used to initiate and evaluate urgent activities, especially development work in elimination techniques and practical experimental work.

It is obvious that the scope of any long-term, concentrated support provided to certain institutions must not be such as to tie up an unreasonable proportion of the Fund's resources. It is also essential that research of a different approach and novel ideas from groups not yet established be accommodated. The conditions imposed when granting long-term assistance or support to research programmes must be so stringent that the proportion of ASF funds devoted to this purpose cannot be other than relatively small.

Development work and practical experimental projects

In its initial years of operation, the Fund's terms did not allow it to provide financial support for technical development activities. However, it soon became evident that the support provided for research and investigative studies could not become entirely meaningful until these activities were followed up by practical programmes of implementation designed to eliminate the problems of the working environment. As a result, the initial limitation was removed and technical development work became one of the tools available to the Fund. However, the news regarding the Fund's means and willingness to provide support for this type of development has not been fully circulated and the organisation should, therefore, consider suitable means of disseminating the information.

Considering that ASF has now been in operation for eight years and that its R&D support has been concentrated on investigative projects and the accumulation of knowledge, there should be a considerable basis for undertaking activities with a practical orientation. The experience necessary for deciding how these should be established should also be available. The same applies (to some extent) to a knowledge of the criteria which should be applied in the event of competition between different activities. However, the basic experience relating to the above-mentioned points is not available in a systematically coordinated form, although it should be possible to achieve improvements by evaluating activities to date. The need for evaluation measures will be dealt with at a later stage of the programme.

The level of support for technical development work has risen substantially in recent years, keeping pace with the overall expansion of the Fund's activities. However, the proportion of total R&D support allocated to development work has remained more or less constant and this programme is permeated, in many areas, by an ambition to raise the level of practically- orientated activities appreciably. The fulfilment of these ambitions would mean that the Fund's support for research would be somewhat reduced and although, as indicated above, ASF should be adequately justified in concentrating more on practical efforts, the question of striking a judicious balance between these and investigative activities will eventually have to be the subject of thorough, impartial examination.

In increasing its support for development work, the Fund has naturally concentrated on projects of widely different characters. Since experience of support given to date is now being assembled and since a much harder look will have to be taken at priorities in the light of the Fund's financial situation, this may be an opportune time for some discussion of the proposed balance between different types of research.

The construction of reference installations is one type of applied research project sponsored by the Fund in several areas in the hope that this type of facility (which is usually expensive) will prove to be "contagious" and stimulate similar activities in other areas. However, this has not been the result in most cases. Since this may be due, in part, to the prevailing economic climate, it is hoped that this development will take place later when conditions are more favourable. Neither should we exclude the possibility that the results achieved in one particular area will become disseminated and enable partial solutions or generalised knowhow to be utilised in other areas. Unfortunately, however, these assumptions are based on tenuous grounds and the chain-reaction effect of reference installations is obviously of such vital importance that evaluation and analysis should be carried out. Furthermore, the conditions which govern the dissemination of results is also so important that it should be considered carefully and should comprise one of the selection criteria applied when allocating grants. Since the opportunities of disseminating research findings are probably greatest when the project has a firm industrial base, the problem should be discussed with various types of industrial representative bodies before projects are launched.

It is important that project management skills be examined in relation to both reference installation construction and prototype production since it often appears to be the case that a high level of expertise is found only in one or other of the areas of science, the working environment, design or production engineering and marketing. The latter, at least, would appear to be essential if the desired chain-reaction is to be achieved.

Another important problem is that of specifying the criteria (other than those of dissemination and project management skills discussed above) to be applied when making a selection from competitive development projects. How is the degree of complexity of a given working environment problem to be evaluated? Since there are no simple answers to this question, it should be made a matter for discussion.

The need for a clear allocation of priorities is obviously greatest in the case of the more expensive project. In general, the Fund should be able to adopt a more liberal attitude when dealing with applications for lesser grants from small companies, individual inventors and so on.

The foregoing discussion has dealt mainly with specific measures such as the construction of reference workplaces and the development of prototype machines etc. However, other, more general facilities for promoting development work should be identified in this context. For example, methods of measurement could be developed which would enable comparative measurements to be carried out and type approval sought. If this were done and given sufficient publicity, the market would, in many cases, probably be relieved of the worst results of production. However, this imposes stringent requirements on the technology of measurement since inferior methods would have an undesirable effect on the market and also, in the long term, on equipment, machinery etc. which would be designed to suit these methods rather than the best working environment.

This sub-section has dealt mainly with financial support for technical development work. There is also a need for research activities, model workplaces etc. in other areas such as in the solution of work organisation problems. Obviously, this raises further important questions which, however, will not be discussed in this context.

Support for new technological development

By far the greatest proportion of the finance which the Fund allocates to technical development work is intended to promote the minimisation or elimination of problems in the existing working environment, since it is quite obvious that the Fund should devote itself to this task. However, it is equally obvious that the Fund must take account of the technology which will create the problems of to-morrow in the physical and psychosocial environments. Otherwise, there may be a risk that although we are successful in eliminating the problems associated with existing technology, the new technology will bring other problems in its train.

ASF's involvement in the development of new technology highlights problems which, to some extent, are already associated with existing technology but are brought into focus by new developments. Although it may be the clear responsibility of the Fund to initiate R&D in the field of the new technology, it is not reasonable that it should be expected to assume general responsibility for ensuring that it is environmentally safe. This responsibility must primarily be that of those responsible for developing the technology, regardless of whether this is carried out by public bodies using public money or by private companies. This is another case in which continued discussion is required regarding the criteria to be applied before grants can be allocated by the Fund.

The scope of development work, the extent to which the results can be applied generally and the opportunities of exerting influence on the working environment problems (e.g. through ASF's financed specialist involvement) are just some examples of the aspects which must be taken into account before deciding whether the Fund should become involved or not. It is essential that there be discussion regarding suitable criteria since, in view

of its leading role in the field of the working environment, the Fund cannot refrain from becoming involved in technical development work on a substantial scale. Even though it is difficult to exert an influence on several factors such as structural changes and imported technologies, the Fund is obliged to recognise and seek to influence the agencies which are motivating activities, regardless of whether these are part of private companies or public bodies. Even relatively moderate financial support from the Fund would, if contributed in the right area, be capable of having a considerable effect on the development work. Opportunities for co-operation in the area of equipment purchase should also be considered. Extremely large orders which also necessitate the development of new technology are sometimes placed by the public sector. In this case also, financial support strategically allocated by the Fund may also yield excellent results. However, co-operation with both the developers and purchasers of new technology does pose one problem for the Fund. Not only must it identify the areas of importance, but it must also do so while there are still opportunities of exerting influence.

Co-operation and interfaces with other bodies

There are reasons why the Fund should seek to co-operate widely, during the planning period, with sister bodies. For example, in selecting suitable areas for long-term and joint research efforts, it is obvious that account should be taken of work already carried out with the support of other bodies such as FRN, HSFR, DSF, RJ, MFR, NFR, BFR and STU,or otherwise privately or publicly financed. In certain cases, there should be a basis for direct co-operation, basic research undertaken by one of the research bodies being complemented by applied research sponsored by the Fund.

On the technical side, it may be essential to monitor and, occasionally, even complement the projects being sponsored by STU. In one instance, as a result of the agreement recently concluded with IVF, this may already be said to have come about since STU is providing the financial support for an extremely comprehensive basic programme being carried out by IVF.

Contacts with STU, BFR and several other bodies are also important since it is often difficult to define the general boundaries between the Fund and other sponsoring bodies. In many cases, a project may suitably be carried out under various auspices. However, with particular reference to STU, it should be noted that this body mainly supports projects at a certain technical level and, consequently, may often impose secrecy on the project for patent or commercial reasons. Although the Fund does not have this facility at present, it is, on the other hand, able to provide support for development work based on fully familiar technology. Obviously, this does not preclude the fact that the Fund is interested primarily in new technology.

The Fund should also expand its contacts with bodies and organisations of the type which can render assistance in bringing

Fund-sponsored projects closer to practical realisation. This includes industrial bodies of various kinds, regional development funds, development companies etc. In addition, close contact with some of the currently-sitting public commissions should be of value to the Fund. Co-operation with the National Swedish Board of Occupational Safety and Health should also be expanded.

International aspects

International matters are dealt with in detail in a separate section. Only a few additional comments to the foregoing discussion will be made here.

It is obviously essential that research activities be seen in an international context. For example, before granting financial support to a Swedish research programme, it should be ascertained whether ASF should actually become involved in the area, or whether another strategy should be adopted in the light of international research developments. For example, it must be decided whether a scaled-down Swedish programme combined with some type of international exchange would meet the requirements. In other respects, the research institutions which receive financial support from the Fund for carrying out basic programmes should also be instructed to monitor international developments in their particular areas on behalf of Swedish interests.

The foregoing indicates the problems inherent in the fact that developments in Sweden are greatly influenced by developments abroad. As in so many other areas, Sweden is highly subject to foreign influences in the field of the working environment. Therefore, it is also important to seek ways of exerting influence on the international scene, for example by promoting standardisation, development activities at international manufacturers' conferences, information exchange etc. Increased efforts to promote development at international level may also be justified by noting that unilateral limitations imposed by Sweden may be interpreted as technical trade restrictions. Cognizance should also be taken of opportunities of exporting Swedish "working environment products", even though this cannot be a primary concern of the Fund.

Evaluation of activities

For several reasons, it is becoming increasingly important that the Fund try to evaluate the results of its activities. On the one hand, the Fund has now been active for so long that relating the results achieved to the resources invested should be of interest in purely general terms while, on the other hand, evaluations of various kinds can provide a basis for setting the priorities for future activities. As against this, there has been little opportunity hitherto of carrying out any comprehensive assessment since the Fund has, until now, been going through a phase of dynamic expansion. Furthermore, it is often advantageous to allow at least a few years to elapse between the completion of a project and its evaluation.

This section deals with the problems of evaluation in general terms only and suggests a few approaches. Although the Fund has already evaluated its activities to some extent in relation to the support given to research and development, training and information as well as its own information activities, experience to date is too limited to enable detailed guidelines to be established. The important point is that evaluation programmes have now been commenced and will be developed continuously in form during the period covered by this programme.

Evaluation may be carried out at various levels ranging from simple follow-up of the dissemination of the results of individual R&D projects to comprehensive reviews of working environment developments in an industry as a result of R&D, training and information projects alike. The problems of methodology increase rapidly in complexity as the level of evaluation becomes higher, and we should commence on a simple level at which the resources required are not excessive. In this manner, we can gain experience which will be useful as a basis for carrying out more comprehensive and sophisticated evaluations of future findings in areas of particular interest. This approach need not, of course, preclude the carrying out of more advanced evaluation exercises at the present time if a particular need should arise.

Follow-up of a lesser scope should already be within the competence of the secretariat's own personnel and should not cause particular problems as regards methodology or evaluation. This is a method whereby the Fund can accumulate experience which will be useful in the course of future activities. In addition, in simple exercises of this nature, use may obviously be made of the experience of those receiving support or information from the Fund. In many cases, it will probably be possible to use simple questionnaires for routine procedures.

For reasons of both capacity and objectivity, it is assumed that an individual or group of consultants independent of the Fund will be used for more wide-ranging, comprehensive evaluation programmes. In certain cases, it is conceivable that a special evaluation group (possibly involving the labour market partners) would be set up or that foreign, preferably Scandinavian, expertise be utilised. The Fund should also encourage applications from outside parties who wish to participate in the evaluation of Fund-sponsored projects.

Repayment of grants

Finally, a few comments regarding the repayment of grants which is closely associated with the question of evaluating technical projects. At this stage, the Fund has provided financial support for several development projects with commercial potential. A number of these projects have now been completed and it should be possible to evaluate them from the commercial viewpoint. It is most unlikely that repayment could justifiably be requested in more than a handful of cases. Nevertheless, given this reference point, it is important that the Fund starts to evaluate development projects in order to gain the experience needed to deal with the anticipated increase in the number of such projects during the next few years. The feasibility of repaying grants should preferably be examined as part of a more general evaluation of technical development projects.

RESEARCH AND DEVELOPMENT GRANTS

CHEMICAL WORKING ENVIRONMENT PROBLEMS

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
10. Chemical problem areas, general *	6,6	9,0	12,1	14,6	16,9
11 Solvents, fuels *	4,4	7,0	7,5	8,0	8,5
12. Lubricating oils and cutting fluids	0,6	1,3	1,8	2,5	3,0
13. Plastic and rubber materials	1,2	2,0	2,4	2,9	3,5
14. Paints, varnishes and glues	1,6	1,8	2,5	3,0	3,5
15. Pesticides	0,1	0,2	0,4	0,5	0,6
16. Welding and cutting, products of	2,4	2,6	2,8	3,0	3,2
17. Minerals and mineral products	2,3	2,0	2,0	2,5	3,5
18. Metals and metallic compounds	2,8	2,0	2,5	3,5	4,5
19. Microorganisms	0,8	0,9	1,5	2,0	2,5
25. Investigation of chemical environments by area	1,7	2,0	2,3	2,6	3,0
26. Investigations of individual chemical substances **	1,3	1,7	0,4	0	0
29. Chemical problem areas, miscellaneous	1,4	2,6	3,5	4,3	5,0
Total cost, SKr million	27,2	35,1	41,7	49,4	57,7
of which the following sums were approved and set aside as of 31 December 1980:	27,2	31,3	15,0	1,0	0

* Distribution of costs among different types of projects is shown below. (The increase in problem area 10 for budget year 1981/82 is partly due to the reallocation of funds to this area from problem area 26).

** This problem area is being phased out and will not be relevant for budget purposes after a short transition period.

The following is a more detailed breakdown of the estimated costs by type of activity in relation to the two foremost (in terms of volume) problem areas, namely chemical problem areas, general (10) and solvents, fuels (11).

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Chemical problem areas, general (10)					
Research of an epidemiological/ toxicological nature	4,4	4,6	6,0	7,3	8,4
Methods/techniques of measurement	1,2	3,7	4,8	5,8	6,8
Technical/hygienic investigations and development work of practical aspect	1,0	0,7	1,3	1,5	1,7
Total, SKr million	6,6	9,0	12,1	14,6	16,9
Solvents, fuels (11)					
Research of an epidemiological/ toxicological nature	2,6	4,1	4,4	4,6	4,8
Methods/techniques of measurement	0,8	0,9	1,0	1,0	1,1
Technical/hygienic investigations and development work of practical aspect	1,0	2,0	2,1	2,4	2,6
Total, SKr million	4,4	7,0	7,5	8,0	8,5

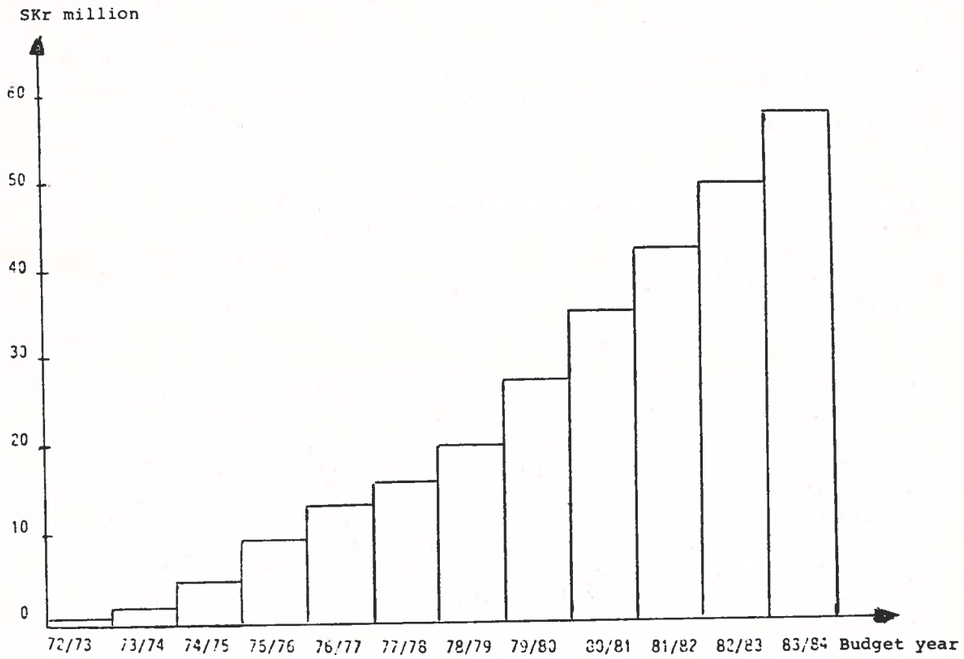
Background

Chemical working environment problems have long been receiving attention and have become increasingly prominent as a result of technological development, which has brought with it an increase in the use of various types of chemical substances, resulting in the creation of hygiene problems in working life. Therefore, from the very inception of the Fund, it was natural that chemical health hazards was one of the four main areas in which working groups were established for the purpose of surveying and analysing the R&D requirements. A reporton "Chemical pollution of the working environment" was published (ASF 1973:3 only in Swedish) The report indicated the need for both knowhow development of a more fundamental nature in the form of toxicological research into the injurious effects of the chemical substances, and development work with a practical bias designed to eliminate the risk factors as far as possible. While giving priority to development work in elimination techniques, the report also pointed out the necessity of gathering knowledge relating to the aspect of potential hazardous effects. The basic attitude described above may also be said to be applicable today.

During the years, the problem areas identified in the report on the first programme have been revised and, in the case of some, special investigations have been carried out to define the R&D requirements more closely. Typical examples are the areas of surface treatment, welding and forging. In addition, groups of substances such as solvents, lubricants and coolants, as well as certain metals, have been the objects of more exhaustive surveys. Major efforts have also been devoted to the problems of dust (in particular, silica and asbestos-bearing dust), gases and vapours in general.

The long-term areas of need identified as part of the first programme included carcinogens and allergens, interaction effects, epidemiological methodology, elimination techniques and chemical analysis techniques. These areas have also proved to be highly important. The Fund has fairly recently completed programmes relating to epidemiological methodology (ASF Report No. 1978:3) and the measurement of chemical air pollution (ASF Report No. 1980:1) which will be of major significance to activities in the years ahead. The requirements of toxicological research concerning chemical health hazards in working life will also be further structured and assigned higher priority through the activities of a recently established programme group.

Support for R&D in the chemical field has increased continuously and rapidly in recent years. In several areas, the level of support is also expected to increase during the current planning period. However, we must expect the Fund's financial support for R&D to level off gradually. This also highlights the need to take a harder look at priorities when allocating grants during the next planning period. The chart below shows the trend to date as well as the current budget and forecasts up to 1983/84 inclusive (at current price levels).



ASF support for R&D relating to chemical working environment problems. Cost outturn for budget years 72/73 - 79/80, estimated cost for 80/81, budget for 81/82 and forecasts for 82/83 and 83/84.

Apart from financial support provided by the Fund for work in this area, cognizance should be taken of grants made by several other funding bodies. Particularly noteworthy among the Swedish bodies are the Swedish Medical Research Council (MFR) and the Swedish Natural Science Research Council (NFR) in the field of toxicological research and the National Swedish Board for Technical Development in the field of research designed to promote the application of improved technology. The steady grants provided by the Swedish Council for Building Research for investigating the chemical working environment problems associated with construction work are also worthy of mention, as is the support provided by the various research councils for developing basic knowhow which can also be used as a basis for R&D work in the field of the working environment.

In order to provide a more detailed description of work carried out and in progress, as well as future R&D requirements relating to chemical working environment problems, it is appropriate to classify the field, firstly by the type of R&D project and secondly, into special problem areas.

Classification by type of project gives the following breakdown:

- Research of an epidemiological/toxicological nature
- Methods and techniques of measurement
- Technical/hygienic investigations and practically-orientated development work

With regard to the first two points, this breakdown provides a picture of the area described in the introductory table of the problem areas as chemical problem areas, general. Reports on other problem areas as specified in the table are given later.

Research of an epidemological/toxicological nature

Projects which are designed, in various ways, to reduce the risks to which people are exposed in working life, by exposure to chemical substances, belong to the chemical problem areas. In some cases, the risks are very familiar and corrective measures can be applied, sometimes after some development work has been carried out. However, in very many other cases, the hazards are not particularly well known and there is a major lack of knowledge as regards both their nature and seriousness. In the latter case, the hazard or hazards must be defined. In other words, the biological effects caused by the particular substance must be described. The magnitude of the hazard is defined by the degree of biological susceptibility present and the content of the substance (or combination of substances) in a given working situation. Alternatively, from the viewpoint of long-term chronic effects, the magnitude may be defined as the dose absorbed during a more or less extended working life.

Experience gathered over a prolonged period has enabled a relationship to be established between old familiar work-related sicknesses and symptoms, and occupation and exposure. It has gradually become more usual to try to identify this relationship by epidemiological investigations - a procedure which is likely to continue to be used for a considerable time ahead. The progression to studies of the effects which occur at an early stage are a likely development of this type of investigation. Given the facilities available to us today, a method which involves waiting for effects to develop after 20 to 40 years' exposure is hardly a satisfactory one.

The availability of information sources of a high standard is an essential prerequisite to epidemiological research.

To enhance the opportunities for epidemiological research into cancer, the Fund has joined with the Swedish Cancer Society to support the National Swedish Board of Health and Welfare in updating its cancer register. In addition, the Fund has contributed support to projects aimed at developing epidemiological methods for application in occupational medicine.

Increasing support has been given to the performance of animal experiments and cell experiments in attempts to demonstrate the effects of various substances encountered in working life. In both cases, research has usually been characterised by an element of methods development combined with the adaptation of established basic research methods. Apart from the Fund itself, several other bodies including MFR, NFR, the National Swedish Environment Protection Board and the Swedish National Food Administation are actively interested in this type of research. A six-year programme entitled "Chemical health hazards in the overall environment" has been set up to support this type of interdisciplinary research. The 1981 budget for the programme (which is administered by the National Swedish Board of Research Councils) is approx. SKr 4.9 million, of which the Fund is contributing SKr 0.7 million. In comparison, the total amount of financial support granted by the Fund for research of an epidemiological/toxicological nature (in all chemical problem areas) for the 1980/81 budget year is estimated at approx. SKr 14 million.

Research sponsored by the Fund in recent years has been devoted mainly to neurotoxic and genotoxic effects, and the occurrence of genetic disorders and tumours frequently associated with these. Disorders of the skin and other organs such as the liver, kidneys and lungs have also been studied, while considerable efforts have been devoted to the study of allergies. Although many of the effects could appropriately be studied within most of the chemical problem areas, nearly all Fund-sponsored projects to date dealing with effects on the nervous system have been carried out under the heading of Solvents.

Noteworthy among projects of a general nature are an epidemiological study of cancer risks and environmental factors using the "cancer environment" register as information basis. Another epidemiological project is being carried out to investigate the relationship bet-

-ween occupational exposure and the incidence of genetic disorders using the malformation register maintained by the Board of Health and Welfare.

Other projects are designed to develop new or modify existing methods of risk evaluation. The aim of one such project is to investigate chromosome changes in individuals exposed to chemical substances, and to determine whether such changes are useful as a measure of general toxic effects. Some projects are designed to examine the feasibility of obtaining information on the toxic effects of various substances at cell level by using test systems with different cell cultures.

A couple of current projects are being carried out to establish the allergy-promoting properties of substances encountered at work. One of these projects (of a more fundamental nature) is being used to study the roll of the islets of Langerhan in working environment-related eczema. The latter project has several purposes. Among other aims, it is hoped to enable allergic eczemas to be distinguished from contact dermatitis and other types of allergies (such as metal allergies).

Methods and techniques of measurement

Interest in the measurement of chemical environmental factors (including the development of methods and instrumentation, sampling and analysis of air pollution or biological samples) has gradually increased as the undesirable effects of chemical substances on the health and welfare of people have become recognised. This has been accommpanied by an increased demand for measurements designed to record the exposure of individuals at work to various chemical substances. Measurements are also a necessary element of elimination methods and of research into the medical effects of substances on the human being.

A large number of projects with various goals are now under way. These include the development, application, complementation or testing of instruments, and the development of sampling and analytical techniques. The projects cover the entire range of problems in the chemical field, with the emphasis on general chemical problems, metals, metallic compounds, minerals and mineral products. Considerable efforts are also being devoted to investigations into individual chemical substances and solvents. Although the number of sub-areas involving biological sampling has increased in recent years, activity in this area represents only approx. 15% of the overall programme.

The Fund's steering group responsible for carrying out industrial hygiene measurements of chemical health hazards concluded its work at the end of 1979 and issued its final report early in 1980. The board of the Fund has decided to implement some of the proposals, including the allocation of SKr 7 million for R&D in the area in budget year 1980/81 - a substantial increase as compared with 1979/80. Two co-ordination and reference groups have been set up. One of these will be responsible for developing high-class sampling and analytical methods for amines and isocyanides, while the

second group will deal with gas sampling by adsorption and chemisorption.

A decision has also been made to set up a group for the purpose of clarifying concepts and proposing development measures relating to the measurement of air pollution from the aspect of industrial hygiene. Procedures, standard methods, type approval, authorisation etc. are some of the subjects which will be dealt with, activities being summarised in a review of the area.

The steering group has emphasised the importance of international co-operation. As a result, certain initiatives have been taken which will stimulate joint activities, mainly with the U.S.A. At present, contacts are being established with a number of the principal American institutions. In addition, a conference in the field, with American participation, is being organised for 1981.

As part of its assignment, the measurement steering group of the Fund conducted a questionnaire survey among safety engineers regarding the measurement of chemical air pollution from the aspect of industrial hygiene. The results showed that the opportunities available to safety engineers of providing companies and their employees with assistance in the area of eliminating chemical hazards are limited. These limitations apply in terms of time, equipment and knowhow. In the light of this, it has recently been decided to carry out a preliminary study for the purposes of planning a survey of the assistance required by company health and welfare departments in improving occupational hygiene where chemical health hazards are present.

Since the problem of processing information such as measured values and other information of interest to functions such as occupational health services has come to the fore in several major projects, a co-ordination group has been established to deal with this matter.

There has long been an express need for research efforts in the field which has been expanding continuously. This has been the case particularly in recent years.

Technical/hygienic investigations and development work with a practical orientation

Obviously, the objective of all R&D work dealing with chemical problems is to minimise the risk of people at work being affected by illness, injury or discomfort due to exposure to chemical substances. For this reason, both short-term and long-term priority must be given to the development of methods of hazard elimination. However, as outlined in a previous section, strong relationships exist between work of a practical nature, on the one hand, and the more fundamental development of knowledge relating to toxicological/hygienic/measurement technique problems on the other.

To achieve a "minimum risk level" in relation to chemical environmental factors, the measures to be taken may be structured as follows:

- the replacement of injurious substances by less hazardous types
- the modification of production processes and handling procedures to reduce the formation or release of undesirable substances
- the provision of ventilation facilities insofar as air pollution cannot be prevented by the measures described above
- the provision of personal safety equipment in exceptional cases.

The latter two points are dealt with as part of the problems of ventilation and (in part) of safety devices and personal safety equipment.

In addition, measures with a practical orientation to which support has already been contributed are reviewed in special reports dealing with the problem areas. In this context, the areas of relative importance are lubricants and cutting fluids, paints, varnishes and glues, the products of welding and cutting, minerals and mineral products, as well as other areas in which considerable work has been done. As regards reports dealing with other areas, those dealing e.g. with workplace and machine layout, and industrial accidents are of particular interest. Consideration must also be given to associations with psychosocial working environment, work organisation and co-determination problems which will play an ever more important role in future.

Initially, Fund support for research in the areas mentioned was very largely allocated on the basis of surveys carried out industry by industry. These frequently consisted of inventories of chemicals and technical/hygienic investigations followed by more specific R&D measures. A relatively small proportion of the subsequent project work had a clear practical bias and, in cases in which methods of elimination produced practical solutions, the disseminative effect achieved must be questioned. The series of continued and detailed investigations into various risk factors which resulted from the industrial surveys was a natural and desirable result, and the fact that a limited number of practical measures resulted may actually be due to insufficient knowledge of the hazards/effects. As regards the disseminative effects, a more detailed assessment is required, partly to achieve some sort of quantification of results achieved to date and partly to identify means of increasing the effects. This would indicate the need for various information and training measures which, when introduced, would include groups which have not yet been primary targets of the Fund. Such groups include production engineers, designers, purchasers and suppliers/manufacturers.

In recent times, several industries have also initiated "second generation" surveys. Although identification of the problems is also the first stage of each investigation, this should be followed by individual projects with a predominantly practical orientation. Intimate co-operation with the companies in each branch of industry should enable the various measures to be tested, successful results leading to a wider application. In many cases also, greater co-operation with manufacturers and suppliers of machinery and chemicals would be a highly desirable result.

The engineering industry has provided the conditions for carrying out several projects with a practical bias. In many cases, these have been designed with the assistance of the Swedish Institute of Workshop Engineering Research (IVF) - the industry's own R&D body which concentrates on the field of production engineering. The scope of recent research by IVF into working environment problems has been such that a general agreement has been concluded with the Fund. Somewhat similar R&D resources are available in other areas of commerce. Examples of other joint industrial research institutions which have participated in projects relating to chemical working environment problems include the Swedish Packaging Research Institute, the Glass Research Institute,the Graphic Arts Laboratory, the Swedish Institute for Metals Research, the Swedish Ironmasters' Association, the Institute of Plastics and Rubber Technology, the Swedish Institute for Silicate Research, the Swedish Institute for Textiles Research, the Wood Centre, the Swedish Forest Products Research Laboratory, the Institute of Wood Preservation and the Institute of Surface Chemistry. An R&D body which should also be mentioned in this context is the Swedish Institute for Water and Air Pollution Research.

The above list of R&D bodies which are partly associated with industry indicates that there should be room for manoeuvre in making greater efforts to ensure that these joint institutions pay greater attention to the problems of the working environment as part of their activities. The procedures whereby this is achieved require further discussion. However, one reason for utilising these R&D facilities, especially in the development of methods of eliminating hazards, is their close relationship with, for example, the development of production methods.

Since many aspects of practically-orientated research are likely to be of major importance to activities in many industries, the interchange of knowhow between different industries is just as important as the disseminative effects within each particular area of industry or commerce. The extent to which special resources need to be created to produce this interchange are debatable. However, it would probably be enhanced by the development of R&D facilities devoted to various types of practically-orientated research to operate in conjunction with the joint industrial research bodies. Typical factors in favour of supporting this type of development include:

- the appreciable need for R&D activities with a practical orientation for the purpose of developing more generally applicable methods based on the needs of the working environment

- the general lack of studies and proposals as to how different practical measures should be developed and widely publicised.

The latter point is also dealt with in the context of physical working environment problems wherein it is proposed that some form of analysis be carried out of the obstacles involved in translating existing knowledge into methods of eliminating hazards. Although covering the full spectrum of Fund activities, it should be possible, in different ways, to achieve a concrete definition,

breakdown and delimitation of the problems involved, following which they could be dealt with. Chemical handling systems may be quoted as a typical area in which R&D is needed to develop generally applicable solutions to chemical problems. As regards the application and dissemination of present-day knowhow, studies are required, for example, of the cost-benefit aspects and problems as they affect small industries. Studies of this type might also be used as the basis for allocating priorities to R&D measures. The various systems employed by companies in dealing with chemical health hazards is a related area which also requires clarification. In other words, the problems relate to the entire sequence of events which determine the choice of chemicals for various purposes.

Last, but not least, it must be emphasised that the Fund should continue to provide substantial support for initiatives taken by individuals, companies etc. to improve the working environment. It is in the nature of things that this type of effort cannot or should not be planned in detail. On the other hand, more information is probably required on the availability of support from the Fund for developing various ideas.

R&D activities in various problem areas

With the exception of the area of general chemical problems, which has already been discussed, the following are some of the areas specified in the introductory table in which R&D activities are in progress.

Solvents are widely used in many sectors of working life. Solvents are frequently biologically active and may cause injuries if present in excessive concentrations in workplace atmospheres. The injuries or effects most commonly observed are of a neurotoxic and genotoxic nature.

Toxicological experiments (animal experiments, cell cultures and bacterial cultures) or epidemiological studies are the normal method used in attempting to establish the relationship between exposure to solvents and the incidence of biological effects or symptoms. In the latter case, it is usual to try to determine the relationship between injuries or symptoms suffered by people at work and the nature of the substance to which they have been exposed.

In 1977, the Fund established a programme committee jointly with MFR for the purpose of surveying and analysing the need for research into the biological effects of solvents. The work of the committee is described in a report whichis entitled "Solvents in the working environment". The report is translated into English.

Approximately half of the projects completed or in progress are devoted to research of an epidemiological/toxicological nature. These include studies of the effects on the central nervous system, chromosome defects, genetic effects, balance disorders, and liver and kidney ailments.

The effects caused by solvents obviously make it essential that there should be means of monitoring the quality of workplace atmospheres and the exposure of employees to the substances. Projects designed to assess methods of sampling and analysing volatile organic substances are in progress.

In its R&D programme relating to sampling, analysis and instrumentation, the above-mentioned measurement steering group has also dealt with problems of major interest in the present context.

Relatively few of the projects are of a practical nature. However, some of them do deal with solvents as part of other problem areas such as paints, varnishes and glues.

In addition, a greater effort in the field of information is now being prepared in order to utilise the experience contained in reports on the problem to date.

With regard to Lubricants and cutting fluids, the activities of the Fund have expanded rapidly in recent years according as the need for R&D in these products and their application has become more obvious, especially in the engineering industry. Until now, medically-orientated research has concentrated on disorders of the skin and respiratory organs, and on the risk of allergies and cancers. Methods of chemical analysis have been developed in conjunction with studies dealing with the contents of the products and the changes which occur during use. Efforts devoted to methods of eliminating the hazards have been devoted mainly to ventilation techniques, although other approaches such as introducting new designs of cutting machines have also been tried recently. A programme committee has produced a position paper dealing with working environment problems associated with the use of lubricants and coolants in metalworking. The committee is expected to publish its final report dealing with R&D requirements at the end of 1981.

The area of Plastics and rubber materials has attracted greater interest in recent years with the rapid growth in the number of applications of these materials. Project activities relating to plastics have hitherto consisted mainly of surveys to establish the extent of use of the various substances and of toxicological studies. Volatile monomers and gases formed by thermal decomposition have been investigated, the main effects being allergic ailments and symptoms similar to asthma. Support has also been given to practically-orientated research to develop improved methods of producing materials such as reinforced plastics. Although R&D work on rubber materials has been more limited in scope, it has dealt substantially with methods of hazard elimination. Systems for handling rubber chemicals provide one example. The industry has also made substantial strides in the area of protective sheeting, which is a development on an earlier toxicological investigation financed by the Fund.

Paints, varnishes and glues have recently become the focus of considerable interest as a result of the knowledge gained regarding the toxic effects of solvents. A relatively fast, wide-ranging

changeover to new materials and methods is in progress. Most of the Fund's support in the area has been allocated to R&D work with an applications bias. Problems involved in the manufacture of paints and varnishes, the painting of products in the engineering industry and the painting of buildings are being examined. In the area of monitoring, development work relating to the analysis of volatile substances given off by water-based paints has been carried out. Although glues have still only been studied to a minor extent, work on techniques of hazard elimination are being planned for this area.

Pesticides are used for destroying insects, weeds, mould, bacteria etc., and are biologically active substances which probably also affect humans. In Sweden, this area has received little attention from the viewpoint of occupational medicine, probably because of the relatively immediate availability of information from abroad.

However, the Fund has provided support for research dealing with certain effects caused by DDT and lindane, and by medical disinfectants. Funding is also being allocated to a number of projects designed to reduce personnel exposure during the handling of pesticides by introducing technical improvements.

Many working people are engaged in Welding and cutting. This is a working environment problem of concern to the Fund since these processes generate atmospheric pollutants. The mandate of the steering group working in this area expired at the end of 1979 and a combined information report on the working environment in welding is expected to be available during 1981. R&D activities in this problem area are largely concerned with the engineering industry. Although efforts have been concentrated on the aspect of knowhow development, the level of applications-orientated research has increased in recent times. Several of the latter projects deal with methods of ventilation. One of these is designed to study alternative flow conditions for ventilating welding stations. Another project is concerned with the development of a special welding gun incorporating a fume extraction feature. During the year, one project dealing with fume entrapment and air supply units for fusion welding workplace ventilation was completed and the final report issued.

Minerals and mineral products. The mining and dressing of ores, and the production of mineral products generally results in the spread of dust - often with adverse effects on the health of people engaged in the production process. Attention has long been focused on the problems of dusts containing silica and asbestos. In this context, fairly comprehensive epidemiological investigations have been, and are being, undertaken. A couple of projects have also been carried out for the purpose of improving techniques of dust analysis, including one dealing with the study of a film-based powder diffraction method for the identification and quantitative analysis of dust samples. Certain projects which may prove important are devoted to the development of methods of reducing exposure to dust,as in the blasting and demolition involved in rebuilding and renovation work in the construction industry. Another noteworthy project is devoted to the development of

asbestos-free friction materials for various types of brakes which, if successful, will represent a major breakthrough.

Metals and metallic compounds occur to varying degrees throughout practically all commercial and industrial life. Although the field may be restricted considerably by considering only metal-bearing dusts, it remains extremely wide. About half of completed and current projects are concerned with the investigation of a range of different biological effects caused by toxic metals. Studies dealing with hereditary effects, cancer risks, pulmonary disorders and allergy hazards are recurrent themes. A number of investigations into the mechanism whereby toxic metals may be absorbed by the body are also in progress or have been completed. Financial support is being provided for some development work designed to improve the measurement of metal concentrations in workplace atmospheres and in biological samples. One project concerned with the design of an X-ray-based, portable measuring instrument for field use may prove to be of particular interest. Relatively few projects of a practical character are being carried out. Completed and current projects designed to minimise the hazards involved in various types of electrolytic surface treatment products are also worthy of mention.

Problems caused by exposure to Microorganisms occur in a whole range of occupations. Support has been granted both to medical/measurement research of a more fundamental type and to development work in hazard elimination. However, there remain major gaps in knowledge as regards the various sub-areas. In the light of this, the board of the Fund has recently decided that special efforts should be made to initiate R&D work in this problem area. A small working group has been set up for this assignment and specialist assistance will be enrolled.

Within the problem area of Chemical health hazards studied by area, the problems associated with anaesthetic gases have recently aroused special interest, projects of an evaluative and investigative nature being followed by practically-orientated research. Noteworthy among current projects is one being carried out by SPRI with the aim of reducing the concentration of anaesthetic gases in hospitals. Studies are also under way in other areas. For example, during the past year, evaluative studies into the chemical environment in newspaper offices have been initiated.

The problem area of Studies of individual chemical substances which has hitherto been used to classify Fund projects, has proved, in time, to be less than suitable for this purpose. In future, it should be possible to meet the need for information regarding R&D work on individual compounds without using this as the main classification for the project.

The category of Other chemical problem areas includes projects which do not fall within any of the more restricted, well-defined areas described earlier, or within the category of general chemical problems. In completed and current projects dealing with biological effects, studies have been made, for example, of the effects of wood dust on the nasal mucous membranes of furniture workers and the incidence of mutagenous substances in various

office materials. A relatively high proportion of the projects deals with methods of improving the working environment. These include the development of techniques for minimising the risks involved in handling surface treatment chemicals and the minimisation of dust levels in grain and seed handling.

Planned activities

The following is a presentation of activities planned in the field of chemical working environment problems. This consists, initially, of a general summary by type of project in accordance with the structure described earlier, followed by discussion of the various individual problem areas.

Research of an epidemiological/toxicological nature

- o Continued support for epidemiological studies dealing with occupational illnesses and symptoms. A trend towards the development of studies of early symptoms should be encouraged, particularly in the area of genotoxic effects.

- o Continued support for toxicological research, particular attention being paid to opportunities of developing simple, accurate and specific testing systems for hazard evaluation. At present, this type of development is concentrated mainly on genotoxic and, to some extent also, on neurotoxic effects in that psychological tests are being evolved. Other important sub-areas of toxicological research include

  - absorbtion, distribution and elimination - development of various measures of absorbtion under different conditions being a major need

  - biotransformation - degree and rate of metabolisation, formation of reactive metabolites and the enzyme systems which cause activation

  - neurotoxic effects - effects on the nerve centres of the brain, pituitary gland hormone release, effects on blood supply to the brain and metabolism

  - other organic effects - investigation of diseases of circulatory organs, and liver and kidney ailments.

The Fund has recently appointed a programme and planning group for toxicological and related research as a step towards improving planning and defining the measures to be taken in the above important area. In this context, the following proposals should also be noted:

- o Seminars and conferences under the aegis of the toxicology group.

- o Continued participation in the FRN programme entitled "Chemical health hazards in the overall environment" which is providing

support for research of general interest in related areas.

Methods and techniques of measurement

- Continued expansion of support for R&D work both in the sub-areas of air pollution and of biological sampling, the latter being likely to increase in importance.

- Follow-up of the procedural programme dealing with R&D work in the area recently produced by the Fund's measurement steering group. The 29 activities detailed in this programme include supplementary investigations relating to R&D programmes for biological sampling, biological air pollution, biological testing systems, toxicological studies and methods of measuring free radicals.

- Special measures dealing with information training in the area by specific occupations.

- Continued and expanded international monitoring and reporting.

- Initiation of and participation in joint projects with other countries.

Technical/hygienic investigations and development work with a practical orientation

- Continued efforts to support the creation of project programmes with a greater practical orientation by carrying out evaluative/investigative studies for each specific industry. In these efforts, the role of the working environment committees of the involved parties have an important role to play in co-operation with industrial companies and the manufacturers/suppliers of machines and chemicals.

- The joint industrial research institutions and other, similar R&D bodies should be encouraged to give greater prominence to chemical working environment problems as part of their programmes. This is desirable, firstly, because these institutions possess technical knowhow as regards the relevant production methods and, secondly, because the institutions provide appropriate channels for disseminating findings in the most efficient manner.

- The allocation of special resources to the support of hazard elimination R&D on an inter-industrial basis should be considered. This should also be a means of promoting the exchange of knowledge between different industries and of concentrating efforts on the methodological study and assessment of the problems associated with elimination techniques.

- Individual inventors, companies etc. should be provided with more information regarding the opportunities of obtaining support from the Fund for practically-orientated research into chemical hazards in the working environment.

- Information and training should be broadened to include groups which have, until now, not been the primary targets. These include production engineers, designers, purchasers and suppliers/manufacturers.

The following points relate to activities planned for individual problem areas as specified in the introductory table. (Note that "Chemical problems, general" is not dealt with as a separate category, the relevant measures being incorporated in the points outlined above.)

Solvents and fuels

- Planned measures relating to epidemiological/toxicological research into the effects of solvents and fuels coincide mainly with the activities described when discussing the general need for this type of research.

- Greater efforts are needed to improve the monitoring and measurement of the concentrations of solvents and other volatile organic substances in workplace atmospheres, and to enable these substances and their metabolites to be measured in body fluids.

- Efforts must be made to replace toxic solvents with "Non-toxic" or less toxic types, as far as possible.

- Production methods and work routines must be adapted to minimise the spread of solvents as far as possible.

Lubricants and cutting fluids

- Major efforts to develop methods of hazard elimination may be expected in both the short and long terms.

- Support should be provided for medical/toxicological research based, however, on a well defined set of priorities.

- Measurement and analytical techniques on both laboratory and field scales require further development.

- Information activities will need to be greatly expanded in order to ensure the widespread dissemination and practical application of the experience gained.

- Thus, in overall terms, the level of financial support provided for both R&D and information activities in the area should be increased during the next three budget years.

Plastic and rubber materials

- The planning basis for initiative work must be improved especially in relation to requirements for more direct practical measures.

- o The problem area is many-faceted in many respects and various sub-investigations are, therefore, needed for the purpose of developing a planning basis.

- o The level of support for R&D activities in the area should be raised somewhat, primarily as regards the development of hazard elimination techniques.

Paints, varnishes and glues

- o Support for development work with an applications bias may be expected to continue at a high level.

- o A major need for both R&D and information as regards product painting in the engineering industry may be expected. Subsidiary problems which should receive special attention include:

  - The scope of support provided by the Fund for development work designed to improve production methods in the form of increased mechanisation/automation/robotisation (including methods which yield an improvement in the working environment as regards exposure to chemical substances)

  - Information problems

  - Further trials (if appropriate) for the development of protective sheeting for individuals or groups working in the industry.

- o Procedures for monitoring measures intended to be introduced in the paints and varnishes industry should be established. In this context, it may be appropriate to produce information material specific to the industry.

- o Efforts should be made to promote development work in the area of glues and glueing operations.

Pesticides

- o Research and development activities designed to produce occupationally safer methods of spraying should be developed. Information activities may also be necessary.

- o Special efforts should be devoted to wood impregnation.

- o Expanded research efforts in the area of disinfectants would be desirable.

Products of welding and cutting

- o Activities should be concentrated mainly on developing methods of hazard elimination.

- o Support should be given to R&D in the mechanisation and automation of welding, taking account of the effects on the work content.

- o Grants are expected to remain largely unaltered during the next few budget years.

Minerals and mineral products

- o Methods - both theoretical and practical - of studying the biological effects of mineral particles need to be developed.

- o Methods of early diagnosis of effects on the lungs following exposure to mineral particles need to be developed.

- o Continued support should be given for developing improved methods of determining dust contents in workplace atmospheres.

- o Development aimed at introducing methods of reducing the generation and spread of dust will continue. Support should be given to the development of ventilation methods.

Metals and metallic compounds

- o Support will continue to be given for research into the biological effects of metals. In this context, greater attention should be paid to metals which have, and which will continue to become more widely used in working life. These include aluminium, tungsten, cobalt, molybdenum, caesium, zirconium, titanium and vanadium.

- o Surveys of how and to what extent the above metals are used.

- o Continued support for the improvement and development of new methods for determining concentrations of toxic metals in workplace atmospheres.

- o The introduction of methods for reducing the generation and spread of metal-bearing dusts, including the ventilation aspects, should receive support.

Microorganisms

- o A general improvement in fundamental knowledge relating to the entire problem area is required.

- o R&D work devoted mainly to the development of methods of eliminating hazards in certain fields of activity should be carried out in parallel with the development of a programme planning basis. These fields of activity include the occurrence of microorganisms in working life, methods of measurement, sampling and analysis, and medical research in the fields of immunology, and long-term effects.

- An appreciable increase in the level of grants allocated to R&D work in the area should be achieved during the next few budget years.

Investigation of chemical environments by specific areas

- Further efforts are needed to develop knowhow relating to different industries.

- Additional toxicological/epidemiological investigations must be carried out.

- High priority is attached to R&D work in the development of hazard elimination techniques, particularly in relation to industries in which dangerous chemicals are handled in such manner that particular risks are involved.

Investigations of individual substances

- This problem area is no longer used as a main project category, which means that it will not be relevant from the budget viewpoint after a short transition period.

Miscellaneous chemical problem areas

- Since this category is of a miscellaneous nature, it is not possible to suggest concrete proposals. Projects included under this heading will probably be concerned with biological effects, handling procedures, environmental improvement measures etc.

PHYSICAL WORKING ENVIRONMENT PROBLEMS

		Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
30.	Physical problem areas, general	1,7	2,0	2,3	2,6	2,9
31.	Radiation	1,4	1,6	1,6	1,7	1,7
32.	Noise	8,4	8,5	11,0	9,5	10,0
33.	Vibrations	1,3	1,0	1,3	1,6	2,0
34.	Climate	0,5	0,9	1,1	1,3	1,4
35.	Lighting	0,3	0,9	0,9	1,0	1,0
39.	Physical problem areas, other	0	0	0,1	0,1	0,1
Total cost, SKr million		13,6	14,9	18,3	17,8	19,1
of which the following sums were approved and set aside as of 31 December 1980		13,6	14,2	3,7	0,6	0

The physical problems attracted attention at an early stage of the debate on the working environment and a certain amount of R&D was in progress at the time the Fund was established. Therefore, it was natural that the budget for this area should grow rapidly. This was true particularly of the noise problem which continuously accounted for more than half of the total R&D resources allocated to research into the physical problems.

Despite the wide-ranging research and development work carried out during the 1970s, several of the physical problems in question are still prominent. For example, questionnaire surveys conducted among employees indicate that noise is still regarded as a serious problem. Furthermore, vibration problems have probably become worse in recent times due to the ever-increasing use of more efficient vibrating tools, among other factors. Thus, technical developments have not always produced an improvement in the physical working environment but, in several cases, have produced the opposite effect.

The groups exposed to these problems are engaged mainly in heavy industry.

Within the field, the Fund is the principal Swedish provider of grants, although a certain amount of support is often contributed by funding agencies such as BFR and STU. In certain sub-areas, the

Fund contributes substantial support to medically-orientated research and is, therefore, a joint contributor with MFR.

The heading of Physical problem areas, general mainly covers projects devoted to specific industries or occupational groups within which studies are in progress or attempts are being made to solve several different working environment problems. Projects on which reports have recently been published include studies of the working environment in the car industry, in the fishing industry and in roadworks. A survey of the working environment in the piping industry is expected to be completed shortly. Major work in progress at the moment includes projects relating to the steel industry, the physical working environment in schools and the conditions of bus drivers. In the great majority of cases, the projects are being carried out with the assistance of a steering or reference group composed of the various parties involved.

In the problem area of Radiation, the predominant project (in terms of cost) in recent years has dealt with the study of possible genetic effects caused by high-frequency electromagnetic fields. The report on this project is expected to be published at the start of the next budget year. Reports have recently been issued on projects dealing with infra-red and laser radiation.

In the area of radiation, the Fund has, as yet, only given support for R&D into non-ionising radiation. However, there is probably a need for research into ionising radiation also, since this may be a hazard present in several different types of workplaces in industry and medical care.

In the problem area of Noise, financial support contributed by the Fund for medical-orientated research has grown to just over SKr 2 million annually. Research is concentrated on the effect of impulse noise, individual hazards and, to some extent, audio measurements and hearing protection. In Autumn 1980, the Fund financed a 3-day international symposium on the injurious effects of impulse noise on the hearing, with the aim of establishing the state of knowledge and identifying the research requirements in the field.

A working group appointed by the Fund to report on its planning of future efforts in noise research from the medical aspect has just concluded its work. There would appear to be a distinct need for further research in the area.

Special working groups composed of representatives of the labour market partnershave been active in several industries during the last ten years in promoting research and development designed to reduce noise problems. Most of these groups have been receiving support from the Fund for several years. However, a number of groups have now concluded their work or are winding down their activities, most of the funding at present being allocated to the food industry group. Noteworthy among the activities of this group are its efforts, in co-operation with the Food Board, the public health committees and the National Swedish Board of Urban Planning, to establish the specifications required of sound

insulation materials in the food industry. For a considerable time, there has been a conflict between the requirements of sound insulation and hygiene. However, the work now being carried out appears to offer the possibility of developing improved "hygienic" sound insulation.

Further research, under the auspices of bodies such as the working groups on noise, would appear to be needed in the textiles, mining and ore dressing, and food industries.

Simultaneously with the activities of the working groups on noise, the Fund has contributed increasing support to work aimed at developing methods of hazard elimination.

A questionnaire has been circulated among a couple of hundred companies to ascertain the possibilities of undertaking projects in co-operation with machine manufacturers and suppliers. This activity is expected to result in a number of development projects. In the case of many different types of machines and equipment, further efforts to develop technical methods of suppressing noise at source are probably still needed.

The problem area of Vibrations may conveniently be sub-divided into those affecting the entire body and those affecting part of the body only. The latter type consists mainly of vibrations transmitted by hand which can produce circulation disorders of the "white finger" type. Recently, these problems appear to have increased in several industries. In the area of vibrations, the Fund is providing support for projects concerned with both the medical and measurement technique aspects, and for technical development work. However, in none of these areas does the scope of activities match the need for research and development work. Therefore, a considerable expansion of activities is to be expected in this area.

In the problem area of Climate, the Fund has undertaken individual activities in the various sub-areas - heating, cooling, methods of measurement and cladding - which represent the appropriate sub-divisions of the area. Current projects include investigations into thermal radiation in laundries and in the steel industry. Several projects dealing with heating problems in drivers' cabs have been completed and a seminar for the parties involved has been arranged. With regard to cooling, a major Fund-sponsored project dealing with the medical aspects has been completed. A seminar for researchers was also organised early in 1981. A wide-ranging survey into working conditions in cold outdoor climates has been commenced and is expected to provide the basis for planning future activities.

There remains a need for further R&D in several different sub-areas as regards climatic problems. Particular priority should be given to activities with a practical orientation.

In the area of Lighting, the Fund has contributed support mainly for applications-orientated projects concerned with various specific types of workplaces. The emphasis has, naturally, been laid on the industrial environment in which the lighting problems are most acute. The locations studied include car service workshops, steel

works and freight terminals. In offices, increasing attention has been given, in recent years, to the lighting problems associated with VDU operation, and the Fund has also provided support for several projects in this area.

The great majority of problems associated with the lighting environment could be eliminated by the application of existing knowledge. For this reason, there is probably no general need for further R&D. However, it may be necessary to undertake individual measures in specific areas. Despite the comprehensive information activities as represented, for example, by the Fund's own informational materials (described in more detail under the heading of "Information activities of the Fund"), the existing knowhow regarding lighting is insufficiently used. Therefore, it would appear essential to devote further efforts to information and training, possibly among key groups such as planners, designers etc.

The need for further efforts obviously applies generally to the Fund's activities - and not merely in relation to physical problems of the working environment. However, in the latter case, particular emphasis might be placed on the need to concentrate on methods of eliminating hazards since there is a high level of knowhow about the problems, thereby making the area suitable for experimenting with different methods of achieving solutions. Examples of possible activities might include a greater degree of project co-operation with manufacturers, carrying out comparative measurements on machines and equipment available on the market, providing information and training for designers and product developers, supplying purchasers with information designed to develop their purchasing skills and so on.

In general, as regards the area as a whole, major importance should be attached to key problems of information and training.

Within one of these well-established problem areas, it would also be useful to carry out a detailed analysis of the factors (apart from economic) which inhibit the translation of available knowhow into practical methods of eliminating hazards in the individual workplaces.

The following are the main elements of the activities planned in the individual problem areas. As regards the relative priority between areas, noise and vibrations must be regarded as the most important, work continuing at the same high level in the case of the former and being increased from the present moderate level in the case of the latter. Lighting problems may probably be regarded as being of a lower priority than the other areas. As regards physical problems in general, a moderate increase in the level of activities is expected during the present planning period. The relatively high 1981/82 budget is attributable to the planned partial financing of a major industrial development project concerning noise.

Planned activities

Physical problem areas, general

- Surveys of the working environment and co-ordinated project programmes for industries, parts of industries or occupational groups at a somewhat expanded level.
- Assessment of industries previously surveyed and/or in which practical programmes have been carried out.

Radiation

- Activities at the same level as at present.
- In addition, it is possible that projects dealing with ionising radiation may be undertaken.
- A review of findings to date should be published.

Noise

- Noise research from the medical aspect at the same level as previously, the emphasis being shifted somewhat towards research of a more practical orientation. Important areas: Impulse noise, identification of groups at risk, early diagnosis, individual sensitivity.
- A review of findings to date in noise research from the medical viewpoint should be published, occupational health service personnel being the main target group.
- Limited activities in the area of ultrasound and infrasound.
- Continued support at a reduced level to noise study groups representative of the labour market partners, with the emphasis on the food industry.
- Increased support for projects designed to develop methods of eliminating hazards.
- Information to designers, product developers, manufacturers, suppliers, purchasers etc.

Vibrations

- Increased activities in the field, especially with regard to projects dealing with techniques of hazard elimination (including alternative methods) and widening of support to include other R&D institutions.
- Development of measurement techniques to enable comparative testing to be carried out and to meet type approval requirements.

- Inventories should be made of machine types and work situations, while epidemiological and medical investigations should be initiated.

- Easily-available information materials should be produced.

Climate

- Activities in this area to be increased somewhat, priority being given to projects with a practical orientation.

- Support for R&D relating to protective cladding and equipment for work in cold and hot conditions.

- Organisation of research seminars on working in hot conditions.

- Joint discussion with BFR on definition of areas of responsibility and co-operation.

Lighting

- Provision of information and training to key groups such as planning, administrative, maintenance, operations and design personnel.

- R&D activities within the framework of an unchanged budget in areas of priority such as heavy industrial work, outdoor work, mobile work and machine lighting.

WORKING POSTURE AND WORK LOAD

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
Cost, SKr million	5,3	5,5	6,5	8,0	9,5
of which the following sums were approved and set aside as of 31 December 1980	5,3	5,0	1,5	0,5	0

For a long time, heavy physical work was a major hardship suffered by many employees in working life. However, as mechanisation has become more widespread, the extent of heavy physical labour has become appreciably less although it is far from being eliminated. In the context of the working environment, other factors such as the chemical problems have dominated the debate. Now, however, the problems associated with overstressing the motor organs have attracted renewed interest in view of the fact that the incidence of sick leave and early retirement due to disorders of these organs remains high. At present, half of all notified occupational illnesses consist of physical stress disorders. The reason for this may be attributable to the fact that increasing numbers of workers are forced to work in fixed, rigid postures while carrying out monotonous, repetitive series of movements. In jobs of this type, the problems are usually confined to the neck and shoulder area. Similar problems, accommpanied by eye fatigue, can occur in visually-demanding tasks such as VDU, microscope and inspection work - tasks which are becoming increasingly common in working life.

The Fund's activities in the field have expanded rapidly in recent years. The original work which dealt mainly with the development of methods for measuring stresses and medically-orientated studies of the lumbar region have been supplemented increasingly by work of a more practical and technical character such as projects dealing with maintenance and handling operations.

In order to structure the area and provide a stimulus to further work, the Fund has appointed a planning group with a three-year mandate as from 1980. In its first year of activity, the group has initiated a survey of the state of knowledge and research requirements relating to occupational disorders of the neck and shoulders. The group commenced its work at the beginning of 1980 with a conference entitled "The physiological and medical effects of lifting and carrying work on the human body".

In the visio-ergonomic field, the Fund has allocated support to several projects including a number dealing with VDU terminal work. The reports on most of these have now been issued and it should now be possible to utilise the knowhow gained in the practical design of workplaces.

There is probably a need for further efforts in the field, both as regards activities with a medical as well as a technical/practical orientation, with greater priority being given to the latter aspect. The more detailed ordering of priorities as regards various potential measures is an important task of the above mentioned-planning group.

As the foregoing table shows, the budget for this area is being greatly expanded in view of the need for increased efforts and in expectation of initiatives to be taken by the planning group.

Planned activities

- o Medically-orientated research on an unaltered or somewhat reduced scale. Reallocation of priorities and concentration of activities.
- o Increase in activities with a practical orientation. The Fund's planning group will submit proposals as to priorities.
- o Provision of training and information to key groups such as designers, production engineers, occupational health service personnel etc.
- o A review of the Fund's activities to date in the visio-ergonomic field will be published, and support for R&D activities will continue on a somewhat reduced scale.

OCCUPATIONAL ACCIDENTS

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
45. Accidents, general	1,6	0,7	1,5	2,0	2,5
46. Technical measures	1.1	2.7	2.8	3.0	3.5
- Occupational accident group	1,3	1,8	2,1	2,3	2,3
Total cost, SKr million	4,0	5,2	6,4	7,3	8,3
of which the following sums were approved and set aside as of 31 December 1980	4,0	4,9	3,5	3,0	0

Occupational accidents are a major problem. Well over 100 000 occur annually in Sweden. An accident affects the individual severely - frequently at a relatively early age in comparison with many other problems encountered in working life. Occupational accidents are also extremely expensive from the national economic viewpoint.

The Fund supports accident-prevention research and development work with a diversity of objectives and approaches. This ranges from the investigation of accident situations throughout entire industries to technical measures designed, for example, to improve the safety of an individual operation or concerned with the design of special machines and tools. The recording and follow-up of accidents which have taken place, as well as "near misses" are dealt with under this heading. For obvious reasons, it is impossible to delineate the area exactly.

Several project activities associated with accident prevention work are dealt with under other headings. One such example is the heading of "Safety devices and personal safety equipment".

Projects in the problem area of Accidents, general include model and methods development, survey projects and hazard analyses. The area includes studies of accident sequences and projects designed to provide increased knowledge of hazardous working procedures, operations and entire production systems.

The area of Accidents, technical measures covers projects designed to develop more specific solutions to problems which adversely affect

safety in working life. By nature, these projects are devoted to solving problems or to methods of eliminating hazards. The area includes technical development work aimed at modifying machines, tools and working processes so as to improve safety, as well as the development of instruments and methods of measurement to warn against accidents.

A great deal of the support provided by the Fund for occupational accident research consists of the basic grant to the Occupational Accident Research Unit at the Royal Institute of Technology (KTH) in Stockholm. The principal aim of the group - which consists of five researchers - is to conduct interdisciplinary research with a practical orientation, and to submit proposals as to measures designed to reduce the number and severity of occupational accidents.

Since its inception, the Fund has assigned a high priority to accident research. Work to date has included a large number of projects dealing with forestry. However, R&D work has either been completed or is in progress in a large number of fields of activity. Several projects have been devoted to the mining industry and underground work, both as regards improving the basis for allocating priorities (statistical analyses) and the development of practical measures which, in some cases, have resulted in the production of prototype equipment. The fields of agriculture, transport and traffic safety have been the subjects of similar studies. Project work dealing with vehicular accidents and accidents due to falls has been undertaken to develop various means of preventing such accidents. Safety procedures and methods of hazard analysis for use in industry are being developed.

The Occupational Accident Research Unit concluded the first phase of its work during 1980 having completed studies of accident hazards and safety activities in five different industries. The reports also include proposals on modifications designed to improve safety. The areas to which the group devoted particular study were steelworks, wire rolling mills, mines, construction, railway operations and maintenance work. The group was also generally involved in activities on the national, Scandinavian and international levels.

Other bodies interested in R&D in the field of accidents include the Swedish Construction Industries Health Research Foundation, the Swedish Council for Building Research (BFR), the National Swedish Board for Technical Development (STU), the Swedish Transport Research Commission (TFK) and several others. The Fund has co-operated with bodies such as BFR in financing project activities relating to traffic safety. Work in this field is in progress at the National Swedish Board of Occupational Safety and Health and, to a certain extent, at the Swedish Centre for Working Life.

The availability of data and statistics which can provide guidelines to developing various types of corrective measures is an important prerequisite to tackling the problem of industrial accidents. The corrective measures referred to relate, for example, to the industries, groups, working operations, parts of the body, machines and tools affected. It is hoped that the Industrial Accident Information System (ISA) operated by ASS will,

in future, facilitate the introduction of such measures. In this context, close and continuous operation is needed between various customer and commissioning groups (of which the Fund is one) in order for the system to be designed in a manner which will guarantee the utilisation and dissemination of the large quantities of information on past accidents recorded by the ISA system. The system is of wide general interest as regards research and development work into industrial accidents since it contains information regarding every such accident which occurs in Sweden, including details regarding the particular working conditions and a description of the events preceding the accident.

An accident is the result of a series of events linked by many different co-ordinating factors. Therefore, it is essential that research and development work in the field of accident prevention is conducted on a wide interdisciplinary basis, R&D work already carried out indicates that an excellent insight is needed into the organisational structure and production methods of the company, how the safety function is organised and how the supervisory function is designed to carry out accident prevention activities in an effective manner.

We are aware that the work organisation is likely to be of major value, in terms of evidence, when an accident occurs. This applies particularly to the production control, information processing and supervisory functions. In addition, the rapid technical changes which occur in working life also entail new and unknown risks.

The effectiveness of the safety organisation and the occupational health service is of great importance in this context. Recent R&D work has demonstrated the need for including organisational studies when making a detailed examination of the responsibility for safety at different levels within companies.

In general, the feedback between accidents and measures designed to prevent or minimise the risks of recurrence is far too weak. Furthermore, far too many injuries are caused by accident hazards which have been known for a considerable time. Departures from applicable agreements and instructions occur frequently. Responsibilities need to be more clearly defined. In this connection, it is hoped that last year's reform of the penal code whereby a prosecution must be brought for contravention of the working environment legislation will also be a corrective factor.

The availability of efficient systems for carrying out the ongoing work of accident prevention in working life is of major importance to the creation of better feedback mechanisms between accidents and preventive measures. In future, the Occupational Accident Research Unit at KTH will be concentrating on activities such as the production of a manual of accident investigations, experimental work (including specific deviation reporting) and applied experiments in hazard analysis for planning construction sites. Greater attention must be drawn to the role played by planning, project and design personnel in relation to safety conditions in our workplaces and to their responsibilities in this regard.

Initiatives should also be taken, together with various bodies

representative of industry, to review the situation regarding accidents and safety, in similarity to what has been carried out in the forestry industry. Safety programmes of this type are also useful in relating associated problems of interest to concrete development work in the improvement of safety, tools, machinery etc. Such problems include the development of purchasing procedures, specifications of requirements, checklists, training and information. Greater attention must also be paid to maintaining liaison with the manufacturing, supply and purchasing functions within companies.

Continued efforts of various kinds must be made to deal with the serious accident problems in mining and underground work, blasting operations and electrical work. Greater attention must be paid to traffic safety, transport, vehicular accidents and falls, as well as to service and repair work. All of these activities are seriously over-represented in the accident statistics from 1979 on.

Easily available information should be produced summarising the work concluded in the forestry area, the measures undertaken in certain industries for reporting near misses and details of certain technical development projects.

Information and training are key concepts as regards this entire problem area. For example, how does one learn that a job is dangerous, given that the likelihood of a single individual meeting with an accident is so small? Creative efforts to develop new ideas are needed as well as more detailed pedagogic/psychological measures and information.

The recruitment of research personnel, the lack of continuity in activities and the associated problem of gathering knowledge in the area must be taken into account during the current planning period. In terms of the Fund's work, the area has a high priority, which, however, is not matched by the level of activity even when the work of the Occupational Accident Research Unit is included. Consideration should also be given to the establishment of Scandinavian and national research grants to develop the requisite project leadership and research skills.

Co-operation at national, Scandinavian and international level is important in view of the extent of the research field and of present requirements such as the development of methodologies. Among other factors, ways must be found of integrating the more practical type of development work with organisational and model study activities. Seminars, possibly including an international gathering as the follow-up to previous seminars, should be arranged as part of this effort.

There are many reasons why the Fund should appoint an assessment and programme group for the accident area as a whole. For example, a group of this type could evaluate the work of the Occupational Accident Research Unit, initiate activities - particularly co-ordinating programmes in close co-operation with the parties involved - and otherwise stimulate interest in accident prevention work. The advent of the ISA system and its utilisation should also provide a reason for

reviewing the conditions relating to future research and development concerning accidents at work.

Planned activities

Occupational accidents as a whole

- Establishment of an assessment and programme group for the area as a whole
- Increased liaison with industrial bodies and institutions for the purpose of initiating R&D, including the co-ordination of safety programmes
- Follow-up and evaluation studies relating to the feedback between accidents and preventive measures
- Initiation of commission assignments and development work in relation to the ISA system
- Holding of national and international seminars
- Production of easily-available summarised information including details of work carried out in the forestry industry, reporting of near misses and certain technical development projects which have been completed
- Increased level of contacts with company manufacturing, supply and purchasing functions.

Accidents, general

- Increased attention to the importance of technical modifications in reducing accident levels
- Organisational studies to be carried out to establish safety responsibilities at different levels in the company/organisation.

Accidents, technical measures

- Follow-up functional studies of equipment, machines, tools etc. which have been developed. Applications, flexibility etc.
- Increased level of contacts with design and project personnel.

Occupational Accident Research Unit

- Continuation of work in accordance with earlier guidelines. Planned activities include the publication of a manual containing details of accident investigations, experimental work including specific deviation reporting and trial procedures for hazard analysis in planning construction sites.

WORKPLACE AND MACHINE DESIGN, VENTILATION AND SAFETY EQUIPMENT

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
50. General work-place design	0,4	0,8	1,2	1,6	2,0
51. Premises	1,5	0,5	0,7	0,9	1,2
52. Layout	0	0,3	0,6	0,8	1,1
53. Design of working area	1,0	1,3	1,8	2,4	3,0
54. Machines	1,7	1,2	2,0	2,5	3,0
55. Tools, equip-ment	0,5	0,5	0,6	0,7	0,8
56. Ventilation	2,1	1,3	1,5	1,7	2,0
57. Safety devices, personal safety equipment	1,2	1,0	1,0	1,0	1,0
Total cost, SKr million	8,4	6,9	9,4	11,6	14,1
of which the following sums were approved and set aside as of 31 December 1980	7,4	6,2	1,5	0,1	0

The first six problem areas listed in the table above cover the physical configuration of the workplace from its overall design to the individual machines and equipment. These areas deal primarily with problems concerning two or more working environment factors. Similar problems which are concerned with just a single factor are dealt with under that specific heading.

As regards ventilation, the problem of general ventilation is dealt with in the context of the premises and workplace as a whole, whereas process ventilation is associated with the technical and mechanical equipment with which the workplace is provided. Safety devices comprise those installed separately in the workplace and those fitted to machines or equipment. Personal safety equipment is required when these safety devices are not considered to give sufficient protection.

The problem areas included under the main heading are extremely wide, and probably affect nearly every working individual in some way or another. Undoubtedly, they include all of the most serious problems of the industrial scene.

However, even though the areas listed include a range of problems concerning workplace design, it should be noted that discussion is confined to the physical conditions. Obviously, there are clear links with other aspects of the working environment such as scheduling, planning, communications between employees, work organisation etc.

Project activities in the areas under discussion are usually of a practical nature and relate to a large number of industries. They may be concerned with the carrying out of investigations and the drafting of proposals as a basis for planning and development, constructing reference installations for specific workplaces or developing prototype technical equipment.

Although many of the projects relate to the engineering industry, the overall pattern shows that support is spread across a large number of different industries. Only a few examples are quoted in the following discussion to show the breadth of the activity. Support from the Fund has enabled a research group to participate in the planning, acquisition and evaluation of catering facilities shared by the local authority and county council at Harnosand. Experience of and development potential for industrial and craft enterprises are being studied. Rustproofing plants, freight terminals and ore dressing plants are other areas of study. The workplaces of locomotive drivers, milking parlour attendants, welders and machinists have been investigated, as have the conditions prevailing in control rooms and at VDU terminals. The prototype of a new type of lifting device for fork lift trucks has been produced. In the area of ventilation, work has been carried out in paint factories, steel plants and on ships. Comprehensive efforts have been devoted to developing point extraction facilities in various working operations. Finance provided by the Fund has also been used to publish a ventilation project planning manual for the engineering industry. Lindholmen AB in Gothenburg have been assisted in carrying out a project devoted to the design and construction of a ventilation research facility. Finally, as regards personal safety equipment, support has been approved for several projects devoted to developing safety gloves for various applications.

The budget for the area as a whole has expanded steadily. However, the budget for 1980/81 is expected to be lower than the 1979/80 outturn. This is due mainly to the fact that activities under the heading of "Premises" have been cut back appreciably with the completion of a couple of major projects, and to a probable temporary lull in the area of "Machines".

Despite the numerous projects which have received ever-increasing support from the Fund, there remains a major need for further efforts in several of the problem areas. High priority should, obviously, be given to those areas in which efforts are being made to deal with the overall physical environment in an integrated manner. Admittedly, the picture is dominated, in many cases, by a single working environment factor. However, interaction between several factors e.g between noise and ventilation, working posture and safety devices, accidents and lighting etc. is much more usual. A wide range of competence is required on the part of the researchers

and project leaders assigned to carry out projects. Apart from experience of the working environment, a knowledge of design engineering and even an insight into the market situation of the final product are required. The scarcity of competent researchers and project leaders is one of the reasons for the present limited extent of the Fund's work in the area. However, suitable personnel should be available from the industrial research institutions, technological institutes, consultancy firms and other private companies. Another reason for the relatively slow pace of development in the area in relation to its needs may be a lack of knowledge as to the willingness of the Fund and the means available to it to provide support for work designed to develop methods of eliminating hazards.

A specific planning basis for granting support to R&D in workplace and machine design does not exist. Therefore, one of the important tasks undertaken during the planning period will be the establishment of contact with different industries to stimulate and initiate projects in the area.

A great deal of R&D work has been carried out in the area of ventilation, although the field has not been covered completely. Therefore, this should now be an appropriate time to review the results achieved, and to use this as a basis for formulating future research and development needs. A need for further knowhow development and applied research into both general and process ventilation can be foreseen. Areas of importance would appear to include the development of a project planning basis and specifications of requirements, and the establishment of procedures and methods of inspection and maintenance.

In the area of safety devices and personal safety equipment, there is a limited need for research in various sub-areas including methods of checking the operation of breathing equipment.

Planned activities

Workplace, machine and tool design

(Referring to designs based on consideration of two or more working environment factors. Where only one factor is involved, see the specific section where this is dealt with in detail.)

- Development of an improved planning basis by surveying industries, occupational groups, machines and types of tools.
- Increased level of contact with designers, product developers and manufacturers e.g. through industrial bodies or other associations. Information conferences on suitable subjects.
- Development of expertise in research and project leadership
- Distribution of information regarding the means available to the Fund for granting support to technical development work
- Increased efforts by the secretariat to initiate projects,

to disseminate information during the final phase of the project and to undertake other follow-up activities.

Ventilation

- o Co-ordinating discussions with BFR and STU
- o Production of project planning basis and specifications of requirements
- o Development of procedures and methods of inspecting and maintaining ventilation plants
- o Engagement of consultants to examine R&D requirements and propose measures to be adopted
- o Publication of a bulletin to disseminate results of projects of a practical orientation

Safety devices/personal safety equipment

- o Additional work on breathing equipment
- o Certain work on safety gloves and protective clothing.

PSYCHOSOCIAL WORKING ENVIRONMENT PROBLEMS, WORK ORGANISATION AND CO-DETERMINATION

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
60. Working life research, psychosocial problem areas, general	3,2	5,5	6,0	6,5	7,0
61. Work schedules	1,6	2,3	2,6	2,8	3,0
62. Working environment and absenteeism/ personnel turnover	0,9	1,1	1,4	1,6	1,8
63. Work organisation with emphasis on production techniques/ technical modifications	3,0	3,2	4,0	4,6	5,0
64. Work organisation	2,3	1,2	2,3	3,1	3,6
65. Planning and development processes	2,4	1,0	1,4	1,8	2,0
66. Co-determination/ exertion of influence	4,4	4,6	4,4	4,5	4,6
69. Working life research, psychosocial problem areas, other	0	0,1	0,6	1,0	1,5
Total cost, SKr million	17,8	19,0	22,7	25,9	28,5
of which the following sums were approved and set aside as of 31 December 1980	17.8	17.4	4.2	2.1	0.1

As the above breakdown shows, the area of psychological and social working environment problems, work organisation, co-determination and working life problems embraces an extremely wide research field.

Many people suffer from pressure and stress,monotony and boredom,and feel that their chances of influencing their work situation are small. For several reasons, it is essential that attention be paid to these problems. There is wide political agreement to the effect that work should be meaningful, and should provide the individual with motivation and job satisfaction.

The advent of the Co-determination Act has stimulated interest in and highlighted the need for research, development and experimental work designed to establish practical forms of democracy in our workplaces.

The area ranges from project activities such as psycho-physiological studies of human biorhythms, the different levels of sleep, gastric and intestinal ailments etc. to co-determination problems, worker representation in companies, the co-determination aspects of company financial planning etc.

The field of research involved here is extremely diversified. In many respects, the psychosocial problems are interrelated with those of co-determination and democracy. However, the areas of work organisation and co-determination are strongly associated with projects relating to machines, premises, tools and equipment etc. (see section dealing with "Workplace and machine design etc.")

The purpose of research in the psychosocial area is often to identify the hazards and problems of the working environment by analysing the individual's experience of it. In this context, the interaction between the individual and his working environment, as seen in the overall perspective, is extremely important. Psychological and social effects can occur, not only as the result of chemical and physical health hazards, but also as a consequence of organisational circumstances, wage forms, working hours etc. Thus, psychosocial conditions may be regarded both as an effect and a cause of various working environment problems. For this reason, many problems and projects of relevance to the psychosocial area are included in other sections of the programme. The orientation of the research measures is largely behavioural.

The various problems analysed in the context of the area as a whole may be concerned with the increased level of computerisation and automation which, although bringing advantages of many kinds to employees, have also created a range of problems. For example, although noise, aerosols, gases etc. can sometimes be reduced or eliminated by the introduction of new methods, other, fresh problems such as a less interesting job content, greater monotony and working assignments of a more isolated nature usually arise.

The solutions may lie in a more carefully considered work schedule, a more democratic work organisation and revised working times. In this area, the Fund has the task of furnishing the basis for activity of a more practical orientation.

Activities in the psychosocial area are wide-ranging both as regards the selection of industries and occupational groups, and with respect to definition of the problems and research methodology. For this reason, the board has decided to set up a special programme and planning group in the area as part of the long-term planning work. The group will contribute in the form of an evaluation of activities to date while devoting greater efforts to initiating continued R&D work, information and training activities etc. in the area. The group will also make proposals as to how the area should be structured in a manner compatible with its requirements.

In its work, the group will cover the entire psychosocial field from psycho-physiological and behavioural-toxicological matters to the more socio-psychological or sociological problems. The group consists of representatives of the principal organisations. Specialist knowledge relating to various scientific areas will be supplied by experts and consultants. The co-determination area and problems regarding the democratisation of working life will include, firstly, projects devoted to direct monitoring of the Co-determination Act and its effects and, secondly, problems of working life related to local union activities, analyses of management and control systems, company problems, the roles of parties and colleagues, the development of forms of co-operation, the problems of exerting influence in conjunction with structural changes etc. Project activities are being conducted from the sociological, organisational theory, psychological or direct legal viewpoints. The private sector is being analysed as well as the public and local sectors.

Although research into the democratisation of working life has been concerned mainly with the Co-determination Act and related agreements, an entire complex of legislation in the areas of the working environment and co-determination are obviously involved in principle. In this context, it is essential to form a picture of these different regulatory systems, their mutual relationships and the effects which they may entail. The relationship between the Companies Act and the Co-determination Act has attracted attention in recent years - something which also applies to the drawing of boundaries to political democracy in the public sector.

Support for research in this wide-ranging area is essential. It is also important that parties affected by the investigations - especially those at local level - be provided with feedback as to the findings. In Sweden, the Fund is the principal provider of finance for research and development in the areas of working life behavioural science and co-determination. However, substantial support is provided by other bodies and, therefore, the Fund has established close co-operation mainly with the Swedish Building Research Council (BFR), the Swedish Social Research Commission (DSF), the Bank of Sweden Jubilee Fund (RJ), the Swedish Humanistic and Social Science Research Council (HSFR) and the National Swedish Board of Research Councils (FRN) in discussing matters such as the joint financing of various R&D activities. Because of their nature, many projects have only fallen partly within the ambit of the Fund's activities. In several such cases, the projects have been financed jointly with one or more of the above bodies.

Several surveys have been carried out in recent years into special occupational groups and in relation to the sub-area of Working life research, psychosocial problem areas, general. This area embraces a wide spectrum of projects dealing with topics such as physical stresses caused by the pace of work, mental stress, monotony and alienation, as well as job satisfaction and deriving a sense of meaning from the job. Groups which have undergone investigations of this type include schoolgoers, office staffs, medical staff, journalists, divers, police and military personnel.

These occupational group investigations have proved to be of major value to the labour market organisations, for example, when planning and allocating priorities to working environment activities. Surveys of this type should continue to be carried out in future. However, as in the case of categories including journalists and bus drivers, the investigations should be succeeded by education, training and practical implementation.

In addition, special analyses have been carried out of the stress concept and of the more psycho-physiological problems associated with stress.

It may also be noted that further efforts are needed in the area of psychosomatic disturbances and the reactions of the body when subjected to the wear imposed by a high work rate, shift work, piecework and a poor working environment. It is important that the relationship between working environment and health be established and long-term R&D measures of a more fundamental character are also needed to this end.

Alcoholic and drug abuse problems are now a major social concern. Every year, alcohol causes the deaths of six thousand people either directly or indirectly. Even though the problem itself is outside the scope of the Fund's activities, it has obvious implications for working life. Alcohol abuse is probably related to factors such as conditions of work organisation, accidents and even absenteeism. For this reason, activities in this field may need to be undertaken during the next few years.

Some further problems should be noted in addition to the research areas listed above. These include solitary workers who are subject to particular pressures at work. Solitary work is carried out in a range of different occupations, those already studied with Fund support including locomotive drivers, hospital night staff and police.

Finally, there is a major need for theory and methods development in the behavioural science field, particularly as regards the production of practicable enquiry forms and batteries of tests as used in company health and welfare, and by industrial medicine clinics. A summary of the present state of the art should also be produced.

There is now a relatively good deal of knowledge concerning Working time schedules, particularly as regards the effects of the working schedule on an individual from the psychological-physiological viewpoint.

One of the central problems is to determine how sleep is affected, for example, by night and early morning working, and to identify the short-term and long-term medical symptoms whereby this is manifested.

One of the more important assignments carried out during this programme will be the experimental introduction of improved working schedules which will subsequently be monitored by researchers and reported on to other interested parties. The utilisation and transmission of the research findings and other experience gained during the seventies will be a primary task during the planning period. A conference on working hours will be organised in 1981 as the first step in this task. This will concentrate on methods of following up research which has been completed in the area.

It may also be advantageous to organise an international conference during the life of this programme as part of the work of stimulating contact between Swedish and international research in the field.

Despite the fact that research has already produced a series of conclusions, there remain important aspects of study in the area. For instance, two-shift working has not been subjected to detailed analysis. Neither have studies been carried out to ascertain whether unsocial hours other than shift work are associated with major problems which may have been overlooked, and whether the social effects have been adequately recognised. We do not have sufficient knowledge of the relationship between certain particular problems and irregular working. This applies particularly to accidents. Special efforts should be made to examine the question of overtime working and its influence on accident rates.

A number of major projects was carried out, as part of the last programme, in the area of Working environment and absenteeism/ personnel turnover. Some of these were devoted to statistical assessments of the relationship between absenteeism and various aspects of the working environment, while others were concerned with the more specific analysis of various special problems. Thus, one of the projects was concerned with women working in two jobs, while another turned the problem of absenteeism upside down and asked, instead, why people go to work every day. Happily, it is possible to discern a trend towards a more practical approach. There has been close co-operation between the Fund's steering group on absenteeism and the corresponding group specially established by the Swedish Employers' Confederation (SAF), the Swedish Confederation of Trade Unions (LO) and the Federation of Salaried Employees in Industries and Services in conjunction with the national wage negotiations three years ago.

As a follow-up to the practical initiatives taken by the latter group, the Fund will hold a conference on sick leave from work in November 1981. In preparation for this conference, two consultants have been engaged to gather information on the practical measures which can be taken by companies and administrations to dealt with the problem of absenteeism.

Research in the field has indicated that there is a clear statistical relationship between sick leave and working environment problems of

various kinds, although a causal relationship has not been established. In general, the level of sick leave absences is higher in workplaces where the physical or psychological environment is poorer than it is in locations with a good environment. Continued efforts are needed to clarify a range of subsidiary aspects. The proposals submitted by the Fund's absenteeism group (ASF Report No. 1978:1) still appear to be partially valid. These are concerned with the relationship between short-term and long-term absenteeism, elimination in labour market competition, absenteeism in relation to technical changes, the importance to the employee of means of exerting influence etc. It is also important to emphasise the need for research activities of a practical nature where e.g. the work organisation is altered.

Finally, it may be taken that concepts which may influence the direction of research in the area will be presented at the above-mentioned conference.

Research dealing with Work organisation with emphasis on production techniques/technical modifications expanded rapidly during the course of the last programme. The Fund is sponsoring several major projects in the computer field and has also held a notable conference on the subject. A conference report entitled Datorer och arbete (Computers and work)is published in Swedish.A long series of public enquiries is under way and the Fund has striven to maintain close contact with these.In some cases,this has also resulted in joint projects.

However, research has still only thrown brief glimpses of light on several important topics and further R&D work in the area remains a major need. The main topics in question include problems associated with automation in industry,such as those resulting from the introduction of industrial robots and numerical control machines. Neither, in view of the rapid expansion which is likely to occur during the next decade, has the subject of office rationalisation been investigated in a sufficiently detailed manner. In terms of research, the effects of computerisation on work organisation and job content have barely been touched on. Furthermore, research in the area should be concentrated to a greater degree than at present on the translation of theory into practical experimental and development measures. Contact should be maintained with the pace-setting industries which are far ahead of the field in modern production technology.

Despite the major gaps in knowledge which still remain in the field of work organisation, considerable experience has already been gathered in Sweden but, perhaps above all, abroad. For this reason, efforts should be made to prepare reports based on this body of accummulated experience and dealing with topics such as how the ideal computer terminal should be designed, how a control room should be laid out, how a robot work station should be arranged etc.

In dealing with the question of employee influence in technical changes, it is important that cognisance be taken of the timing aspect or, in other words, that the employees are consulted at a sufficiently early stage of the process.

In this area, probably more than in other area of research, R&D activities should preferably be of an interdisciplinary character. The technical, ergonomic and behavioural aspects of the environment must be considered together,particularly in cases in which it is a matter of developing and testing proposed new work organisations in experimental form.

The need for theoretical research of a more long-term nature is great in this area, just as in the psychosocial area and in the area of co-determination as a whole. Research has now arrived at a number of findings by means of case studies and similar methods, and it should be possible to integrate these in research models etc. capable of advancing developments.

Several projects dealing with the analysis of work organisation problems, such as those which result from group work, have been assigned to the medical care sector, even though there have been similar projects associated with the car industry, the sawmill industry, the hotel and restaurant industry and others. Apart from a few projects in the medical care sector, research has left the problems of working in groups (including the self-regulating type) relatively untouched. This would seem to be remarkable given the considerable interest aroused by these problems during the sixties and seventies.

Both the employer and employee organisations have emphasised the importance of establishing satisfactory procedures for work organised in groups. The Fund should seek to initiate this type of activity during the coming period.

There is also a need for R&D which will clarify aspects of work such as the relativity of responsibilities, the demands of alertness and concentration, the duration and scheduling of rests and meal breaks, work leadership, solitary working, wage and salary problems, and the influence exercised generally by employees over their own work situation.

The area of Planning and development operations includes projects dealing with the actual process of building and renovating working premises, and with changes to the working environment in general. Examples include a project on dairies, and studies of the planning and development functions in large and small engineering companies.

Several ongoing or completed projects deal directly with the construction industry. For example, working environment manuals have been prepared for project engineers and building consultants.

Projects related to planning and development operations have also been undertaken in the medical care, hotel and restaurant, and manufacturing industry sectors.

The development of shopping centres and office buildings/craft centres represents a special problem of particular interest which have been highlighted by a number of projects. In this case, the important aspect is not the relationship between employer and employee but that between the two groups concerned, on the one hand,

and the building contractor on the other. R&D activities in the area are concerned mainly with the means whereby those working in these locations are given a voice in the actual planning and development process. The problem is related to that discussed under "Local safety activities/company health and welfare" and also to the discussion in the section on the Co-determination Act. The Fund has appointed a special working group to study the role and modus operandi of the safety function. The group is expected to suggest ideas and propose essential projects which will probably be mainly of a practical, experimental nature and related directly to the problem described above. The group appointed to deal with the psychosocial area as a whole is also likely to become involved in this aspect.

Mention should be made of some areas in which research is needed, apart from the activity basis which the two above-mentioned groups may propose. For instance, there is insufficient information on the influence and information aspect of planning procedures. As mentioned earlier, the planning process is of particular importance in the context of new technology. In addition, company long-term planning and budgetary activities represent a further important area for R&D.

Furthermore, it is important that a complete project programme be selected for study, preferably one which can be carried out under ideal conditions. Regional safety officers, chief safety officers, supervisors, safety engineers and other groups require the best aids possible for carrying out their work. Thus, it is essential that the experience and observations of the Fund and other bodies be incorporated in working environment manuals and factual summaries of various kinds.

The Fund should also take the initiative in disseminating the information directed specifically to important groups such as manufacturers, developers, architects, contractors etc.

The problems of co-determination and influence represent an extremely wide field of activities. Interest in the area should naturally be viewed against the background of the co-determination reform, the Fund's broadened terms of reference and the inception of the Centre for Working Life (ALC). In 1976, as part of its altered terms of reference, the Fund was given the responsibility of carrying out a programme in the area. Since then, several major projects have been initiated and are in progress. This work centres on the performance of evaluations and local monitoring to ascertain how the Co-determination Act is functioning under working conditions. The Fund has financed studies of co-determination in the private sector, and in government and local bodies, both large and small enterprises or administrations being investigated in all cases. Two major conferences have been organised and active work is being carried out continuously in co-operation with ALC in the co-ordination of project activities.

Certain attempts were also made to monitor how the various research projects worked in terms of co-operation with local union organisations, employers, reference groups etc. It is hoped that this will contribute experience which will be useful to future research.

Problems currently being examined include that of how a project should be initiated, monitored and evaluated. Another important question is how information should be disseminated if the activity is to fulfil the specified objectives.

Assessements and analyses of the entire judicio-industrial complex i.e. including legislation and regulations other than the Co-determination Act also fall within the scope of this area.

The basis available for continued work in the area of co-determination include the report on the Fund's programme (Co-determination and working life, ASF Report No. 1978:2), the published programmes of the parties, the requirements identified by government commissions and the judgments of the researchers themselves as to what should be the subject of further analysis. With regard to the latter, it may be noted that the Fund, in Autumn 1980, assembled and summarised the researchers' proposals as to the areas which should be given priority during the next few years. This document has been circulated among the principal organisations with the intention of stimulating discussion within them.

At present, research in co-determination is concentrated on investigative case studies undertaken in companies and administrative bodies. The emphasis should be shifted gradually towards other R&D activities of an urgent nature, such as research dealing with control systems, development of the working role, management problems, and board, representative body and personnel administration. However, surveys should continue to be carried out into national and local co-determination agreements already signed.

Investigations of a legal nature are among those required to establish the relationship between various industrial laws and ordinances and, for example, to determine the interaction between the Co-determination and Companies Acts. Relationships with other groups of laws such as the Employee Representation Act, the Employment Security Act and the Promotion Act are also of special interest. The functioning of the relationships vis a vis the system of political democracy, at both national and local levels, is also an important aspect. The mechanism of interaction between labour and co-determination legislation, for example in relation to the introduction of new technology or long-term company planning, is another aspect which requires investigation.

During the period, the new working rights committee was continually provided with information on the Fund's co-determination project. The ASF report on co-determination (ASF Report No. 1978:2) assigned priority to a main area which now appears to be of even greater interest. The area was referred to as working life in the political, economic and legal structure. Co-determination was treated in a wider context than ever before.

Co-determination in relation to cutbacks in operation and closures affects the Fund's activities in two ways - as an important co-determination problem and also as a psychological and social stress imposed on the particular employees in their working lives.

In the area of co-determination, the first wave of projects is now

in the course of completion. Therefore, it is also essential that the information be utilised and disseminated in the best possible manner. Experience gained from R&D to date also indicates the necessity of stimulating theoretical analysis.

It is also important that future R&D activities be based on the results which are now available. Therefore, various types of discussions between interested parties and researchers regarding the orientation of the research work are planned for 1981/82.

Planned activities

The area as a whole

- Practical testing and experimental work. Knowledge which can be translated into practical applications is now available in several sub-areas. This is a matter of identifying and evaluating solutions of a work organisational or other character which may serve as the prototypes for other solutions, and of designing reference workplaces in order to develop complete or partial solutions.

- Long-term, theoretical work of a scientific nature for the purpose of assembling practical experience from case studies and individual projects into cohesive entities, partly to summarise the research activities and partly to create a basis for future efforts.

- Continued support for studies dealing with work load and health, an important element being psycho-physiological into the relationship between psychological and physical health.

- Analyses of the psychological and social consequences of physical and chemical working environment factors. Among other considerations, greater attention should be paid to the behavioural aspects as part of the development of elimination techniques in the physical and chemical areas.

- Better use than at present should be made of foreign experience, for example through the agency of the Fund's scholarship and guest researcher programme.

- Behavioural science methods development.

- Follow-up and initiatives relating to the work of the programme and planning group dealing with psychosocial problems in working life.

Working life research, psychosocial problem areas, general

- Continued studies into the occurrence and treatment of stress, together with additional research of a psycho-physiological character.

- Continued studies of individual occupational groups and

branches of industry, including the follow-up, from the practical aspect, of surveys already completed.

- Studies relating to organisation, communications and decision -making processes in the area of medical care. Special research into long-term care and experimental activities in the sector. Corresponding activities in industry.

- Studies and information dissemination relating to solitary work.

- Equality in working life.

- Alcohol problems directly associated with working life.

- Initiatives by the newly-established programme and planning group for psychosocial problems in working life.

Work schedules

- Two-shift and rota work, irregular forms of working other than shiftwork, and problems associated with overtime working should receive priority.

- Relationships between work schedules (especially overtime) and accident hazards.

- Continued study of biorhythmic adaptation to different types of irregular working. Theoretical work designed to integrate Swedish and international research findings into usable research models.

- The association between work scheduling and technical developments. Special problems: automation, elimination of night shift, employment effects and insecurity.

- Support for experimental activities and practical testing of "ideal" work schedules.

- Conference in 1981, possibly followed by international conference in Spring 1983.

- Activities of a practical orientation.

Working environment and absenteeism/personnel turnover

- Relationships between absenteeism/personnel turnover and elimination in labour market competition.

- Relationships between absenteeism and technical changes, employee influence, and on-the-job introduction and training.

- Effects of altered work organisation on sick leave.

Work organisation with emphasis on production techniques/technical modifications

- Close co-operation with government commissions currently in session with regard to priorities and the need for research in the data processing field.
- Projects dealing with highly technical workplaces in industry and administration (office working environments). Strategies for dealing with the use of alternative technologies.
- Computerisation and solitary work.
- Theoretical development.

Work organisation

- Continued studies of various types of work organisation problems such as experiments in group working.
- Work organisation factors such as illness promoters, and the clarification of psychosomatic and psycho-physiological changes.
- Further activities relating to the requirements of altertness and concentration at work, responsibility relationships, breaks, work leadership, means of contact at work, control of the pace of work and specialisation in working life.
- Management roles at different levels.
- Problems of mobile workplaces.
- Increased support for practical experimental activities with the emphasis on overall rather than partial solutions. Long-term analytical work based on experience gained.
- Utilisation of foreign experience.

Planning and development operations

- Studies dealing with the exertion of influence and the information process.
- Criteria of a good planning basis for modifying the working environment.
- Special planning problems related to the introduction of new methods and studies dealing with the overall development process.
- Production of aids such as manuals, checklists etc.
- Further information activities relating to successful planning and development operations.

- Initiatives and proposals by the newly-appointed groups studying the role and method of operation of the safety function, and the psychosocial problems of working life.

Problems of co-determination/influence

- Some re-orientation of research into co-determination from investigative case studies to aspects such as the study of local co-determination agreements, analyses of a more specialised nature and practical experimental activities.
- Support for investigations into the interaction between the various labour laws and ordinances, including the Working Environment Act, the Employee Representation Act, the Promotion Act, the Employment Security Act and others.
- Studies of the problems of exerting influence and psycho-social effects associated with redundancies and structural changes.
- Support for scientific analytical work regarding the development of industrial democracy, based on the experience which has been gained.
- Dissemination of information.

LOCAL SAFETY ACTIVITIES. COMPANY HEALTH AND WELFARE

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
Cost, SKr million	2,8	2,5	2,2	2,6	3,0
of which the following sums were approved and set aside as of 31 December 1980	2,8	2,4	1,0	1,3	0,4

This area deals with projects concerned with analysing the pre-requisites for productive safety and working environment activities in companies and administrative bodies. This includes analyses of the functions of key safety personnel, including their dealings with the industrial inspectorate and others responsible for the working environment. The area also embraces projects carried out as part of the experimental activities financed by the Fund in the area of company health and welfare for small companies in co-operation with the county councils , and other projects dealing with the forms and approaches of company health and welfare activities. This area is one of main activity which has a relatively small budget. However, some extensive studies have been carried out, particularly in relation to the approach to company health and welfare. A number of projects have dealt with the effectiveness of safety activities in small and large companies, while another was devoted to analysis of the aids and procedures used in making safety rounds. The role of regional safety officers has also been studied, while a number of projects relating to the problems of accidents are also in progress.

The form and organisation of local safety activities vary considerably from sector to sector of working life, the area being one in which wide variations in efficiency and work form may be observed between different companies and branches of industry. General discussions constantly produce the complaint that the operation of local activities in the area of the working environment is poor and that many of the relevant problems are never solved due to deficiencies in the safety organisation.

The foregoing underlies the decision of the Fund to set up a working group representatives of the parties involved to examine the role and workings of the safety function. The main task of the group, as a planning and initiative body, will be to develop R&D projects of a practical orientation designed to serve as examples of how working environment problems can be dealt with at local level in various sectors of working life.

Since its formation in Autumn 1980, the group has discussed a wide range of project proposals and possible initiatives. These include the outline development of an attempt to develop procedures to assist small companies in their safety activities.

A hearing involving researchers in the field has been held as a background to the continued work. (Published in swedish in a report entitled "The role and workings of the safety function", ASF researcher hearing, 1980).

This area is related most closely to those of work organisation, planning and development. However, the problems affect most of the various projects financed by the Fund, especially those with a practical orientation.

In the area of company health and welfare, projects are being conducted in Stockholm, Gotnenburg and Bohus counties, and under the direction of the county council in Kopparberg.

The organisation of these projects and the experience gained to date are detailed in the two sub-reports which have been circulated to the current company health and welfare committee among other recipients. It has proved uniformly difficult to persuade companies to join the company health and welfare programmes available. The decision-making process within the county council organisation has also proved to be somewhat of an obstacle to project development in most of the councils where experimental activities are in progress or being planned.

A project in the form of a preliminary study was carried out under the direction of the Swedish Council for management and organizational behaviour to plan experimental work dealing with the organisation of the psychosocial function in company health and welfare. The concepts and experience which emerged from the project should be of value in developing similar research activities into various forms of psychosocial work in the field. In this context, the Fund's new programme and planning group for the psychosocial area is expected to produce interesting proposals.

Company health and welfare and industrial medicine information systems are being dealt with as part of a major project programme underway at the Orebro Occupational Medicine Clinic and Linkoping University. The programme deals with the collection, storage and processing of information relating to exposure and health. There is a considerable need for the development of a co-ordinated system of collecting information regarding environment and health for processing within individual health and welfare units. The development of methods and systems of computer-aided epidemiological occupational medicine is an extension of this. At present, there are major problems involved in the use of epidemiological studies to obtain a clear picture of the relevant exposure data. Measurement procedures must be developed to provide a proper means of estimating the incidence of chemical substances and other environmental hazards.

The Company Health and Welfare Commission, Linkoping University and the Swedish University of Agriculture at Garpenberg have all received support for similar activities. Since the work is related to a number of other efforts in the area which received financial support from the Fund at an earlier stage, a special

co-ordinating group has been set up within the framework of the project package.

The company health and welfare committee will continue its work during 1981 and 1982 ,and the Fund should devote careful study to the various priorities and requirements advanced in this context. Experimental activities involving various forms of psychosocial work are being carried out, with the assistance of the Fund, at several locations throughout the country. It is essential that these activities be documented and evaluated in some way. The Fund's support should be concentrated on projects which establish useful forms of psychosocial field work in companies and administrative bodies.

The working group on the role and workings of the safety function will submit a draft programme this year.In this connection, it should be noted tnat it has already been decided to propose research measures which emphasise the relationships between the company safety function on the one hand and the line organisation on the other.An awareness of the working environment and a sense of responsibility must be integrated into the line organisation in a suitable manner as determined by the group. This conclusion is also supported by several other Fund projects. Thus, its achievement is one of the basic premises used in planning R&D activities on the part of the working group.

The group will assign particular prominence to the problems of small companies. The problems are also greatly accentuated in cases in which there is no safety committee. This highlights the need for improving the working basis of the regional safety officer and also the conditions for operating company health and welfare on a regional basis.

The working group will attach particular importance to the study of successful examples of how to conduct safety and working environment activities. Investigations will be carried out in the private, primary municipal, county council and government sectors.

In summary, the level of R&D activities should increase, and ideas proposed by the ASF working group and the company health and welfare committee should form the basis of orientation of the Fund's project work in the areas of company health and welfare, and the working procedures and effectiveness of working environment activities.

Planned activities

- Continued co-ordination of projects relating to company health and welfare,and occupational medicine information systems.
- Support for practically-orientated projects devoted to analysing the relationships between working environment activities by both the safety function and the line organisation.
- Priority for studies dealing with working environment research in small companies.

- Analysis of the conditions required to improve the role of the regional safety officer and regional company health and welfare.

- Studies of "successful" examples of how to conduct safety and working environment activities.

- Support for various measures and initiatives aimed at taking account of the psychological and social aspects within the framework of the work of the safety and company health and welfare functions.

- Follow-up activities and initiatives associated with the work of the company health and welfare committee, and of the Fund's working group dealing with the role and workings of the safety function.

GRANTS FOR TRAINING AND INFORMATION ACTIVITIES

TRAINING

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
80. Production of training materials	8,1	17,5	11,0	12,0	12,0
81. Basic training, residential	10,3	10,7	15,0	25,0	25,0
82. Study circles	3,4	3,7	6,0	7,0	8,0
83. Further training, residential	8,5	10,5	17,5	17,5	20,5
84. Further training, study circles	1,8	2,5	2,0	3,0	3,0
85. Training of discussion leaders	4,4	3,0	8,3	8,3	8,3
89. Training, miscellaneous	1,6	2,0	4,5	5,0	5,0
Total cost, SKr million	38,1	49,9	64,3	77,8	81,8
of which the following sums were approved and set aside as of 31 December 1980	38,1	34,0	0	0	0

Background

Since the establishment of the Fund, training problems have represented a key aspect of its activities. The following was one of the statements made regarding training at the very outset in the original commission report and the Bill introduced to establish the Fund:

"In the opinion of the Commission, it should be possible to provide support for supplementary advanced training of various occupational groups in the company health and welfare area, and in the area of industrial safety in general. The Commission considers it especially important that particular attention be devoted to the training problems as they apply to safety officers - both as regards basic training and ongoing advanced training. This is probably an

area where there is room for substantial, capital-intensive measures."

On the other hand, it was stated that finance should not be made available for basic training involving various educational reforms or similar measures. Neither was it proposed to provide grants for the basic education of personnel such as doctors, safety engineers, ergonomists and industrial hygienists working in the company health and welfare field.

These statements formed the basis of the work subsequently delegated to the working group set up by the Fund in 1972. The task of this group was to examine the problems of training and information in the area of the working environment. In June 1973, the group submitted a report (1973:5) detailing the work proposed to be undertaken in the area. In summary, it was proposed that priority be given to the following:

- o basic training of all safety officers
- o preparation of training materials
- o training of instructors and discussion trades
- o experimental activities and assessment of new training methods
- o advanced training of other personnel in the company health and welfare field
- o review of the role of the safety officer to facilitate the revision of existing and the preparation of new training packages.

In 1974, the existing Industrial Safety Act was amended and regulations were introduced placing on employers and employees the joint responsibility for ensuring that safety officers received the requisite training.

It was assumed that the direct costs of training should be met from the Fund's finances.

As a result of the provisions of the Act, the principal organisations in the various areas met to conclude detailed agreements on the principles and scope of training.

The "Training committee for occupational safety matters" which was attached to ASS (then known as the National Board of Industrial Safety and health), was established at this time. The committee was set up to act as a consultative and co-operative body in training matters, and to propose recommendations to the board of the Fund regarding the granting of finance for training activities. All of the above formed the basis for a unique national effort in the field of training in the working environment - an effort which is probably without parallel in any other country.

To date, the Fund has contributed nearly SKr 0.25 billion to various training projects (up to the middle of 1981). One-third of the grants have gone to the basic training of safety officers and supervisors, and about one-fifth to further training of the same categories. Nearly 400 000 individuals have undergone some form of training during the period.

The implementation of such a comprehensive training programme required major efforts on the part of the labour market organisations, either jointly or individually, industrial bodies such as the Vocational Training and Working Environment Council of the Transport Trades (TYA) and the Construction Industries Health Committee, and of the training bodies. The latter, in particular, represented a major resource in carrying out training in study circles, and in training discussion leaders and circle leaders.

The Swedish Joint Industrial Safety Council (AN) was largely responsible for co-ordinating the production of training materials.

Nearly 400 000 copies of the course entitled "A better working environment" were printed, approximately 100 000 copies of a revised edition being published in 1980. This publication forms the basis of all basic training, appropriate modifications being made for various branches of industry. In addition, a series of advanced training materials dealing with noise, lighting, planning, chemical health hazards, ergonomics and local safety activities have been produced.

In several instances, such as in the construction and forestry industries, as well as in the state sector, the parties involved have themselves produced training materials.

The training materials produced to date have been designed mainly for safety officers and supervisors. To a lesser extent, support has also been given for more specialised courses or target group training.

It will soon be eight years since this major training effort was launched and the question must be asked whether the objectives set have been achieved or whether the approach has been correct.

The answers to these questions may be found, in part, in the assessment of "A better working environment" which was carried out under the direction of AN and the result of which were published in Autumn 1978. One of the facts which emerged was that approximately half of all safety officers had not yet received basic training at that time. This provided the stimulus for a working programme designed to revitalise training. This work has just commenced and will probably be of major importance to the training activities of the next few years. Somewhat different methods of organising training must be devised if the aim of providing newly-appointed safety officers with training within a reasonable time after their appointments is to be successfully achieved.

For this reason, it is conceivable that an investigation into training, similar to that described in ASF Report No. 1973:5,

may be undertaken. Now as then, there is a need to review and analyse existing and above all, future requirements in the area.

New training methods should be adopted on an experimental basis. The conditions applying to grants should be reviewed and modified to suit the practical circumstances.

By 1980, just over 30 000 safety officers and supervisors were being trained annually. However, in general terms, this number merely corresponds to the annual turnover of safety officers and a doubling in the level of training is the minimum required if the supply is to be exceed the demand! Added to this are the new groups which can affect the working environment by one means or another by their work. A further requirement is the demand for advanced training materials adapted for various branches of industry, in which the findings of completed research can be used to increase the level of knowledge.

In summary, there remains a substantial need for training materiel in the working environment area. Present trends also indicate the need for continued efforts in the field.

General description of the area

The fundamental conditions governing the principles whereby grants are allocated for training and information in the area are specified in the Fund's terms of reference.

The board of the Fund is obliged to issue more detailed regulations concerning grants. Therefore, in accordance with the recommendation of the training committee, standards dealing with the provision of support for basic, advanced and discussion leader training have been published, the current standards dating from 1 January 1981.

Training is specified as applying to safety officers, supervisors, technical planners and others involved in, and capable of influencing developments in the working environment.

Training involves long-term planning and no rapid changes have occurred during the past years. However, this may not be the case during the coming years. Efforts designed to revitalise training have commenced. This applies principally to the basic and further training of safety officers and supervisors. However, there is an increased need for training other groups including project, design and purchasing personnel who perform jobs in which the possibilities of influencing the working environment directly are enormous.

The training materials preparation project started in 1973 was largely completed during 1980. This work culminated largely in the production of the course entitled "A better working environment" - a basic course designed for use at work by as many groups as possible. The subject material produced by the Swedish Joint Industrial Safety Council also provides an excellent basis for further training.

It is also important to implant a knowledge of the problems of the

working environment at as early a stage as possible of secondary school and university courses. In this respect, the Fund should be able to provide support for a certain amount of development and materials projects.

Research findings can be made more easily available if the material is "translated" into training and informational material. Direct association with completed R&D projects is often desirable. The production of courses and materials for special groups or purposes will be initiated. During the coming period, problems relating to evaluation, new methods of training and statistics will also be examined.

The Fund's standards for allocating grants should be reviewed to prevent them from becoming inhibiting in nature to the development of the principles and implementation of training in the field.

A number of current projects deal with the problems associated with structural changes, alcohol and work, and methods development. In recent years, there has been a noticeable increase in interest in undertaking projects of this type.

Current and completed activities

The production of materials deals mainly with materials used in basic and further training. Apart from this, materials with a particular orientation are required for certain groups or purposes. Projects of this nature may include the development or production of manuals, audiovisual materials etc.

As described in the preceding section, the 1973 objectives have now been met by the current working group. (See also under "Background".) This applies both to basic and further training materials which are produced largely by AN. Apart from the latter, the Swedish Government Work Environment Council (SAN) and certain industries such as the construction and forestry industries have produced their own materials.

Just over SKr 70 million or about 30% of the finance provided for training has been set aside for the production of materials up to and including budget year 1980/81.

The efforts of the next few years will be largely devoted to the production of further editions of materials already published or with the revision of these materials to take cognisance of legal changes, revised agreements or new regulations. In addition, it should be an objective to incorporate, in the training, the research findings presented in various reports on the areas involved. Already, the tendency is towards an increased demand for materials which are more specific to various branches of industry, particularly as regards further training.

The question of formulating training and informational material so as to incorporate a feedback of knowledge to those in the job is often raised in the context of R&D project reporting. Forestry workers and public transport drivers are examples of jobs in which this has already been carried out. Greater provision should be

made for this type of project in coming years.

The production of training materials is a direct function of the extent to which training will be carried out during the next few years. It is expected that there will be an increase in the amounts budgeted earlier, partly because of the trend in costs and partly because of the wider scope of training which is expected.

Basic and further training are the forms on which there is formal agreement between the parties. This refers e.g. to basic training using the "A better working environment" study material and versions modified for various branches of industry, special materials specific to various industries and further training materials prepared by AN or the Swedish Government Work Environment Council.

Examination of the extent of training reveals that in the area of basic training, the numbers have fallen steadily since 1976 when grants were given for training 82 000 people. Between then and 1980, this figure was more than halved to just over 31 000. In the case of further training, the situation is, happily, the reverse. In 1976, nearly 13 000 people took part in various advanced training courses, while the 1980 figure was 23 000. However, both figures for 1980 are lower than the minimum levels estimated in earlier programmes. There has also been a shift towards increased participation in residential rather than external courses. In 1980, approx. one third of the training courses were residential as against one fifth in 1975-76.

The following tables show the numbers of individuals in respect of whom training grants were approved from 1974 to 1980 inclusive.

Basic training, "A better working environment" (including versions adapted for various branches of industry)

	Circles	Participation in circles,%	Residential/ external	Total
1974	-	-	850	850
75	51 300	80	12 200	63 500
76	66 100	80	15 700	81 800
77	34 500	73	12 400	46 900
78	25 400	69	11 400	36 800
79	20 000	60	13 000	33 000
80	19 500	62	11 900	31 400
	216 800		77 450	294 250

In addition, approx. 10 000 participated in the "Forest working environment" course.

Further training, AN course materials (including versions adapted for various branches of industry)

	Circles	Residential/ external	Total
1974	-	220	220
75	-	1 500	1 500
76	-	12 600[x]	12 600
77	2 300	9 500[x]	11 800
78	5 700	6 300	12 000
79	10 300	10 000	20 300
80	13 700[xx]	9 100	22 800
	32 000	49 220	81 220

x)
Incl. the functional training courses organised nationally by LO and the Swedish Central Organisation of Salaried Employees (TCO)

xx)
The course entitled "Work with meaning" (TCO/TBV) accounted for most of the increase in 1980. (TBV is the Salaried Employees' Educational Association.)

Various initiatives are required to increase the overall level of training in order to deal with the falling numbers, particularly in the area of basic training. Accordingly, preliminary work is under way in both the private and public sectors for the purpose of devising methods of achieving this end. The objective will require efforts by the various organisations on the national, regional and local levels with the support of the training and co-operative bodies in the various industries.

As part of this effort, the Swedish Foremens' and Supervisors' Association (SALF) has initiated wide-ranging information activities designed to encourage supervisors to participate to a greater extent in the courses on offer.

Apart from "standardised" training, the Fund provides support, on a lesser scale, for specialised training which is usually of a development or experimental nature. The courses or areas covered include occupational audiology, chemical health hazards in laboratory work, safe truck driving, epidemiology, psychosocial problems and the training of company health and welfare committees. In addition, further training is conducted by the union organisations in the form of functional training or the training of regional safety officers. The latter group, in turn, represents an important resource in terms of passing on knowledge in their workplaces.

The training committee is presently occupied with the development of proposed training programmes for groups such as planning, project and purchasing personnel, and is expected to publish its decisions shortly.

Analysis of the finance required during the next few years is dependent on several interrelated factors. The first - and most important - of these is to determine how many participants will be involved, while the second is to decide on the method of study to be used. Cost trends such as inflation and altered grant levels represents the third factor.

The training requirements for the coming period may be estimated on the basis of calculations and the experience of the last few years, as well as on assessment of the likely results of the activities now being commenced. It is assumed that the annual turnover of safety officers will be approx. 25% in addition to those who, although already occupying the post, have not previously received training. In the LO sector alone, 20 000 people per year are estimated to require training. The basic training requirement is assumed to be as follows:

	81/82	82/83	83/84
Safety officers	25 000	30 000	35 000
Supervisors	10 000	20 000	20 000
Others	10 000	10 000	10 000
	45 000	60 000	65 000
No. participating in study circles	30 000	35 000	40 000

This means that the level of training up to 1983/84 must be doubled in relation to the 1980 figures.

The further training requirement is estimated to be as follows:

	81/82	82/83	83/84
Functional training incl. regional safety officers	3 000	3 000	3 000
Training in specific subjects including courses adapted to various branches of industry	20 000	25 000	28 000
	23 000	28 000	31 000
No. participating in study circles	10 000	15 000	15 000

For the purposes of the financial estimates, it is assumed that approx. two-thirds of the basic training and about half of the further training is carried out in study circles.

Type of training	Cost per participant	81/82 Participants	81/82 SKr million	82/83 Participants	82/83 SKr million	83/84 Participants	83/84 SKr million
Basic training, study circles	200	30 000	6,0	35 000	7,0	40 000	8,0
Basic training, residential/ external	1 000	15 000	15,0	25 000	25,0	25 000	25,0
Further training, study circles	200	10 000	2,0	15 000	3,0	15 000	3,0
Further training, residential/ external	1 000	10 000	10,0	10 000	10,0	13 000	13,0
Functional training (5-day courses)	2 500	3 000	7,5	3 000	7,5	3 000	7,5
		68 000	40,5	88 000	52,5	96 000	56,5

The training of suitable discussion leaders is required to ensure the continuity and a high standard of training. This is necessary for the replacement of those no longer willing or able to lead study circles and also to ensure that new course materials are passed on according as they are produced. Discussion leader training is carried out by the training bodies in co-operation with parties representative of various branches of industry, and covers both basic and further training courses.

The availability of a sufficient number of discussion leaders is a prerequisite to conducting training in study circles. Since training is expensive, efforts must be made to utilise, as far as possible, those who have already undergone training - the quality of this training, however, being of equal importance.

Intensified training is needed to ensure that sufficient discussion leaders will be available to cope with the expansion expected to take place during the coming period. It is also considered that the course should be lengthened. Taken overall, the level of support required during the next few years will be greater than in the recent past. It must also be our aim to arrange for discussion leaders to lead several study groups to a greater extent than before.

On average, approximately 2 000 discussion leaders are expected to be required annually in the areas of basic and further training alike. It is estimated that basic training and further training will require five and three days respectively.

Example

Basic training	2 000/year	cost: SKr 2 500/ participant	Total: SKr 5,0 million
Further training	2 000/year	cost: SKr 1 650/ participant	Total: SKr 3,3 million

A number of projects of a specialist orientation (classified as other training) will probably be commenced in parallel with the "standardised" training projects. These will include projects dealing with special groups or concerned with activities of an experimental or development nature.

There is an increasing demand for research findings to be translated into training or information activities and several projects of this type are in progress. The Fund should also be in a position to support projects devoted to the introduction or development of courses at secondary school or university level.

The supplementary training of certain groups in the company health and welfare field is also an important task.

As a consequence of the stimulative measures described earlier which will require a greater than normal financial contribution, it may be necessary to experiment with various organisational methods of conducting training. Above all, it must be ensured that training is made available to participants from small workplaces without involving excessive travel.

A summary and evaluation of the Fund's efforts to date in the area is an important task which, together with an organised statistical review of all training activities, should be commenced as early as next year. Special finance has been set aside for this purpose.

In addition, the basic principles underlying the rules governing standardised training should be modified to accord with developments.

Planned activities

At present, the area of training accounts for approx. one third of the Fund's resources in the form of project grants. It is estimated that planned activities will account for approx. SKr 60-70 million annually. "Standardised" training - which is expected to increase in scope - will be accommpanied by projects with a more specialised orientation.

The increased work load will impose ever-greater demands on the resources of the Fund's secretariat and certain assignments will have to be contracted out e.g. to consultants to ensure that the quality of the work is satisfactory.

Production of materials

- o Additional printing of originally-produced course materials for basic and further training.
- o Adaptation of materials or production of additional materials for certain branches of industry.
- o Production of new materials for further training.
- o Development of new materials for special groups.
- o Development of materials for use in secondary schools or third-level colleges.
- o Production of new audiovisual materials.
- o Production of training materials based on research reports. These should be capable of use both as supplements to other training materials and for special activities. Forestry and public transport are examples of areas in which these activities have been initiated.

Training

- o Activities designed to increase the scope of basic and further training, especially for the safety officer and supervisor categories. The planning and implementation of the training will require overlapping efforts on the part of the various associations and branches of industry.
- o Increased support for the development of courses for important special groups such as company health and welfare, design and planning personnel.
- o Development of courses within certain special areas such as psychosocial problems and epidemiology.
- o The content, orientation and scope of discussion leader training will be reviewed. The organisation and training bodies must co-operate in determining the practical conditions. Regional and local activities must be initiated to co-ordinate training.

Other training

- o The Fund's training standards should be modified to suit the practical implementation and conditions of training. Therefore, an overall review of the standards must be carried out during the coming year.
- o Development of systems and methods for summarising statistics relating to training carried out.

- Experimental activities relating to co-ordinated regional training for participants from small workplaces or those in which new personnel have recently been elected.

- A review and analysis of the Fund's activities in the training area from 1972 to 1981 would be of interest and would be appropriate as the end of the Fund's first decade approaches.

INFORMATION

	Costs outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
90. Production of materials, information	0,9	1,8	2,0	2,5	2,5
91. Conferences/ campaigns	1,9	1,6	2,5	3,0	3,0
92. Information systems	0,3	1,1	0,5	0,5	0,5
93. Information grants to employee organisations	3,8	4,3	4,8	5,3	6,0
94. Publications	3,4	3,6	3,9	4,5	4,5
99. Information, miscellaneous	2,3	1,5	1,0	1,0	1,0
Total cost, SKr million	12,6	13,9	14,7	16,8	17,5
of which the following sums were approved and set aside as of 31 December 1980	12,6	12,4	0	0	0

General description of area

The Fund's contribution to the area is intended to consist mainly of a widely-based information service for major groups of personnel in working life. As a result, bodies such as the employee organisations receive an annual grant for general information activities, while the journal Arbetsmiljo (The Working Environment) receives a grant to enable it to be distributed free of charge to safety officers.

Similar grants are made for the production of materials, conferences and campaigns. Most of these are allocated for information regarding new developments in the field of legislation such as the Working Environment Act. Research projects frequently include information media as a natural element.

Information measures as a complement to training will assume greater importance in coming years. This year, a government commission (INRA) will submit proposals designed to increase the effectiveness and co-ordinate the dissemination of all information at present produced in various different quarters.

The direct verbal communication of information in the workplaces (referred to as "tracking down" activities) has proved to yield excellent results. This method has been adopted in a number of projects in the wood and concrete products industries.

In other respects, the target groups are the same as in the Fund's own information activities.

It is probable that there will be an increasing trend towards the production of informational materials such as films, videocassettes, etc. for use during conferences or short meetings. Conferences dealing with the same topics and held for the same purpose may be organised equally well by the Fund or by external agencies.

A high proportion of the information activities is, otherwise, carried out in direct conjunction with current or completed R&D projects. Intimate co-operation between the R&D and information units will be required.

The materials production area deals mainly with the preparation of brochures, manuals, visual materials etc. Films have been made dealing with eye injuries in modern industry, radiation hazards in the medical field, working procedures for welders and automation in the engineering industry.

To mark 1981 - the Year of the Handicapped - the rehabilitation organisations were given financial support for the publication of a manual of potential technical solutions to the problems of integrating the handicapped into working life, and for the production of a film strip dealing with the problems of the deaf or people with impaired hearing at work.

Several projects are concerned with the printing of reports - more or less completed - of conferences and other activities.

The conferences/campaigns area may be divided into two main categories, namely conferences/symposia and campaigns. The level of conference activities has been largely unchanged in recent years.

Several of the conferences were organised on the initiative of the Fund or in consultation with other applicants.

Some of the symposia were of an international character.

Subjects dealt with included allergies, impulse noise, computer and VDU work, work in cold conditions, the working environment in the medical care sector and in the paint industry.

Campaigns usually consist of several elements including conferences, preparation of materials and various other workplace activities.

A "tracking down" exercise is currently being carried out in the wood industry in which engineers responsible for the working environment and regional safety officers are communicating knowledge gained from earlier surveys or via R&D findings in the course of visits to companies. Since this activity has been well received and appears to be yielding excellent results, further measures of this type are a likely development.

The frequency of short conferences or information sessions will probably increase as a complement to training which usually takes 20 to 40 hours. The purpose of these will be to publicise new developments regarding legislation, agreements and research findings.

The exact consequences of the provisions of the Working Environment Act and their relevance to the educational sector are still unknown. In 1980, the National Board of Education produced a report containing the proposal that the Fund should provide additional support for the training of pupils. A final decision on this matter is expected from the government in 1981.

At present, more comprehensive joint efforts of the type which characterised the information on the Working Environment Act are not envisaged.

In the information systems area, annual grants have been made towards the basic costs of the information systems operated by the Swedish Council for management and organizational behaviour. This has now been discontinued with the transfer of the activity to the Centre for Working Life.

Lund University has received a grant for a project on graphical information processing, while the Karolinska Institute has been granted support for an information project dealing with chemical teratogens/reproduction toxicology. The Fund is also supporting a number of projects devoted to the co-ordination of information processing in the company health and welfare field. These are classified under the R&D sections.

Although it is difficult to evaluate developments in the area, a certain amount of finance should be allocated.

In the grants to employee organisations area, LO, TCO and SACO/SR* have received an annual grant for general information activities in the working environment area since 1975, the amounts being based on the number of members in each organisation and member association. The sum of SKr 4,3 million was granted for 1980/81. The amounts have been increased somewhat by stages.

At present no change in the conditions governing this grant are envisaged and the amount is expected to remain at the present level during the planning period.

* Swedish Confederation of Professional Associations/

In the area of publications, the Occupational Safety Association receives an annual grant for distributing the journal Arbetsmiljo (The Working Environment) free of charge to safety officers. This contribution, which completely dominates the area, has increased in step with production costs and postal charges.

Discussions have taken place as to how the Fund might use Arbetsmiljo to disseminate information on its activities, publicise research findings etc.

Another publication - Arbetarskydd (Occupational Safety) - which is published by ASS, has recently increased its circulation considerably. This publication deals with new developments regarding research, directives and regulations for which the National Board is primarily responsible.

The question of co-ordination between Arbetarskydd and Arbetsmiljo as regards the dissemination of information to categories such as safety officers was discussed by the board of the Fund when dealing originally with the provision of a grant to the latter. During the coming period, it may be appropriate to initiate a discussion regarding the principles of support for publications by the Fund.

In recent years, the journal Lag och Avtal (Laws and Agreements) received a development grant to assist the launching of the publication which provides a summary of information on legislation and judicial decisions affecting the labour market.

Only a modest increase is expected to be granted to meet increased costs during the period.

Information, miscellaneous was originally part of a common area which also included miscellaneous training activities. The area is now divided, in addition to which travel allowances and scholarships are included under the heading of "International activities".

Examples of projects which have been retained in the area include the introduction of reporting of "near misses" in forestry, the evaluation of information campaigns, fire defence in department stores and a project dealing with comradeship as a supportive element in tackling alcohol problems. The latter project is being conducted by LO in co-operation with the Verdandi Society (the Workers' Temperance Society) in Varmland.

The area is a difficult one to assess as regards the coming period. It is proposed that approx. SKr 1 million be allocated annually subject to the availability of a better assessment in the future.

Planned activities

Production of materials

- o Increased production of informational materials of the type prepared specifically for various branches of industry and intended for use in "tracking down" activities.

- o Increased production of films, videocassettes and brochures.
- o Re-processing of R&D reports into informational material.

Conferences/campaigns

- o Initiation of measures such as the "tracking down" type of activity directed to particular branches of industry or problem areas.
- o Scientific symposia or conferences with or without international participation.
- o Conferences for employers and employees to complement training activities in general.
- o Conferences dealing with the provisions of the Working Environment Act especially for teachers and pupils.

Information systems

- o Although no new projects are planned, certain development projects may be carried out in the area.

Information grants to employee organisations

- o Continuation of grants to the employee organisations in accordance with existing conditions.

Publications

- o As before, although some further individual projects may be carried out.
- o Discussion of principles of support for publications.

INTERNATIONAL ACTIVITIES

FELLOWSHIPS AND VISITING RESEARCHERS (75)
TRAVEL, EDUCATIONAL VISITS (76)
MONITORING OF WORKING ENVIRONMENT ACTIVITIES ABROAD

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
75	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	0,4	2,5	3,5	4,0	4,5
of which the following sums were approved and set aside as of 31 December 1980	0,3	1,1	0,4	0	0
76					
Cost, SKr million	0,05	0,07	0,15	0,3	0,4
of which the following sums were approved and set aside as of 31 December 1980	0,05	0,03	0	0	0
Monitoring activities					
Cost, SKr million	0,3	1,0	1,2	1,3	1,5
of which the following sums were approved and set aside as of 31 December 1980	0,3	1,0	0	0	0

General

Not only in Sweden have developments in the area of the working environment proceeded rapidly during the last decade - there has been a considerable increase in activities dealing with the various problems in many other countries and on the part of several international organisations.

For several reasons, it is important that Sweden should participate in and monitor these international developments.

Working environment conditions imposed by international organisations or individual countries may have appreciable commercial implications. For example, they may have an influence on free trade agreements such as the GATT accord and Sweden's free trade agreement with the EEC. Therefore, the co-ordination and standardisation of these conditions is of major importance in forestalling problems such as the erection of technical trade barriers.

An area in which international exchange is assuming ever greater

importance concerns co-operation in surveying hazards e.g. those associated with chemical substances or products. The reason for this is that the related working environment problems have become so complex and varied that it is difficult, if not impossible, for a small country to keep abreast of developments in all areas.
A further aspect is the fact that impartial hazard evaluations from abroad may be useful to have, for example in "alert" situations.
An example of current co-operation is the World Health Organisation (WHO) programme dealing with chemical safety and the drafting of standard documentation for purposes including the establishment of hygienic limits. Another example is the international Health Hazard Alert System devised by the International Labour Organisation (ILO). This system is designed to alert its users to the potential hazards associated with specific substances and to stimulate research into such substances. The creation of international data bases in areas such as literature research is a further expression of the increased complexity of environmental problems and the need for international exchange. There is also reason to assume that Sweden will need to increase its monitoring of international developments in production engineering and their effects on the working environment.

As regards the drafting of regulations, the division of the work on an international basis offers major advantages in that the "spade-work" may be carried out by one country and then adapted by others in framing national legislation. The advantages inherent in this arrangement are of both an economic and time-saving nature. This type of co-operation has already been undertaken under the aegis of the working environment committee of the Nordic Council of Ministers. Among other activities, a group of Nordic experts is engaged in developing the basic documentation for establishing hygienic limits.

Swedish participation in international work takes a number of different forms. Apart from participation in the work of various international bodies such as the ILO, WHO and the Council of Europe, agreements already exist or are being drawn up with countries including the U.S.A., Poland and Hungary as well as the EEC.
In addition, many institutions and individual researchers maintain contacts with equivalent institutions and other bodies in various countries - a type of co-operation which frequently and rapidly produces concrete results.

The Fund's participation in international working environment activities must be confined primarily to R&D exchange. Although the level of involvement has increased successively, it must still be regarded as relatively modest. This applies equally to activities which have merely been initiated by the Fund and to those carried out entirely by it. However, the demand for international exchange may be expected to increase according as expertise in various research fields is developed and expanded.

Similarly, the lack of Swedish expertise in certain areas may necessitate the importation of research findings or concepts from other countries. Against this background, it is expected that there will be a continuation of the increased interest shown, particularly during the last budget year, in the Fund's fellowship and visiting researcher programmes and in its travel grants.

Earlier in this report, it was noted that the scope of Swedish working environment research in many areas is now such that stricter priorities must be allocated between individual areas of activity which are important in themselves and R&D projects. This consideration makes the monitoring of international developments even more important since it is essential to be familiar with what is being or has been done abroad in order to assign priorities to local activities. Comprehensive R&D programmes are under way in several other countries such as the U.S.A. and West Germany. Furthermore, the fact that it is impossible for a small country such as Sweden to cover all areas of R&D indicates the necessity of acquiring the expertise needed to keep abreast of international developments.

Thus, the involvement of the Fund in international exchange activities can be expected to increase steadily. At present, it is difficult to quantify this wider involvement in financial terms. To some extent, this is due to the expanded facilities for co-operation with the U.S.A. and the EEC which have resulted from the conclusion of the co-operative agreements. However, the ultimate importance of this to the Fund is difficult to evaluate. Nevertheless, the following discussion contains certain assessments of the efforts which the Fund will need to expend during this planning period in the area of international exchange.

Certain problems relating to the area were discussed earlier in the section entitled "Some viewpoints on strategies and forms".

Fellowships and visiting researcher activities/travel/educational visits

The Fund has been carrying out fellowship and visiting researcher activities on an ongoing basis for several years. Within the framework of this programme, the Fund is attempting to stimulate researchers/technical personnel (including those engaged in practical work) to undertake studies and research work at foreign institutions. Similarly, the Fund provides financial support for visiting research and lecturing activities carried out by personnel including leading foreign researchers at Swedish research institutions. A total of eleven new scholarships was granted during the 1980 calendar year, while four grants to visiting researchers were also approved.

To date, the facilities provided by the Fund for financing studies or research abroad have been publicised mainly by advertisements in the daily press and in certain professional journals. The great majority of the applications received have been motivated by interest on the part of individual researchers or engineers in acquiring foreign experience and training in their particular areas.

At the end of 1979, the Fund circulated a questionnaire to a large number of researchers and other specialists in the working environment in an attempt to estimate the level of interest in and the need for international exchange in the area. Most of the replies testified to the need and many concrete proposals for co-operation were made.

On the basis of investigations such as the foregoing, a number of

researchers were invited to attend meetings of the Fund fellowship committee to review the need for international co-operation in a number of (as yet) limited R&D areas. In certain cases, these researchers were subsequently requested to develop detailed proposals relating to this type of exchange - this being carried out following consultation with other researchers in similar or related fields. Areas which have been subjected, to date, to detailed examination of this nature include

- behavioural toxicology
- automation and conditions for production engineering development
- non-ionising radiation
- epidemiology

It is intended that these more detailed analyses will enable the Fund to take steps towards establishing a more systematic international research exchange programme. This is obviously related to the need for setting stricter priorities as regards support for R&D projects. These analyses should result not only in a higher level of interest on the part of the institutions involved, but should also provide the Fund with a basis for initiating foreign exchange activities more directly. For example, in certain cases, the Fund may provide financial support to enable "handpicked" fellowship candidates to study or carry out research abroad in order to build up expertise rapidly in a research field.

As earlier, it should be possible to provide support for study or research at institutions abroad, as well as for the work of visiting researchers at Swedish institutions. The level of grants should be increased somewhat during the period.

The "marketing" of scholarship and visiting researcher grants should be improved. A further means which should be tried of disseminating the findings of these activities would be for the Fund, in certain instances, to publish the reports and to include them in the summary series in the same way as R&D projects. Details of fellowship and visiting researcher grants should be included in the Fund's project catalogue.

Educational visits represent an area which is closely related to fellowship and visiting researcher activities. In this case, the Fund provides the finance for working visits e.g. to foreign research institutions within the framework of R&D projects financed by the Fund. In some cases, support is also provided for educational visits not directly associated with current projects. Travel associated with visits by foreign specialists for lectures, seminars etc. may also be financed from this source. The level of support should also be increased somewhat in this area. In some cases, it may be appropriate to make greater use of educational visits instead of providing fellowship grants over an extended period.

Monitoring of working environment activities abroad

Since 1977, the Fund has been financing the monitoring of working environment activities in the U.S.A. and Japan. As of 1 August 1980, the main responsibility for these activities in the U.S.A. was assumed by the Department of Labour. At the same time, the activities were expanded to include the EEC countries and working environment attaches were appointed in Washington and Brussels to monitor the U.S.A. and the EEC. This work is still being financed by the Fund and is being carried on as an experimental activity until budget year 1982/83 inclusive. Working environment monitoring activities in Japan are jointly financed by the Fund and the Royal Swedish Academy of Engineering Sciences. In this instance, the individual responsible is required to devote half his working time to working environment problems.

During the period, working environment monitoring activities are expected to continue at the same level as during the current budget year i.e. occupying two full-time employees and one on half-time. Price and wage increases have been allowed for in calculating the sums budgeted.

Measures to improve the utilisation of the working environment attaches (or their equivalent) were taken during the current budget year. These include the review of report distribution and the devotion of greater attention to the question of direct, special order reports etc. dealing with specific areas. It is also desirable that the attaches should provide detailed reports on certain problems to a greater extent than hitherto.

Insofar as the experimental activities involving the working environment attaches are due to end with the 1982/83 budget year, they should be evaluated during the current planning period. However, as indicated above, funds have also been set aside for the 1983/84 budget year.

Other international contacts

In addition to financing fellowship and visiting researcher activities, travel and monitoring of the working environment, the Fund is engaged in a range of other activities, both temporary and ongoing. As indicated earlier, the Fund organises or sponsors conferences, seminars etc. in which foreign researchers and experts participate. Some of the conferences and other sessions of this nature which have been organised or are planned are dealt with under the appropriate headings. However, one conference of a wide-ranging nature which was held in 1980 is worthy of particular mention. This was a Swedish -American conference dealing with chemical health hazards in the working environment, organised jointly by the Fund and the U.S. Occupational Safety and Health Administration (OSHA) and held in Washington from 4-7 March 1980. Sweden was represented by about forty researchers, representatives of the labour market partners, official agencies and the Department of Labour.

Support for conferences etc. involving foreign participation should be maintained. In this context, one of the questions to which

greater attention should be paid is the extent to which such conferences provide an effective means of influencing parties such as foreign manufacturers when working environment research findings indicate that their products should be modified.

Agreements on co-operation in working environment matters are expected to be concluded between Sweden and the U.S.A. and EEC respectively during the 1981 calendar year. The existing draft agreements specify a wide range of areas in which co-operation and information exchange is adjudged to be of value. These include R&D in the chemical, physical and behavioural science aspects of the working environment, as well as training and information matters. Activities undertaken within the framework of the agreements are expected to include meetings between various categories of technical experts. Information received privately from officials of both the American Department of Labor and the EEC Commission indicates that the draft agreements will probably be initialled shortly. Therefore, the resources required for the Fund's involvement in activities carried out under the agreements (such as the organisation or financing of conferences) should be estimated for the coming budget year.

Certain other measures relating to the establishment of international contacts should also be taken to expand the opportunities available to the Fund and its clients of monitoring developments in given areas. This applies, for example, to the establishment of more permanent contacts with certain foreign institutions involved in working environment/production technology/work organisation problems, the purpose being to gather general information and exchange research findings. A co-operative programme including regular meetings and other contacts has already been set up with the Fund's sister bodies in the other Nordic countries i.e. with the Danish Work Environment Fund, the Norwegian Department of Local Government and Labour and the Finnish Work Environment Fund.

In several instances, informational material prepared by the Fund or with its support has aroused international interest. This includes, for example, the Fund's information on noise which has been translated by OSHA in the U.S.A. and the "A better working environment" study circle course which has been translated into English, Spanish and Portugese by the International Federation of Metal Industries. ASF material has also been translated by the Finnish and Norwegian working environment agencies. Discussions are currently being held with various international bodies regarding the translation of other informational material published by the Fund.

The Fund's annual report has been translated into English, as has the programme report entitled "Solvents in the working environment". Translations of other materials such as programme and conference reports, the project catalogue and certain R&D reports may be required in future, since the Fund must be regarded as having a general responsibility for publicising Swedish working environment research both at home and abroad.

In addition, the Swedish Export Council has shown an interest in co-operating with the Fund (for example, during exhibitions) in publicising Swedish working environment techniques developed with

Fund support. The Fund has also received enquiries from certain commercial concerns with regard to activities of this nature, which are also receiving some attention from the working environment attaches. In 1980, for example, the American attache organised a conference dealing with American safety requirements as they affect Swedish equipment, in co-operation with the Swedish Export Council.

Planned activities

Fellowship and visiting researcher activities/travel/educational visits

- A more systematic review of the need for international research exchange in certain areas.
- Increase in fellowship and visiting research grants.
- The selection of "handpicked" fellowship candidates (in certain cases) in order to build up expertise in specific research fields.
- Improved "marketing" of fellowship and visiting researcher grants.
- Publication of fellowship and visiting researcher reports through the Fund. These should also be suitable for inclusion in the summary series.
- Increased level of grants for travel/educational visits.

Monitoring of working environment activities abroad

- Unaltered level of monitoring activities.
- Measures to improve the utilisation of working environment attaches (or equivalent). Review of report distribution.
- Evaluation during the course of the period.

Other international contacts

- The financial resources required for the Fund's involvement in activities under the terms of planned co-operative working environment agreements between Sweden and the U.S.A. and EEC respectively, should be estimated.
- Establishment of more permanent contacts with certain foreign institutions involved in working environment/production technology/work organisation problems for the purpose of gathering general information and exchanging research findings.
- Increased translation of Fund material into other languages. This applies both to translations commissioned and financed by the Fund and by international bodies.

THE FUND'S INFORMATION ACTIVITIES

GENERAL

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
Information about the Fund	581	870	1 025	900	950
Information on projects	4 251	4 900	5 300	6 350	6 670
Total cost, SKr thousand	4 832	5 770	6 325	7 250	7 620

The need for information designed to improve the working environment has become strongly emphasised in recent years. The establishment of bodies such as the Fund has helped the possibilities of increasing our knowledge of factors which affect the working environment. Therefore, the Fund has devoted ever-greater resources to disseminating this knowledge among those involved in working life.

However, a further need to expand and increase the efficiency of efforts in this area has emerged. Among other measures, the Government has appointed a commission (INRA) which is directed, by its terms of reference, to submit proposals on "how to implement effective and advanced monitoring of working environment hazards, and how to ensure the satisfactory dissemination of information on such hazards", the starting point for the commission's activities being "the dissemination of all available research information to those involved".

Without pre-empting the findings of the commission, it is expected that the Fund - as the principal financing agency for working environment research - will assume an increasingly important role in these activities. However, it should be emphasised that the Fund does not have a general responsibility for disseminating information regarding working environment problems. The Fund's own efforts in the field of information must be concentrated primarily on following up and evaluating the research and technical development work being carried out with Fund assistance, and publicising the findings in various ways.

At present, this is achieved by means of various activities directed primarily towards supervisors, various categories of safety officers, and company health and welfare personnel - all of whom play important roles in the local safety function. Other important target groups include the trade unions, industrial associations, official agencies and the mass media.

Investigations have shown that those involved in local safety activities frequently encounter difficulties in acquiring the information currently available. This does not apply specifically to the informational material provided by the Fund but to the area as a whole. For example, the following opinions were expressed in a

questionnaire survey carried out by INRA.

Employers indicated that there is too much information in relation to the time available for dealing with the problems. It is suggested, therefore, that brief summaries and resumes specific to various industries be published, preferably through the agency of the various industrial organisations or other central bodies.

Employees (safety officers) expressed the view that the published material is often written in difficult language and, therefore, advocate the oral transmission of information as part of safety meetings, conferences etc. In this case also, the people concerned are interested mainly in information specific to their industries and in reports on measures taken in other workplaces in the industry.

Company health and welfare personnel represent a third key group in safety activities. These have expressed the need for an overview of what is happening in other companies as regards research, safety measures etc. This group also requires considerable knowhow as regards methods of investigation.

Similar viewpoints have emerged in an interview survey entitled "Effects of research and development work by the Swedish Work Environment Fund" which was carried out for the Fund by an consultative agency.

The foregoing has formed the basis for proposals designed to achieve certain improvements and modifications in the Fund's information activities. The measures proposed are discussed in the following section on the basis of the Fund's system of accounts, starting with a review of completed and current activities and followed by a review of planned activities by cost centre. The discussion concludes with a summary of the principal elements of the planned activities.

INFORMATION ABOUT THE FUND

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
Annual report, project catalogue, programme of activities, programme reports	364*	650	600	650	700
Advertising, exhibitions	121	175	175	200	200
Miscellaneous	96	45	250**	50	50
Total cost, SKr thousand	581	870	1 025	900	950

* The low outturn for 1979/80 is due to the fact that the greater proportion of the programme report costs will be returned in the 1980/81 budget year.

** Figure includes costs relating to the tenth anniversary of the Fund.

Completed and current activities

The scope of activities has been the same as in earlier years. The annual report was published in Swedish and English, the latter version being supplemented with a list of current projects. Certain changes to be made this budget year to the project catalogue will make it more easily understood and will provide additional information.

Details of research programmes and the need for research in different areas are contained in the Fund's series of programme reports. A report entitled "Solvents in the working environment" (1980:2) has been added to the series and will be published in English during the current budget year. This also applies to a report entitled "Occupational hygiene measurements of chemical air pollutants" (1980:1) and to a position paper entitled "Lubricants and coolants in metalworking".

Information regarding the Fund's activities is communicated to large groups through exhibitions such as Elmia Arbetsmiljo 80 (Elmia Working Environment 80) and Skydd 81 (Safety 81), press bulletins issued mainly to the trade union press, and announcements of application dates and fellowship activities in the daily press.

In 1980, a new information folder dealing with the Fund was published in Swedish, English, Finnish, French and German.

Planned activities

Project catalogues will be distributed, as previously, to parties such as the labour market organisations, chief safety officers,

company doctors and nurses, and safety engineers. Further review and editing of individual project reports is planned to accommodate the desire of our clients for more easily understood texts. The supplementation of material such as search registers is another requirement to which attention should be paid.

The Fund has appointed special working groups for the purpose of surveying and analysing research needs in various fields of activity in order to develop a supportive basis for research and development. The groups report on suitable measures, research requirements etc. in programme reports or position papers. During the coming budget year, reports of this type on topics such as microorganisms and working posture/work load will be issued.

Further efforts are planned in the areas of advertising and exhibitions. Apart from announcements regarding application dates and fellowship activities, advertising should be more conciously designed to provide information regarding current research in individual project areas and to increase the knowhow of target groups such as safety officers, designers/manufacturers etc. In the working environment and working life field, the considerable interest in research and technology provides further incentive for the Fund to participate in certain industrial exhibitions with screen exhibits and informational material, and to take part in congresses arranged by the labour market organisations.

The level of information supplied to the mass media regarding the Fund's range of activities can be increased by means of press bulletins, press conferences and seminars for journalists.

The budget proposal is based on a list of known costs for annual report and project catalogue production, and for producing the information regarding the Fund's activities described above. In other respects, as regards the 81/82 budget year, special funds have been set aside for preparing a wide range of information on the Fund's activities to mark its tenth anniversary in 1982. Appropriate activities proposed include the publication of a book or journal containing a description and commentary on the ten years of research and development work, training and information in the working environment field. Conferences and other activities may also be organised.

INFORMATION ON PROJECTS

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
Summary series	1 270	1 600	2 000	2 200	2 400
Outline reports, brochures	647	600	700	750	800
Reports	151	100	200	250	270
Conferences, seminars,	843	300	500	550	600
Campaigns	1 338	2 200	1 800	2 500	2 500
Miscellaneous	2	100	100	100	100
Total cost, SKr thousand	4 251	4 900	5 300	6 350	6 670

This is the most important, and the most expansive, part of the activity. Each year, the Fund receives approximately 150 final project reports, most of which produce some form of information activity. The first stage in disseminating information regarding project findings is to produce a brief summary which is distributed to safety officers, occupational health personnel etc. It is estimated that 390 individual project report summaries will have been produced by the end of the budget year. In several cases, it is necessary to prepare outline reports which describe the state of knowhow, research findings and new techniques. Thus, 13 reports dealing with current research, a number of brochures and 8 project reports have been published (the latter by the Joint Industrial Safety Council). Two major co-ordinated information campaigns - one dealing with noise abatement and one with lighting - have been carried out. A campaign dealing with the working hazards caused by solvents is planned to commence in Spring 1982.

Informational material associated with the campaigns has also aroused major interest in the neighbouring Nordic countries, and co-operation has been established with the Work Environment Fund in Finland, the Work Environment Fund in Denmark, and the National Board of Occupational Safety and Health and the Industrial Safety and Welfare Administration in Norway.

From 1973 to 1981, a total of approx. SKr 14 million has been spent on information regarding projects. Of this amount, SKr 6.5 million has been spent on campaigns dealing with noise, lighting and solvents.

The funds hitherto devoted to information activities are, despite

all, limited in relation to the major need for easily-available reports on research and development work findings as expressed by both employers and employees. However, in view of the large quantities of information produced at present, a method should be developed for monitoring completed and planned information activities in parallel with current activities.

Summary series

Completed and current activities

During the years, the production of order catalogues and the reporting of projects in the summary series has stabilised at 7 to 8 catalogues, corresponding to 105-120 summaries per budget year.

During the current budget year, an assessment was made of the categories which order summaries through the order catalogue in the journal Arbetsmiljo (The Working Environment). This showed that safety officers comprise the largest group (57%),followed by the supervisor and safety official category (20%),and occupational health doctors and nurses (7%).The remaining group (16%) included representatives of company management and official agencies,libraries,industrial inspectors etc.as well as engineers, designers and consultants.

Planned activities

It is planned to issue summaries of most of the projects on which the Fund receives reports prior to the coming budget year. Further revision and editing are also planned to make the research findings available to our target groups to an even greater extent.

At present, all subscribers to Arbetsmiljo receive information on new summaries through the order catalogue which accommpanies the journal as a supplement. This represents the publication of the information eight times annually at the planned rate of issue. In addition, the catalogue is forwarded directly to companies, company health and welfare centres, libraries, official agencies, industrial and trade organisations etc. Furthermore, the great majority of supplements are ordered by means of the coupon in the catalogue and the number of orders has increased steadily since the system was introduced. However, apart from the overall marketing of the summary series by means of the catalogue, there is a need for disseminating more selective information to certain target groups. This would satisfy the demand for the provision of information of a nature more specific to various branches of industry, as expressed by both employers and employees.

Therefore, a review of the marketing measures relating to the summary series is called for. One possibility which should be explored would be the inclusion of an advertisement in each issue (15 annually) of Arbetsmiljo, and in the union, industrial and trade press. The transition to advertising could be supplemented periodically by a separate printing such as a six-monthly list of published summaries which could be sent directly to the Fund's major target groups.

In addition, it is planned to issue quarterly information sheets/ folders containing specific information on research projects of interest to important target groups such as occupational safety and health services design and production personnel.

The budget proposal envisages the printing of approx. 120 summaries per year and marketing measures including the distribution of information folders to special target groups as outlined above.

Outline reports/brochures

Completed and current activities

The need to provide a co-ordinated picture of current and completed research in different areas is increasing as the number of final project reports increases. To date, the Fund's outline report series includes 13 publications, all of which are in considerable demand. Although these have been distributed mainly through the associations and unions involved, there has also been an appreciable demand from the occupational safety and health services, among others.

The chemical and physical research fields dominate the report series, and further publications dealing with welding and with surface treatment are planned for the current budget year.

In addition, the report of a debate on the problem of work schedules will be published during the current budget year and will be distributed in conjunction with a planned conference. A pamphlet dealing with working environment hazards associated with wood mould and the handling of wood chips for fuel will be a further publication.

Planned activities

The need for outline reports is increasing as knowledge and the findings from several major research areas become available. Outline reports on the areas of medical care, the working environment in schools and, possibly, one dealing with the sleeping problems of shift workers and other personnel working unsocial hours, are planned for the 81/82 budget year.

In the chemical area, it should be possible to publish outline reports dealing with topics such as lubricants, coolants and plastics.

In the physical area, it may be opportune to publish an outline report of noise research from the medical aspect. This also applies to an outline report of the state of knowledge in the areas of neck/shoulder and back ailments, and radiation. In the longer term, it should also be possible to publish summaries of this type dealing with the areas of visual ergonomics, technical measures to be taken following accidents and workplace design.

The budget proposal envisages the production of 4-5 outline reports per budget year.

Reports

Completed and current activities

Since 1 October 1977, the Fund has been issuing research reports published by the Swedish Joint Industrial Safety Council (AN). Seven reports have been published to date and an eighth has gone to press. The shortfall which arose due to lower than expected sales has been covered by the publishing grant which the Council received, by agreement, during the introductory period. Co-operation in the publication of research reports as described above has now been terminated by mutual agreement between the Fund and the Council pending a review of how project resports should be published in future.

Several other reports have been produced and distributed by the Fund itself. These include, for example, a report on a method of improving the working environment in the engineering industry. During the current budget year, a popular report is also being prepared, in co-operation with the Swedish Municipal Workers' Union, on the working environment of of bus drivers.

Planned activities

Certain contacts have been initiated during the year in an attempt to develop new forms of co-operation as regards the publication of reports. Thus, for example, future co-operation between the Fund and the Swedish Joint Industrial Safety Council should be concentrated on research findings which are naturally related to the training material offered by the Council. There is a major need for supplementary reading material of a topical nature and for the publicising of research findings in areas such as workplace planning, chemical health hazards, ergonomics and lighting. In the public sector, similar co-operation should be planned with the Swedish Government Work Environment Council.

In the area of co-determination, co-operation is already under way with the Centre for Working Life. Most of the Fund's many co-determination projects are in their final stages and the work of producing outline reports dealing with these projects has commenced. A series of reports on projects dealing with areas such as local authorities and county councils, the public sector, industrial group problems, work organisation and co-determination is planned for the coming budget year. These will be produced in co-operation with the Centre for Working Life and with the Tiden publishing firm.

Research findings which, for various reasons, are not included in the above-mentioned co-operative ventures must be published under the aegis of the Fund itself or in co-operation with an appropriate publishing firm. The forms of publication and co-operation with the publishers in terms of the implications regarding personnel and financing, are being examined at present.

Conferences/seminars

Completed and current activities

The number of conferences dealing with various areas of research has increased appreciably in recent years. The major conferences include the U.S.A. conference on chemical health hazards, a two-day conference on computers and work, a conference on research in the area of co-determination and a conference dealing with lifting and carrying work. Conference reports containing details of the papers presented and debates have been published in most cases. An additional number of working seminars on topics including lubricants and one dealing with measurement techniques are planned for the current budget year.

As part of its experimental activities, the Fund organised conferences to initiate contacts with regional safety officers in co-operation with the Swedish Commercial Employees' Union and the Swedish Union of Graphical Employees. The purpose of these sessions was to disseminate research information and to provide a forum for discussions between researchers and the regional safety officers.

A seminar dealing with metals was organised as a means of reaching company doctors and nurses, and safety engineers with advanced information on completed and current research activities. This meeting was distinguished particularly by the mutual need for researchers and company health and welfare specialists to discuss research findings and their realisation in practice. A similar seminar on radiation was held in May 1981.

Planned activities

Conference activities must be regarded as an essential element in the Fund's efforts to publicise the findings of current and completed research and development work, and as a means of identifying future needs in the area. In addition to the conferences and seminars held under the aegis of the Fund, substantial support is also given to related activities initiated e.g. by programme and working groups etc. With regard to the planning of conferences and seminars for the coming budget year, the potential areas of consideration are detailed below. However, the budget proposal is concerned only with funds for those conferences arranged by the Fund itself and for publishing the conference reports associated with these. Other conference activities will be dealt with in the usual manner on receipt of applications (see the section entitled "Grants for training and information activities").

It is planned to hold a number of conferences in the behavioural science area. These will include conferences on unsocial working hours, absenteeism and solitary work, one conference relating to the activities of the SKO group, and one dealing with the psychological and social problems of working life.

In the physical problem area, one conference on the office climate may be held (possibly in co-operation with BFR), together with one or more sessions dealing with working posture/work load.

A couple of smaller seminars on microorganisms and, possibly, a conference on plastics are expected to be held in the 1981/82 budget year.

The experimental activity of holding open days for regional safety officers and research seminars for company health and welfare specialists has not yet been concluded. On conclusion, the activity will be evaluated to obtain an assessment of the need for future activities. However, the high degree of appreciation with which both researchers and participants have welcomed open days and seminars, together with their relatively low cost as compared with supplying printed informational materials, would appear to justify the continuation of the activity in an expanded form.

Campaigns

Completed and current activities

The term "campaigns" is used to denote wide-ranging information activities which are used to present a more thorough review of available and practically-applicable research findings. Experience to date from two major co-ordinated information campaigns of this type dealing with noise abatement and lighting has been extremely good. Among other factors, this has been due to the active participation of industrial organisations, trade unions, employer organisations and other central bodies. In addition, the material was, as far as possible, designed specifically for various branches of industry and target groups.

The informational material relating to noise abatement and lighting are mainly in the form of printed matter. Practical handbooks entitled "Noise abatement - principles and application" and "Good workplace lighting" have been produced for the two areas. These are supplemented by pamphlets (twelve dealing with noise and four with lighting) applying to different branches of industry. A fifth leaflet entitled "Lighting problems in VDU work" will be published during the current budget year. The material on noise abatement was presented at a number of regional conferences in order to meet the demand for oral information expressed mainly by regional safety officer groups. In the case of lighting, the need for stimulative material has resulted in the production of a package including slides for use during union meetings, safety committee meetings, workplace meetings, occupational health service discussions etc.

The demand for the lighting information, in particular, has been considerable and both the manual and pamphlets have been printed in large numbers. For example, of the 140 000 copies of the manual which were printed, 100 000 had been ordered a year after the campaign was launched.

Informational material dealing with the two campaigns has also attracted wide interest in the neighbouring Nordic countries. The noise handbook has been translated into Danish and Finnish, and into English with the co-operation of the U.S. Department of Labor. The Swedish version of the lighting material has been distributed in Norway and the handbook was translated into Finnish

during 1981.

Planned activities

In view of the wide-ranging support which the Fund has contributed to research and development work designed to solve the problems caused by the use of solvents at work, the board has sanctioned the funding of an information campaign in this area. Basic information will be produced in a similar manner to previous campaigns. In other words, this will consist of a handbook accommpanied by other information produced especially for specific branches of industry in the form of pamphlets, folders, posters etc. With the benefit of the experience gained from earlier information campaigns, it is planned to process the material on solvents into a pedagogic form suitable for purposes such as disseminating group information. To the same end, major importance should be attached to the production of stimulative informational material such as discussion pamphlets, film strips, videocassettes etc. The campaign is also intended to include a number of seminars/conferences.

The handbook and some of the industrial pamphlets are expected to be introduced in the spring of 1982. Prior to this, the ground will be prepared by means of continuous press releases, bulletins to working personnel through the trade unions and employer organisations etc. The budget proposal is based on the funds already allocated by the board for the solvents campaign.

During the 82/83 and 83/84 budget years, it should be possible to summarise the campaign activities carried out in several areas. In this context, accident research is a major area and there is much to suggest that minor campaigns directed at special target groups will be carried out in several, more limited areas. Campaign funding will require the approval of the board in the normal way.

Summary of planned activities

In summary, it is proposed that activities be concentrated on the following aspects:

- An intensification of efforts to supply those involved with easy-to-read summaries of working environment research in a quick and specific manner

- Organised co-operation with the industrial organisations for the purpose of producing outline reports on problems and solutions relating to specific branches of industry

- The expansion of conference and seminar activities for the purpose of providing oral information to certain key groups in working life

- Increased efforts to reach key groups which are capable of transmitting information further to individual workplaces. Examples of such groups include:

  - regional safety officers
  - occupational health service personnel, occupational medicine clinics

- teachers in vocational and trade schools
- supervisors of premises
- LO and TCO districts
- mass media, particularly the trade union press

o Increased efforts to reach key groups which are capable of influencing the working environments of others. Examples of such groups include :

- manufacturers and importers
- engineers, architects and designers
- political decision-makers

GRANTS FOR SPECIAL PURPOSES

INFORMATION AND TRAINING RELATING TO CO-DETERMINATION IN WORKING LIFE

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	115,0	121,9	125,0	135,0	148,0

General description of the area

Since the 1976/77 budget year, the Government has provided support from central funds for training and information activities. The Government has also issued regulations as to how these funds are to be allocated and used.

The Fund is required to specify detailed regulations relating to accounting etc.

Organisations in receipt of finance are obliged to submit an annual report of their activities.

The following sums have been allocated during the years.

Year	SKr million
76/77	35,0 (six months)
77/78	75,0
78/79	103,0
79/80	115,0
80/81	61,0 (six months)

The Swedish parliament has decided that activities shall be financed from occupational safety and health contributions as of 1 January 1981.

The Government has also specified the basis on which the total amount of the contribution is to be calculated. In the 1981 calendar year, this means that 30% of the contribution, equivalent to SKr 121.8 million, is to be used for training and information in the area of co-determination.

Of this amount, a maximum of one-eighth, or 12.5%, may be paid to the employer organisations, the remaining 87.5% being paid to the employee organisations. This gives the following breakdown:

12.5% = SKr 15 225 000 to the employer organisations in 1981
87.5% = SKr106 575 000 to the employee organisations in 1981

The finance is distributed in relation to the number of employees and members in the respective organisations. Funds are transferred to an account at the Work Environment Fund, each organisation having its own individual account from which monies are requisitioned. Detailed regulations are specified by the Fund.

Under the terms of a decision reached in December 1980 by the board of the Fund, these funds may be used, until further notice, for

research into problems of equality.

One result of the decision to revise the method of financing is that longer term planning can be carried out. The preliminary allocation of resources is based on the revenue from occupational safety and health contributions as calculated by the National Swedish Social Insurance Board.

In February 1981, all recipients of finance were invited to an information session dealing with the altered regulations. This initiative received a very positive welcome and the wish for regular meetings was expressed.

Planned activities

- o Activities will continue as before i.e. being undertaken by the particular organisations.
- o Regular information sessions with recipients of finance.
- o New payment and accounting procedures.

TRAINING OF EMPLOYEE REPRESENTATIVES ON COMPANY BOARDS

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	9,8	10,0	12,0	13,0	13,0

General description of the area

Since the 1976/77 budget year, the Government has made special provision, as part of the "Contribution to Working Environment Fund" appropriation in the national budget, for the training of employee representatives on the boards of companies and state bodies. The Fund is responsible for administering these monies and the board of the Fund has laid down rules governing the payment of funds to the organisations. Under the terms of these regulations, payments are made on the principle that costs will be covered in full. However, compensation for loss of earnings is not paid.

Payment is made on the submission of accounts to the Fund, 75% of the cost of the planned activity being payable in advance.

The contribution is designed to cover all reasonable costs incurred in planning and implementing the training, and in producing training materials.

In recent years, the following grants have been approved and paid out.

Period/year	Approved	Paid out	
73/74 - 76/77	10,8	6,2	(as per final account)
76/77	12,0	5,3	(")
77/78	20,0	8,9	(")
78/79	10,0	10,9	(")
79/80	5,0	9,8	(")
80/81 (six months)	2,5	10,0	(estimated)
	60,3	51,1	

Funds which remained unused at the end of 1980 reverted to the Fund's capital assets.

The Swedish parliament has decided that the activity, as of 1981, shall be financed by occupational safety and health contributions. Of the total allocated, 3% may be disbursed in contributions to LO, TCO and SACO/SR, and to trade unions independent of these organisations for training employee representatives on boards.

For 1981, this represents a sum of approx. SKr 12 million. Detailed regulations are laid down by the Work Environment Fund.

In accordance with earlier regulations, costs may be recovered in full on submission of accounts. This will continue to apply in future as will the entitlement to advance payment.

Planned activities

- Activities will continue as before. In other words, the organisations will carry out training in various subjects and will produce suitable training materials.

GRANTS FOR ACTIVITIES RELATING TO REGIONAL SAFETY OFFICERS

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	28,2	35,0	40,0	45,0	50,0

The Fund has provided financial support for activities involving regional safety officers since 1974 when a special condition to this effect was incorporated in the Fund's terms of reference.

Up to and including 1978, contributions were disbursed through the National Swedish Board of Occupational Safety and Health, which was responsible for distributing the funds to those union organisations which had obtained the permission of the industrial inspectorate to appoint regional safety officers.

As of 1979, in accordance with a Government decision, the funds have been paid out directly to the employee organisations in accordance with a modified payment system. The contributions for the 1979 and 1980 calendar years were SKr 25 175 000 and SKr 28 170 000 respectively.

Regulations governing the new system of payment were laid down in a Government decision of December 1980 and came into force in 1981. Under the terms of these regulations, contributions are paid in advance to the recipient organisations on application. Allocation of the funds is based on a standard calculation of the true costs of the activity, including (apart from normal wage costs) an additional 10% of the wage costs to cover the costs of premises and travel. The grant for activities relating to regional safety officers was raised to SKr 35 million in the budget submission for the 1981 calendar year. No cost framework has yet been specified for the following period.

The funds allocated by the Government for 1981 are entered here as the estimated cost for the 1980/81 budget year. The increase in costs during the following budget years is unknown. However, this is estimated provisionally as SKr 5 million annually.

GRANT TO NATIONAL BOARD OF OCCUPATIONAL SAFETY AND HEALTH

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	30,2	19,3	20,0	19,0	19,5

Under its terms of reference, the Fund is required to provide an annual grant to the National Board of Occupational Safety and Health for training personnel in occupational safety and health and for carrying out special projects and investigations in the area of occupational safety and health. Earlier grants for regional safety officer activities are now paid through the appropriate labour market organisations.

In the 1981 calendar year, the Government has stipulated that the Fund shall allocate SKr 8.1 million for the training of personnel in occupational safety and health, and SKr 9.7 million for special research projects.

In accordance with the terms of bill 1980/81:20 relating to cutbacks in the activities of state bodies, the Government has also decided that the Fund shall place a further SKr 1.5 million at the disposal of the National Board of Occupational Safety and Health during the current budget year as part of the finance for the research activities of the Board's department of occupational medicine. At the same time, the Board's disposable assets for the year as specified in the national budget have been reduced by an equivalent amount.

In this context, it is worthwhile recalling the statement of the Minister when presenting this measure, in view of the fundamental importance attaching to the statement as regards the future utilisation of the Fund's finances.

> "In my opinion, based on the capital assets of the Fund and its commitments, an added withdrawal of this order may be made from the Work Environment Fund without necessitating cutbacks in working environment research or other research supported by the Fund.
>
> Providing increased financial support for the research activities of the occupational medicine department from the Work Environment Fund will enable the appropriation for the Board to be reduced by an equivalent amount".

This year's draft budget includes preliminary provision for a similar capital withdrawal from the Fund as a financial contribution to the Board in 1981/82.

The funds set aside by the Government for 1981 and the special contribution to the activities of the Board's occupational medicine department are included here as an estimated cost for the 1980/81 budget year. The budget proposal for 1981/82 also makes allowance for an extra withdrawal of SKr 1.5 million for the same purpose.

The high outturn shown for 1979/80 is due to a certain amount of delay in paying out funds and final payments relating to the grant for regional safety officer activities.

GRANT TO CENTRE FOR WORKING LIFE

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	17,65	21,0	22,0	23,5	25,0

The activities of the Centre for Working Life are financed by the Fund, partly by means of an annual contribution to cover the fixed basic costs (basic finance) and partly by means of an annual basic grant for project activities (project programme). The former contribution is specified by the Government, while the latter is determined by the board of the Fund.

Originally, the cost to the Fund of financing the Centre for Working Life was met by the national budget. However, as of the 1981 calendar year, this assistance is no longer provided because of the Government decision to modify the system of financing the Fund. Thus, the contribution towards basic costs and the basic project grant are now financed from occupational safety and health contributions.

Under the terms of a decision taken by the board of the Fund on 18 February 1981, the annual project programme of the Centre for Working Life is fixed at a given percentage of the Fund's estimated income from occupational safety and health contributions for the particular budget year. The figure for the next few years has been fixed at 4.2%.

On the basis of presently available income forecasts, the 1981/82 project programme of the Centre for Working Life is estimated at SKr 14.5 million. This represents a percentage increase of 4.3% in comparison with the figure for the current budget year (SKr 13.9 million).

The preliminary estimates for 1982/83 and 1983/84 are SKr 15.7 million and SKr 17.4 million respectively.

The following table shows the costs associated with the Centre for Working Life since its inception.

Year	Fixed costs (SKr)	Project programme (SKr)
1976/77	1 500 000	–
1977/78	4 500 000	4 800 000 [1]
1978/79	4 900 000	8 300 000
1979/80	6 750 000	10 900 000
1980/81	7 100 000	13 900 000
Total	24 750 000	37 900 000

1) of which SKr 3 947 900 was spent.

The budget proposal also includes the cost of providing basic finance for the Centre for Working Life. However, an accurate basis for calculation is unavailable in this instance.

GRANTS FOR ACTIVITIES DESIGNED TO STIMULATE RESEARCH

	Cost outturn	Estimated cost	Budget	Forecast	Forecast
	79/80	80/81	81/82	82/83	83/84
Cost, SKr million	5,0	5,0	5,0	(5,0)	(5,0)

In accordance with a decision of the Swedish parliament (bill No. 1978/79:119 dealing with certain problems relating to research and researcher training), the Fund allocated SKr 5 million to the employee organisations in the 1979/80 budget year for activities designed to stimulate research. In accordance with the guidelines specified in the bill, the grant was intended to be used for general research activities not necessarily related to the working environment field.

A corresponding contribution has been allocated in this year's budget proposal to assist the continued development and organisation of the activity for a further period. In the opinion of the Secretary of State who laid the bill before parliament, the organisations should then be in a position to provide their own finance and the special grant from the Fund should be terminated.

As a result of the proposal in the draft budget submitted by the board of the Fund, the organisations in question have stated their case for continued support for their activities. Thus, for the duration of the planning period, the amount of the grant has, provisionally, been left unaltered pending the final decision of the Government on the matter.

WORKING GROUPS AND SPECIALISTS

WORKING GROUPS AND SPECIALISTS

	Cost outturn 79/80	Estimated cost 80/81	Budget 81/82	Forecast 82/83	Forecast 83/84
WORKING GROUPS AND SPECIALISTS (Total)	1 954 606	1 904 000	2 485 000	2 600 000	2 700 000
Remuneration and fees	1 270 902	1 250 000	1 750 000		
Committee report fees	531 267	500 000	550 000		
Travel and sub-sistence allowances	142 095	140 000	170 000		
Expenses	10 342	14 000	15 000		

The costs relate to those working groups and specialists engaged for external (mainly project-related) activities. Consultancy expenses incurred by the secretariat are budgeted for under that heading.

The cost estimates are based on current and planned specialist involvement, and on an estimated average number of members and meetings per year.

The fees paid to group members are in accordance with the government scale of remuneration for committee assignments, a number of "familiarisation" payments being included for each meeting in accordance with current practice.

A list of the Fund's working groups is included in the 1980 annual report.

Travelling expenses and subsistence allowances are paid in accordance with government regulations.

The estimated cost of fees for committee reports assume that current levels of payment will remain unchanged.

THE SWEDISH WORK ENVIRONMENT FUND
Box 1122
S–111 81 STOCKHOLM
Phone 08-14 32 00
Visiting address: Tunnelgatan 31

asf

NOISE CONTROL

A guide for
workers and employers

U.S. Department of Labor

Occupational Safety and
Health Administration

NOISE CONTROL

A guide for
workers and employers

U.S. Department of Labor
Ray Marshall, Secretary

Occupational Safety and Health Administration
Eula Bingham,
Assistant Secretary for Occupational Health

Office of Information
1980
OSHA 3048

This book was edited and adapted by Matt Witt, director of the American Labor Education Center, from a publication of the Swedish Work Environment Fund, and is printed with the Fund's permission. The Fund was established by national legislation in Sweden to conduct research and education in the field of work environment improvement. It is operated jointly by Swedish employers and labor unions. Its annual budget of $75 million is financed by a 0.1 percent tax on each employer's total wage bill.

For more copies of this guide, contact the nearest OSHA office listed in the back of the book.

Contents

Introduction

Noise.

It can destroy hearing.

It can create physical and psychological stress.

And it can contribute to accidents by making it impossible to hear warning signals.

An estimated 14 million workers in the U.S. are exposed to hazardous noise.

Luckily, *noise exposure can be controlled.* No matter what the noise problems may be in a particular workplace, technology exists to reduce the hazard.

It may be possible to:

- *Use quieter work processes.*
- *Alter or enclose equipment to reduce noise at the source.*
- *Use sound-absorbing materials to prevent the spread of noise by isolating the source.*

In the field of noise control, where there's a will, there's a way.

The Occupational Safety and Health Administration (OSHA) was established by the U.S. Congress to help eliminate job safety and health hazards such as noise.

This book is presented by OSHA for workers and employers interested in reducing workplace noise. OSHA believes that highly technical training is not generally necessary in order to understand the basic principles of noise control. Noise problems can often be solved by the workers and employers who are directly affected.

The book contains five major sections.

First, a brief overview of the effects of noise on human health.

Second, a discussion of some of the key words and concepts involved in noise control.

Third, an explanation of specific principles of noise control which the reader can apply in his or her workplace.

Fourth, a discussion of particular techniques for controlling noise.

Fifth, a description of the ways OSHA can help employers and employees, including an explanation of the legal requirements for noise control which employers must follow.

OSHA hopes that the information in this book will be discussed by employers, workers, and union representatives. If more help is needed, contact the nearest OSHA area office listed in the back of the book.

Noise: Its effect on health

The ability to hear is one of our most precious gifts. Without it, it is very difficult to lead a full life either on or off the job.

Excessive noise can destroy the ability to hear, and may also put stress on other parts of the body, including the heart.

For most effects of noise, there is no cure, so that prevention of excessive noise exposure is the only way to avoid health damage.

Hearing

The damage done by noise depends mainly on how loud it is and on the length of exposure. The frequency or pitch can also have some effect, since high-pitched sounds are more damaging than low-pitched ones.

Noise may tire out the inner ear, causing temporary hearing loss. After a period of time off, hearing may be restored. Some workers who suffer temporary hearing loss may find that by the time their hearing returns to normal, it is time for another work shift, so, in that sense, the problem is "permanent."

With continual noise exposure, the ear will lose its ability to recover from temporary hearing loss, and the damage will become permanent. Permanent hearing loss results from the destruction of cells in the inner ear—cells which can never be replaced or repaired. Such damage can be caused by long-term exposure to loud noise or, in some cases, by brief exposures to very loud noises.

Normally, workplace noise first affects the ability to hear high frequency (high-pitched) sounds. This means that even though a person can still hear some noise, speech or other sounds may be unclear or distorted.

Workers with hearing impairment typically say, "I can hear you, but I can't understand you." Distortion occurs especially when there are background noises or many people talking. As conversation becomes more difficult to understand, the person becomes isolated from family and friends. Music and the sounds of nature become impossible to enjoy.

A hearing aid can make speech louder, but cannot make it clearer, and is rarely a satisfactory remedy for hearing loss.

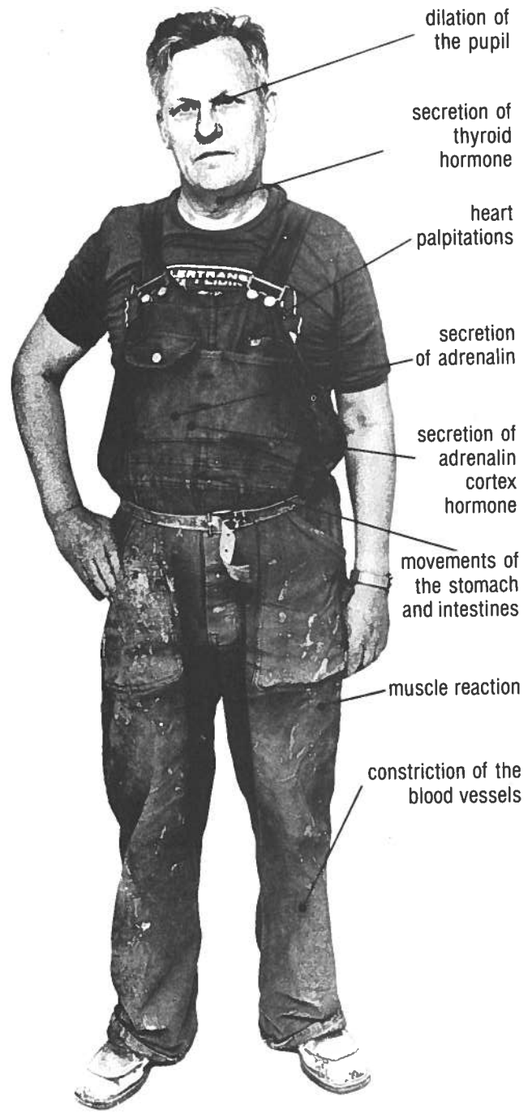
Workers suffering from noise-induced hearing loss may also experience continual ringing in their ears, called "tinnitus." At this time, there is no cure for tinnitus, although some doctors are experimenting with treatment.

Other effects

Although research on the effects of noise is not complete, it appears that noise can cause quickened pulse rate, increased blood pressure and a narrowing of the blood vessels. Over a long period of time, these may place an added burden on the heart.

Noise may also put stress on other parts of the body by causing the abnormal secretion of hormones and tensing of muscles (see Figure 1).

Workers exposed to noise sometimes complain of nervousness, sleeplessness and fatigue. Excessive noise exposure also can reduce job performance and may cause high rates of absenteeism.



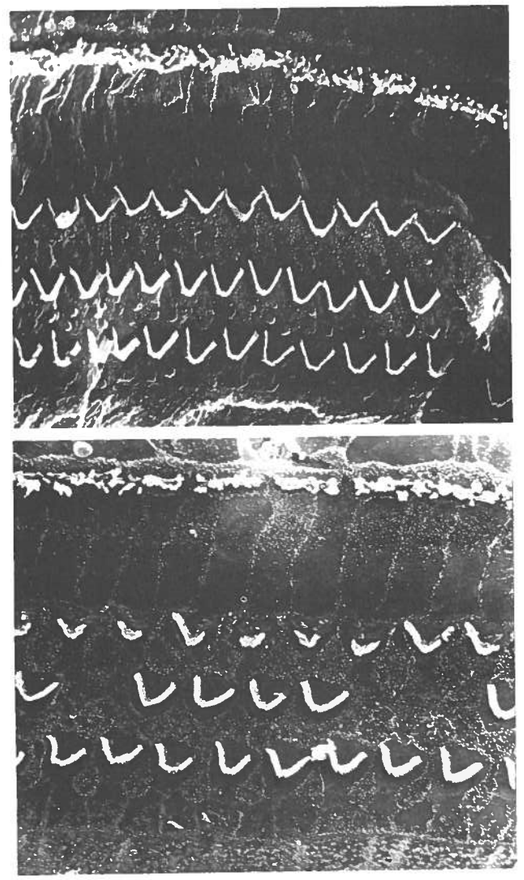


Figure 1. In addition to causing hearing loss by destroying the inner ear, noise apparently can put stress on other parts of the body by causing reactions such as those shown at left.

Figure 2. Severe destruction of the hair cells in the hearing organ. Top picture: normal hair cells, lower picture: hair cells destroyed by noise.

Noise control: Basic concepts and terms

There are a number of words and concepts which must be understood before beginning a discussion of noise control methods.

Sound

Sound is produced when a sound source sets the air nearest to it in wave motion. The motion spreads to air particles far from the sound source. Sound travels in air at a speed of about 340 meters per second. The rate of travel is greater in liquids and solids; for example, 1,500 m/s in water and 5,000 m/s in steel.

(Note: Measurements in this book are generally given in the metric system. To convert, one meter equals about 39.4 inches, one millimeter equals 0.04 inches, and one kilogram equals about 2.2 pounds.)

Frequency (Hz)

The frequency of a sound wave refers to the number of vibrations per second, measured in units of hertz (Hz). Sound is found within a large frequency range; audible sound for young

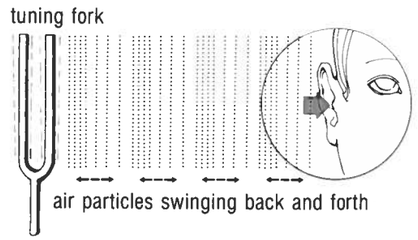


Figure 3. The sound source vibrates and affects air particles, which strike the ear drum.

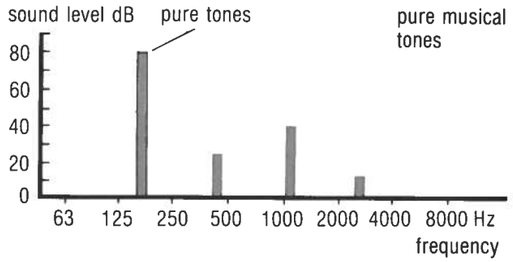


Figure 4. A pure tone is marked by a single column indicating the frequency and the sound level or intensity. Musical notes contain several tones of different frequencies and intensities.

persons is between about 20 Hz and 20,000 Hz.

The boundary between high and low frequencies is generally established at 1,000 Hz.

Sound may consist of a single pure tone, but in general it is made up of several tones of varying intensities.

Noise

It is customary to call any undesirable sound "noise." The disturbing effects of noise depend both on the intensity and the frequency of the tones. For example, higher frequencies are more disturbing than low ones. Pure tones are more disturbing than a sound made up of many tones.

Infrasound and ultrasound

Sound with frequencies below 20 Hz is called infrasound, and sound with more than 20,000 Hz is called ultrasound. There is some evidence that these sounds which cannot be heard can under certain conditions be hazardous to workers' health. This book deals only with noise which can be heard.

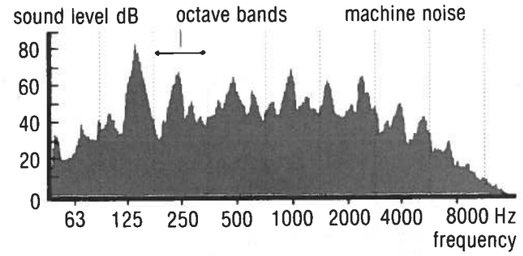


Figure 5. Noise is a disorderly mixture of tones at many frequencies.

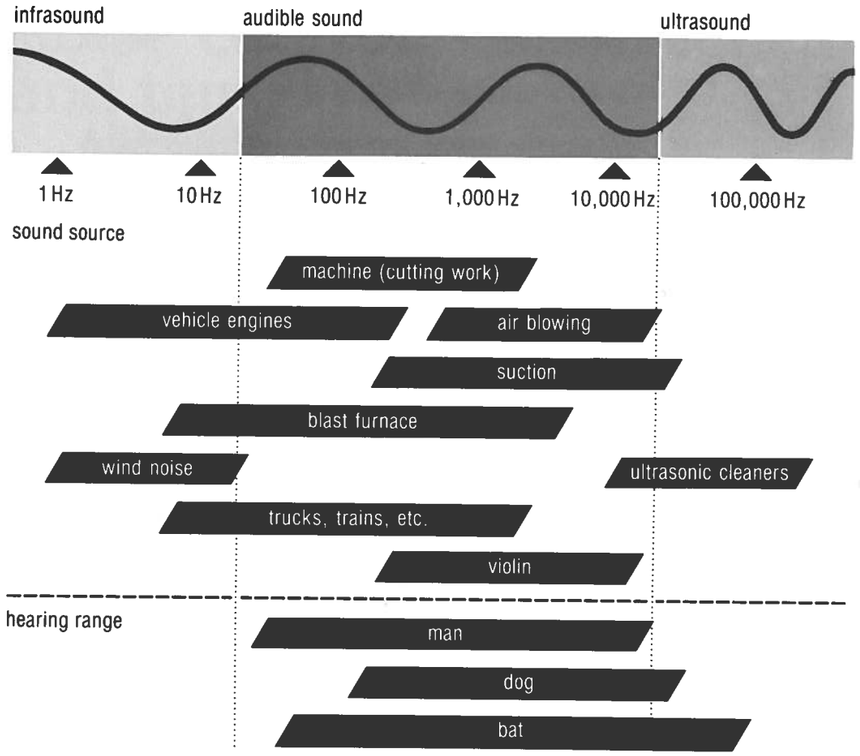


Figure 6. At the same intensity, the noise from a truck is less disturbing than the sound of air blowing or suction because it is at a lower frequency.

Decibel (dB)

Sound levels are measured in units of decibels (dB). If sound is intensified by 10 dB, it seems to the ears approximately as if the sound intensity has doubled. A reduction by 10 dB makes it seem as if the intensity has been reduced by half.

Noise level measurement

In measuring sound levels, instruments are used which resemble the human ear in sensitivity to noise composed of varying frequencies. The instruments measure the "A-weighted sound level" in units called dB(A).

Workplace noise measurements indicate the combined sound levels of tool noise from a number of sources (machinery and materials handling) and background noise (from ventilation systems, cooling compressors, circulation pumps, etc.).

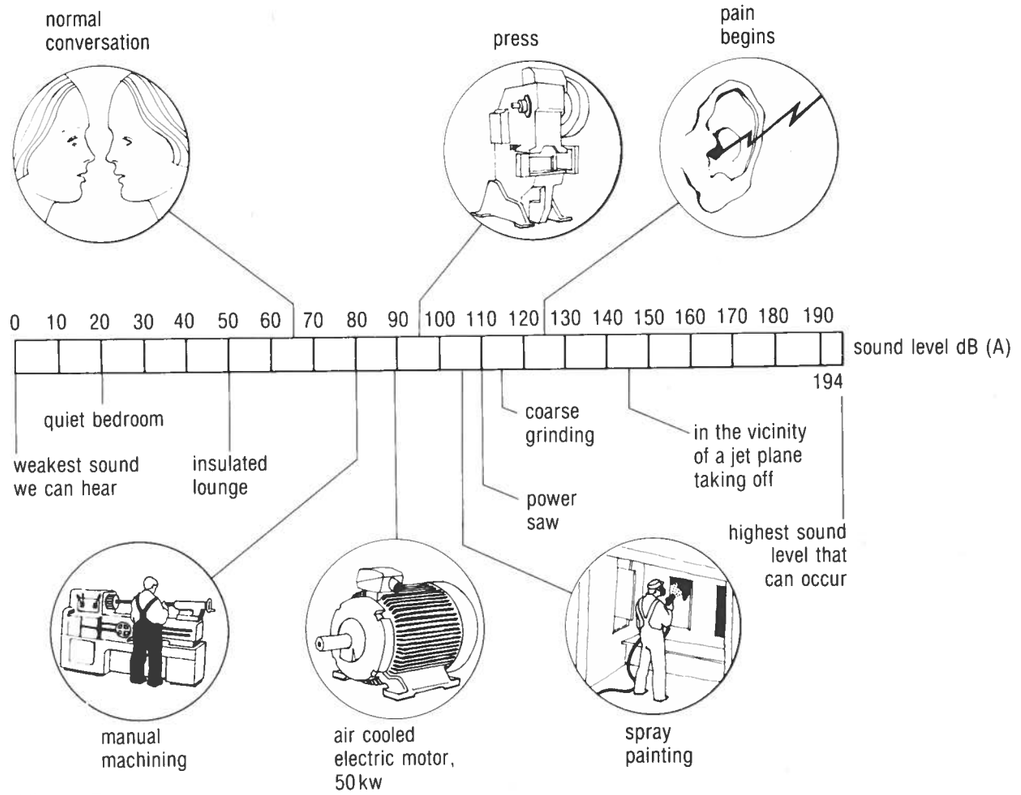


Figure 7.

In order to accurately identify all workplace noise problems, the noise from each source should also be measured separately. Measurements at various production rates may be useful in considering possible control measures. A number of manuals for noise measurements are commercially available.

Adding noise levels

Decibel levels for two or more sounds cannot simply be added. Figure 8 shows how the combined effect of two sounds depends on the difference in their levels. Two or more sounds of the same level combine to make a higher noise level.

Octave band

It is common practice to divide the range of frequencies we can hear into eight octave bands. The sound level is then listed for each octave band. The top frequency in an octave band is always twice the bottom one. The octave band may be referred to by a center frequency. For example, 500 Hz is the center frequency for the octave band 354-708 Hz.

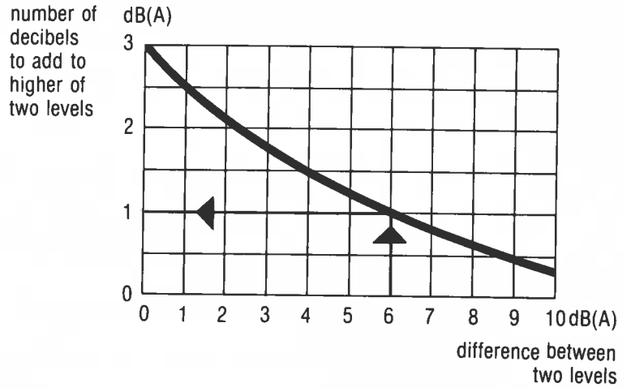


Figure 8. A fan produces a sound level of 50 dB(A). Another fan produces 56 dB(A). The difference is 6 dB(A), and according to the diagram, 1 dB(A) will be added to the highest level. Operating together, the fans will result in a level of 57 dB(A).

Sound transmission

The word "sound" usually means sound waves traveling in air. However, sound waves also travel in solids and liquids. These sound waves may be transmitted to air to make sound we can hear.

Resonance

Each object or volume of air will "resonate," or strengthen a sound, at one or more particular frequencies. The frequency depends on the size and construction of the object or air volume.

Sound reduction by distance

Sound spreading in open air and measured at a certain distance from the source is reduced by about 6 dB for each doubling of that distance. Sound is reduced less when spreading inside a room. (See Figure 9.)

Sound transmission loss (TL)

When a wall is struck by sound, only a small portion of the sound is transmitted through the wall, while most of it is reflected. The wall's ability to block transmission is indicated by its transmission loss (TL) rating, measured in decibels. The TL of a wall does not vary regardless of how it is used.

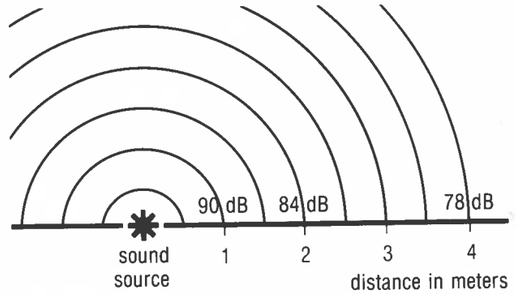


Figure 9. If a small sound source produces a sound level of 90 dB at a distance of 1 meter, the sound level at a 2 meter distance is 84 dB, at 4 meters 78 dB, etc.

Noise reduction (NR)

Noise reduction is the number of decibels of sound reduction actually achieved by a particular enclosure or barrier. This can be measured by comparing the noise level before and after installing an enclosure over a noise source. NR and TL are not necessarily the same.

Sound absorption

Sound is absorbed when it strikes a porous material. Commercial sound-absorbing materials usually absorb 70 percent or more of the sound that strikes them.

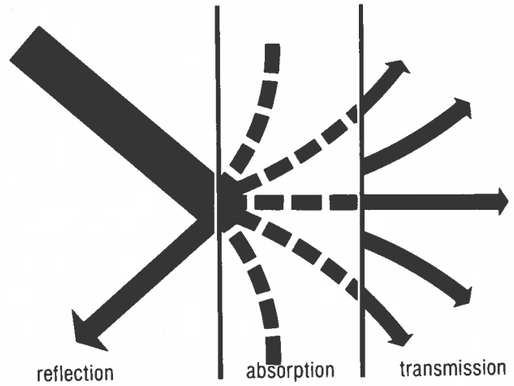


Figure 10. Part of the sound that strikes a wall is reflected, part is absorbed, and part is transmitted. The transmission loss (TL) of the wall is determined by the portion of the noise which is not transmitted through the wall.

Application of noise control principles

The following section explains how to apply basic noise control principles. In many cases, several principles must be applied and several control measures must be taken. Of course, these principles do not cover every possible noise problem.

The principles are discussed in eight sections:

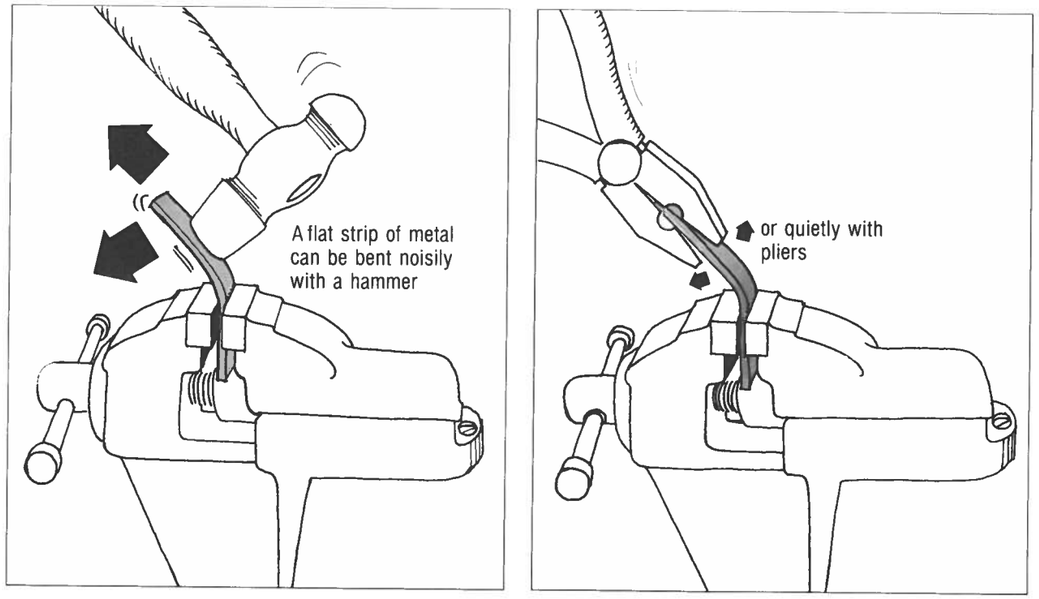
A. Sound behavior
B. Sound from vibrating plates
C. Sound production in air or gases
D. Sound production in flowing liquids
E. Sound movement indoors
F. Sound movement in ducts
G. Sound from vibrating machines
H. Sound reduction in enclosure walls

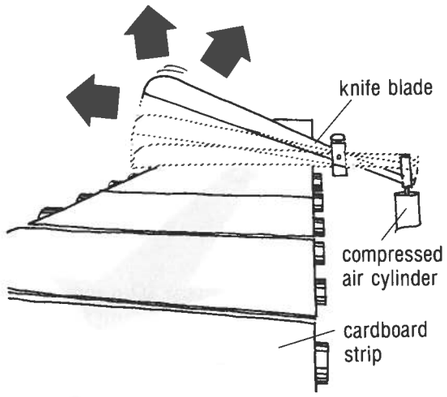
A number of symbols are used throughout the drawings. For example, large black arrows indicate strong sound radiation and smaller ones show reduced radiation.

Changes in force, pressure, or speed produce noise

Sound is always produced by changes in force, pressure, or speed. Great changes produce louder noises and small changes quieter ones. More noise is produced if a task is carried out with great force for a short time than with less force for a longer time.

Principle



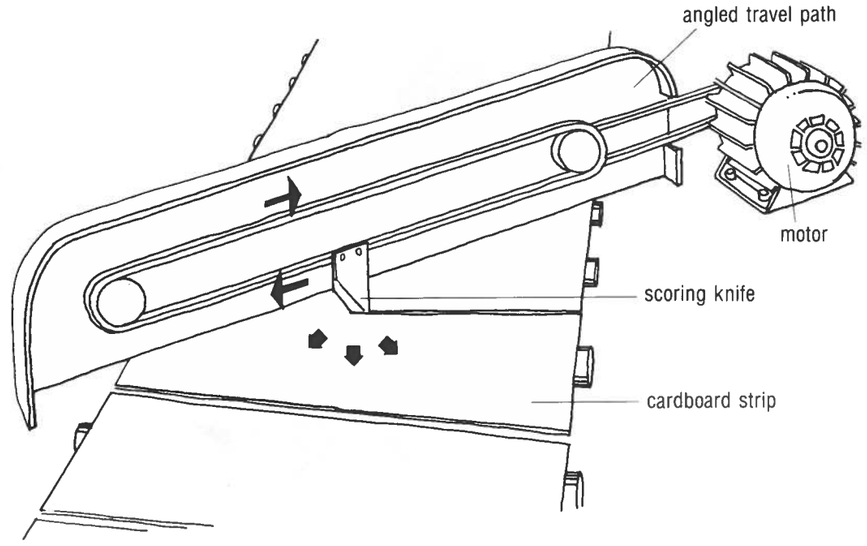


Example

In a box machine, cardboard is cut with a knife blade. The knife must cut very rapidly and with great force in order for the cut to be perpendicular to the strip. Much noise results.

Control measure

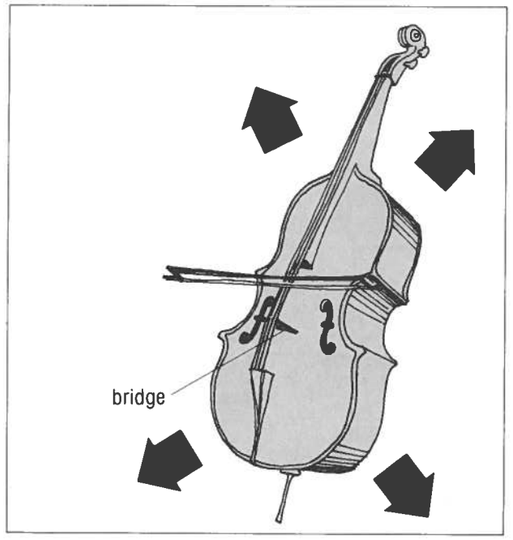
Using a blade which travels across the strip, the cardboard can be scored with minimal force for a longer time. Since the cardboard strip continues to move, the knife must travel at an angle in order for the cut to be perpendicular. The cutting is practically noise free.

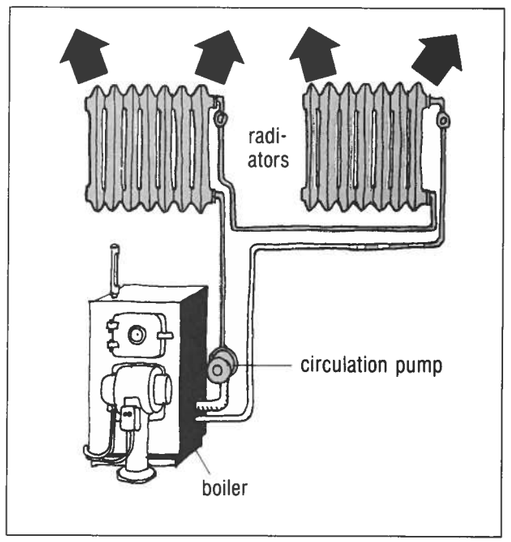


Airborne sound is usually caused by vibration in solids or turbulence in fluids

For example, vibrations of the strings in a musical instrument are transmitted through the bridge to the sound box. When the sound box vibrates, sound is transmitted to the air. A circulation pump produces pressure variations in the water in a heating system. The sound waves are transmitted through the pipes to the radiators, whose large metal surfaces transmit airborne sound.

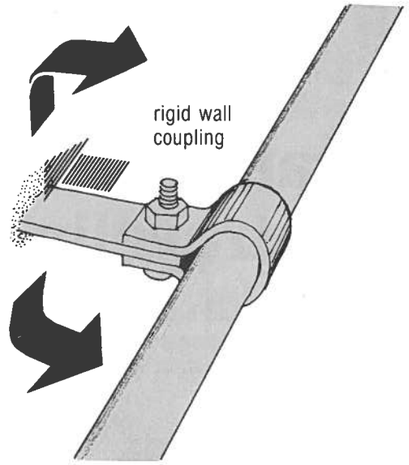
Principle





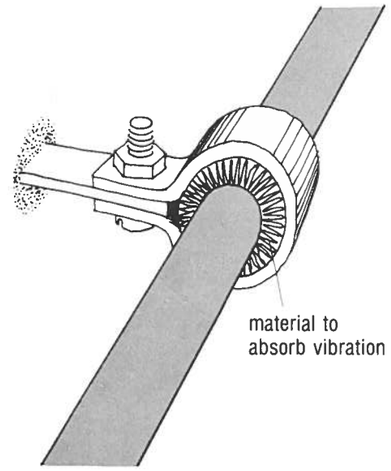
Example

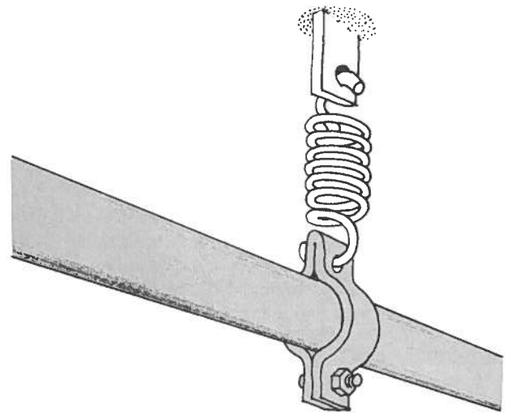
Turbulent fluid flow within pipes produces sound which can be radiated from the pipes and even transmitted to the building structure.



Control measure

In addition to reducing the turbulence in the pipe, the pipe can be covered with sound-absorbing material. The vibrations can be isolated from the wall or ceiling with flexible connecting mechanisms.

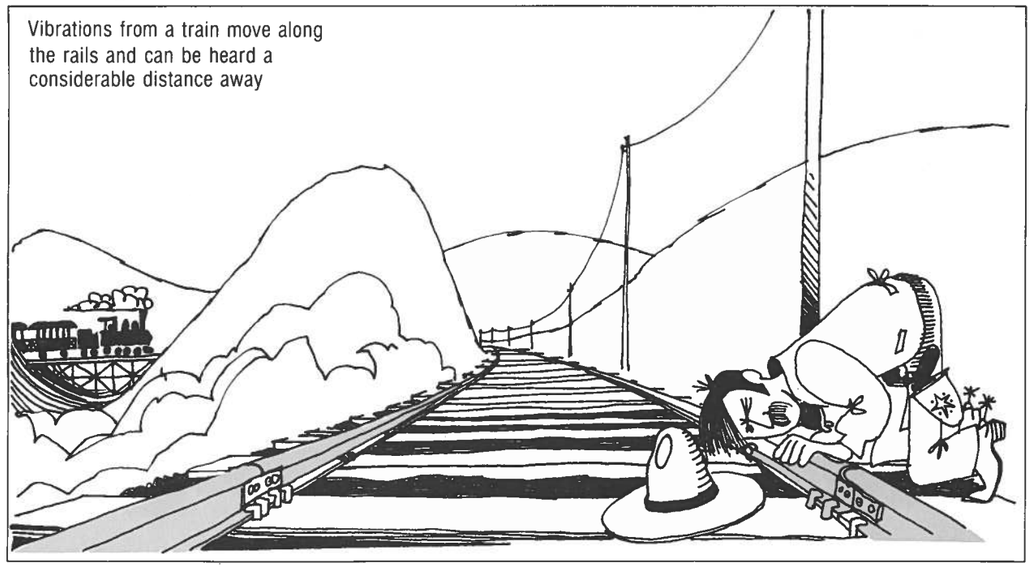


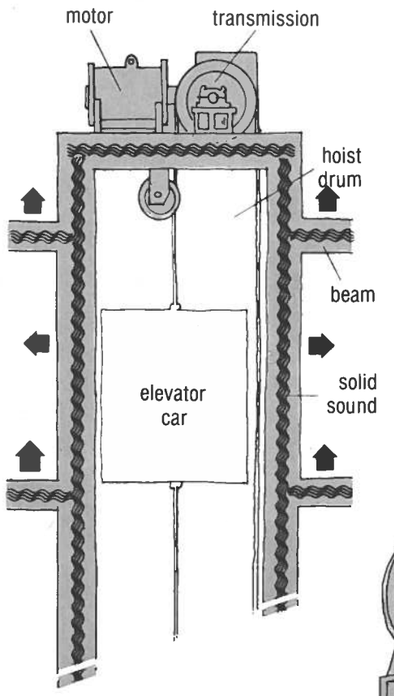


Vibrations can produce sound after traveling great distances

Vibrations in solids and liquids can travel a great distance before producing airborne sound. Such vibrations can cause distant structures to resonate. The best solution is to stop the vibration as close to the source as possible.

Principle



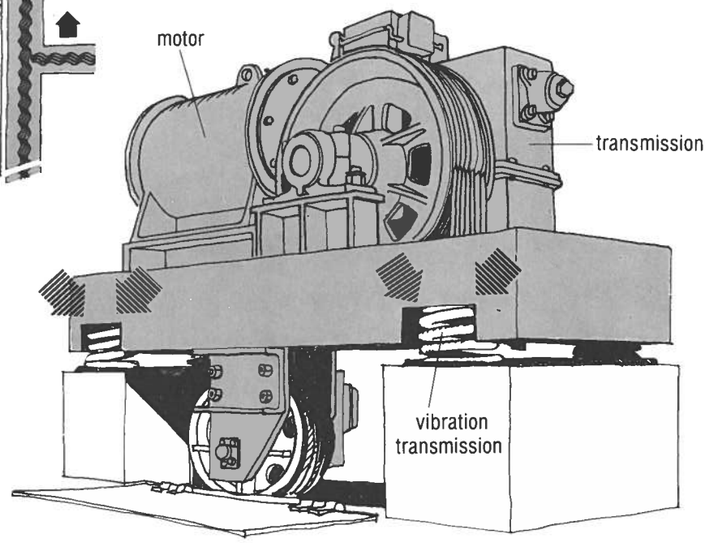


Example

Vibrations from an elevator are transmitted throughout a building.

Control measure

The elevator drive can be isolated from the building structure.

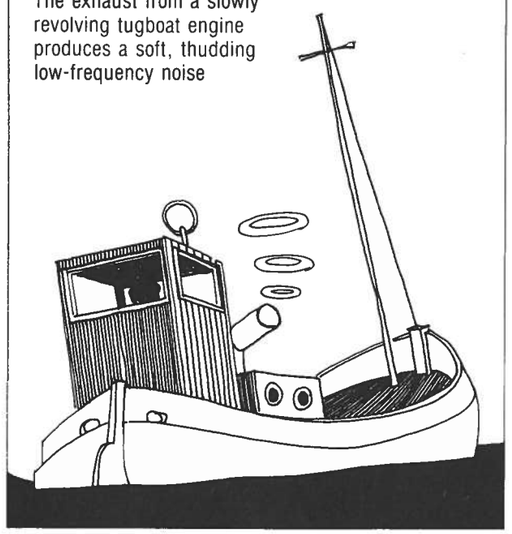


The slower the repetition, the lower the frequency of the noise

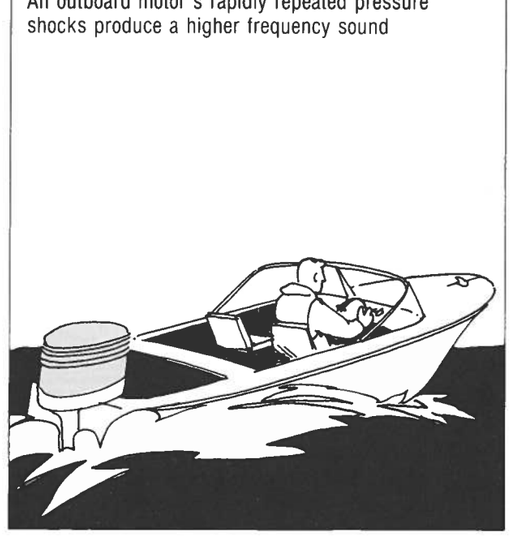
The level of low frequency noise from a sound source is determined primarily by the rate at which the changes in force, pressure, and speed are repeated. The longer the time between changes, the lower the frequency of the noise generated. The level of noise depends on the amount of the change.

Principle

The exhaust from a slowly revolving tugboat engine produces a soft, thudding low-frequency noise

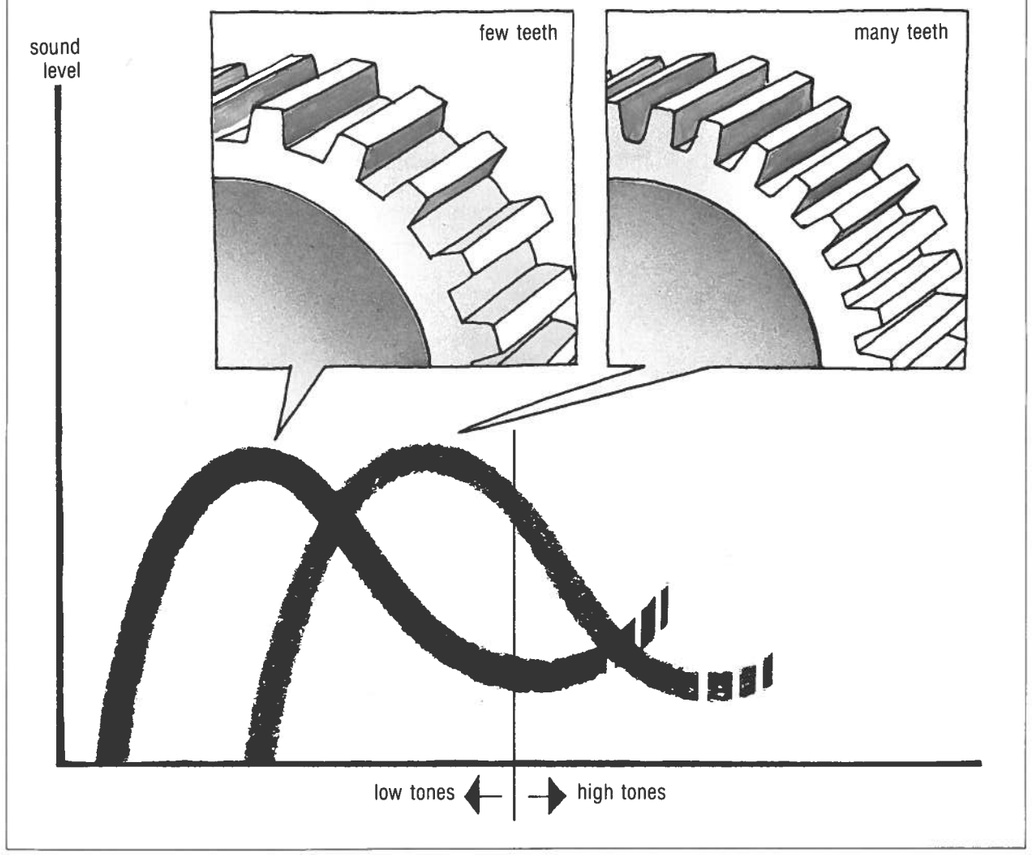


An outboard motor's rapidly repeated pressure shocks produce a higher frequency sound



Example

Two gears have the same pitch diameter but different numbers of teeth. If they rotate at the same speed, the gear with fewer teeth will produce a lower frequency noise.

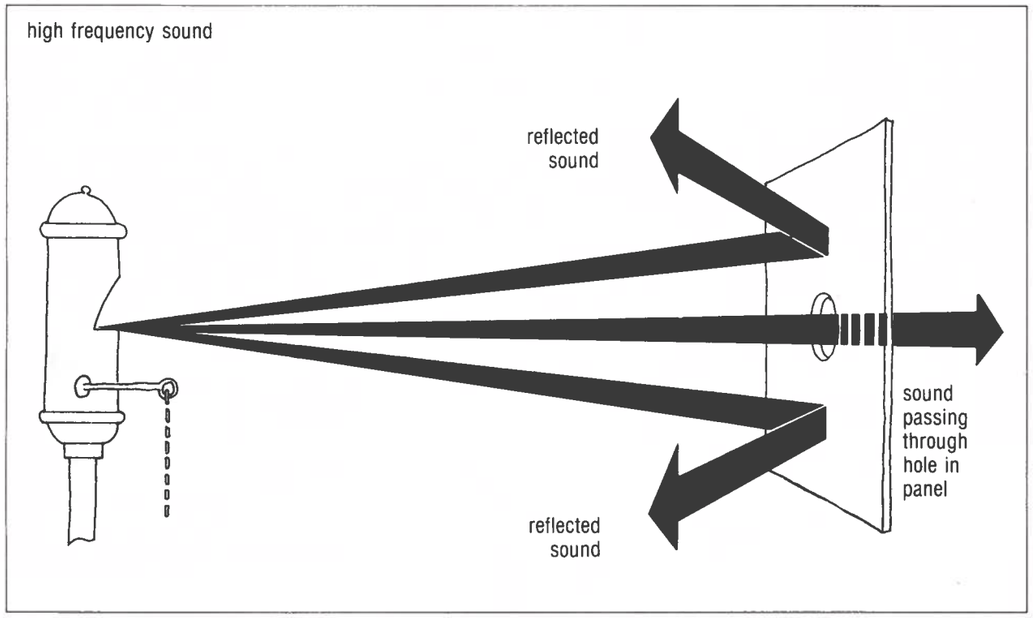


High frequency sound is strongly directional and more easily reflected

When high frequency sound strikes a hard surface, it is reflected much like light from a mirror.

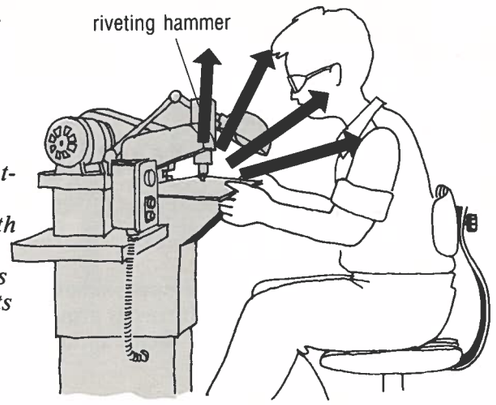
High frequency sound does not travel around corners easily.

Principle



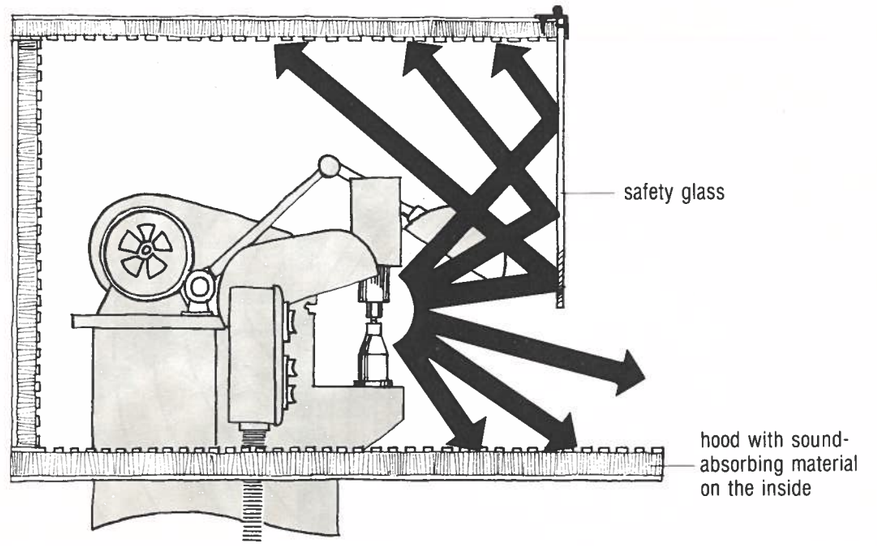
Example

High frequency noise travels directly from the high-speed riveting machine to the worker's ears.



Control measure

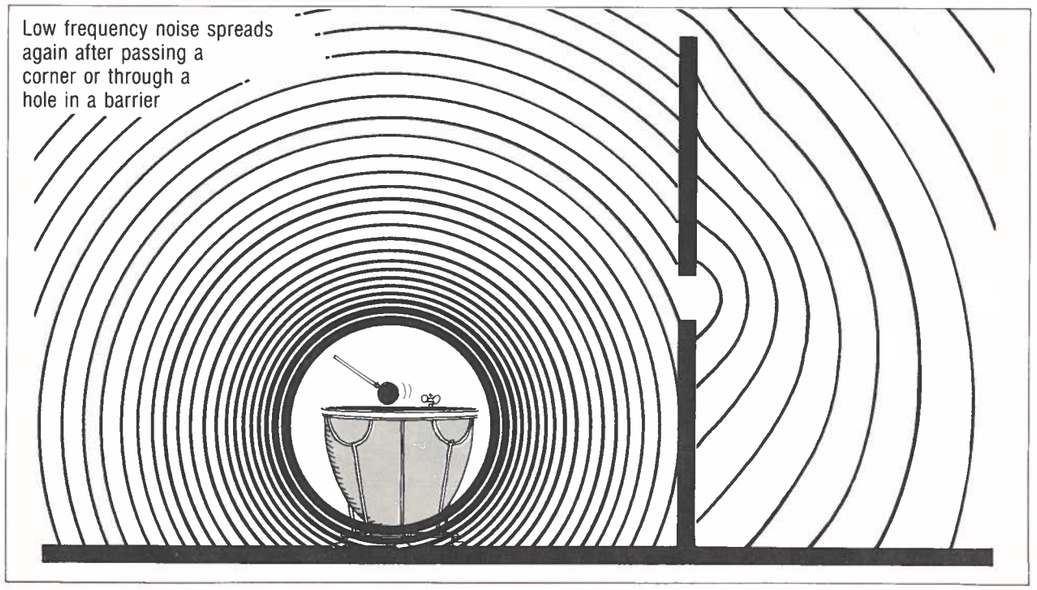
A sound-insulating hood, open toward the bottom of the machine, is constructed above the hammer. The hood is coated on the inside with sound-absorbing material. The upper portion of the opening is covered with safety glass. As sound starts towards the ears, the glass reflects it against the sound-absorbing walls. The sound level for the machine operator is thus reduced.



Low frequency noise travels around objects and through openings

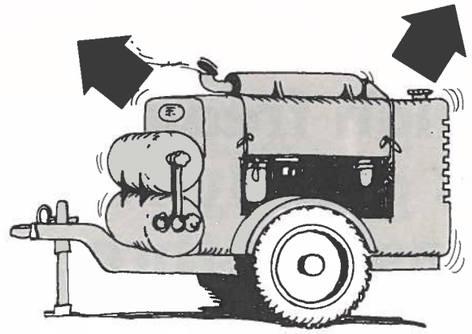
Low frequency noise radiates at approximately the same level in all directions. It travels around corners and through holes, and then continues to travel in all directions. A shield has little effect unless it is very large.

Principle



Example

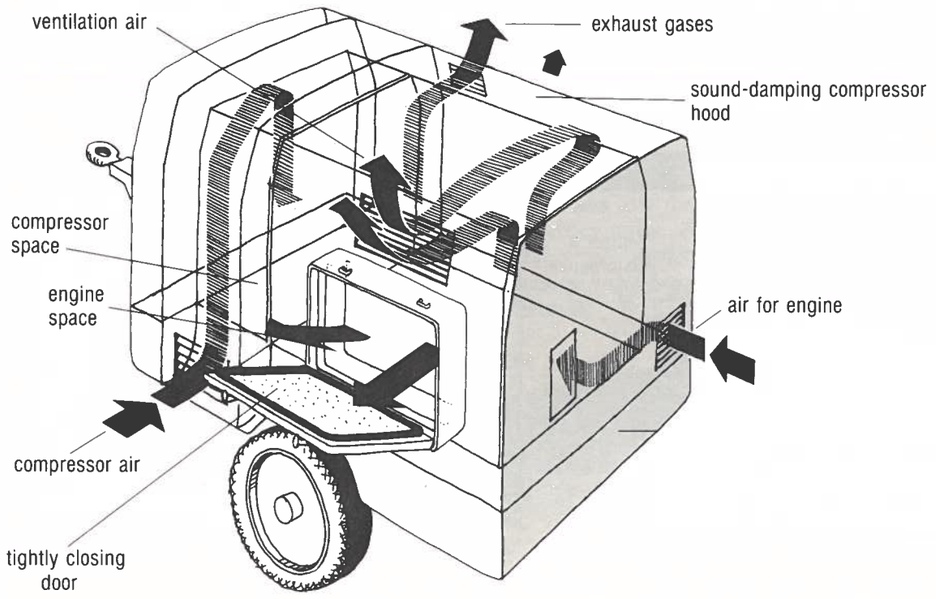
Compressors and the diesel engines inside them both may produce strong low frequency noise, even if they are provided with effective mufflers at the intake and exhaust.



non-sound controlled compressor

Control measure

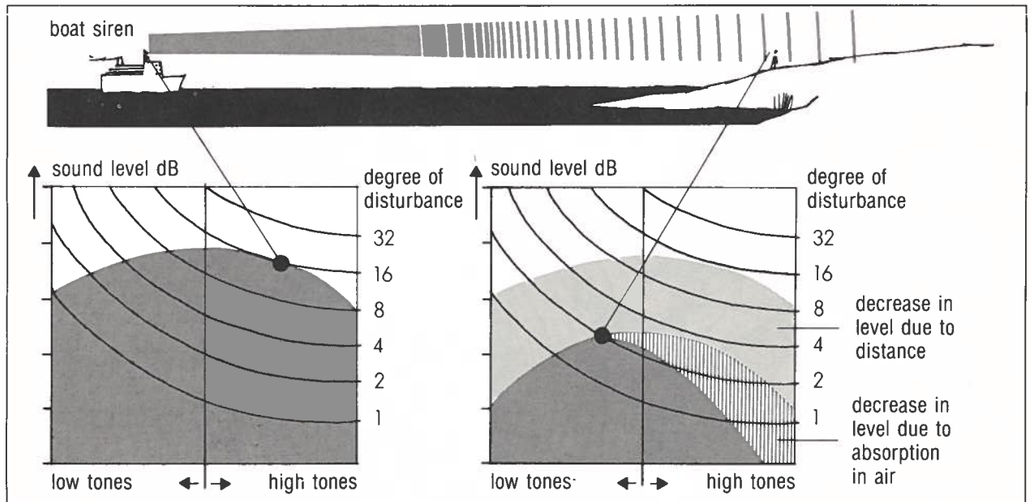
A complete enclosure of damped material lined with sound absorbant will help. The air and exhaust gases must pass through mufflers which are partly made of channels with sound-absorbing walls. Doors for inspection must close tightly.



High frequency sound is greatly reduced by passing through air

High frequency sound is reduced more effectively than low frequency sound by passing through air. In addition, it is easier to insulate and shield. If the noise source does not cause problems in its immediate vicinity, it may therefore be worthwhile to shift the sound toward higher frequencies.

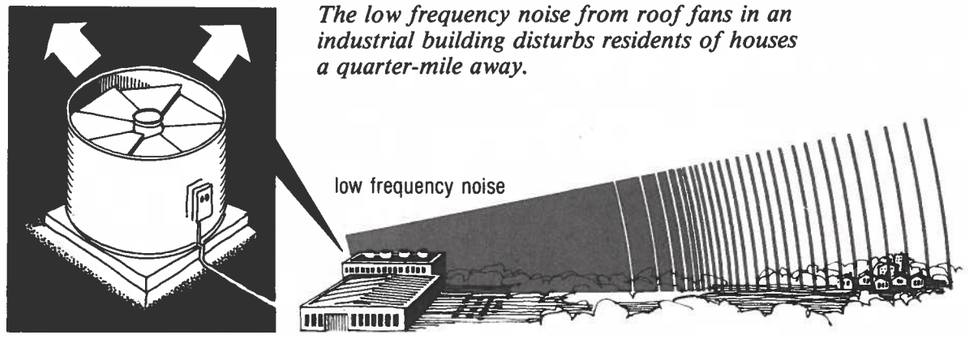
Principle



The boat whistle, which seems extremely loud to those on board, is much less loud at a distance

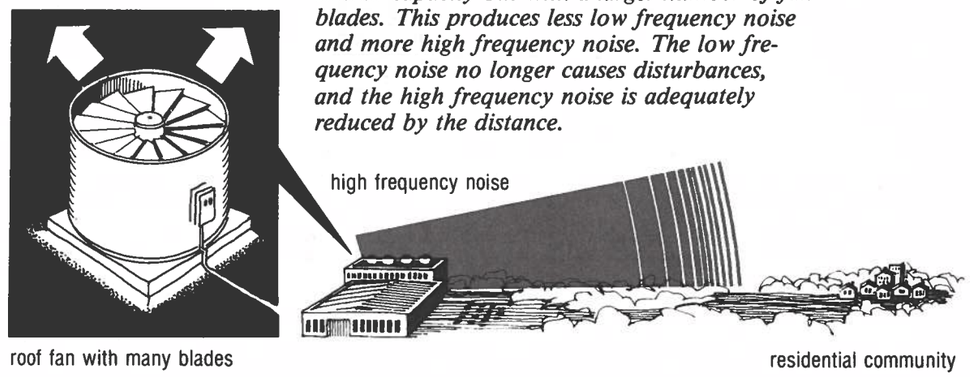
Example

The low frequency noise from roof fans in an industrial building disturbs residents of houses a quarter-mile away.



Control measure

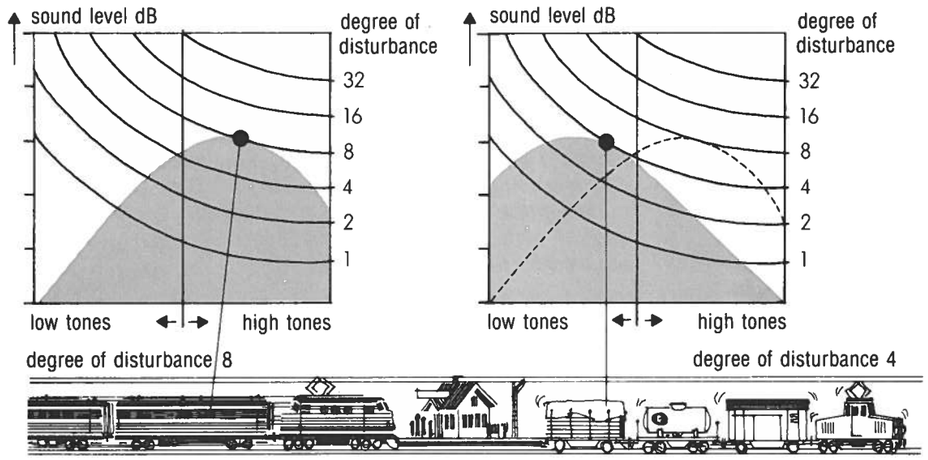
The rooftop fan is replaced by another one of similar capacity but with a larger number of fan blades. This produces less low frequency noise and more high frequency noise. The low frequency noise no longer causes disturbances, and the high frequency noise is adequately reduced by the distance.



Low frequency noise is less disturbing

The human ear is less sensitive to low frequency noise than to high frequency noise. If it is not possible to reduce the noise, it may be possible to change it so that more of it is at lower frequencies.

Principle



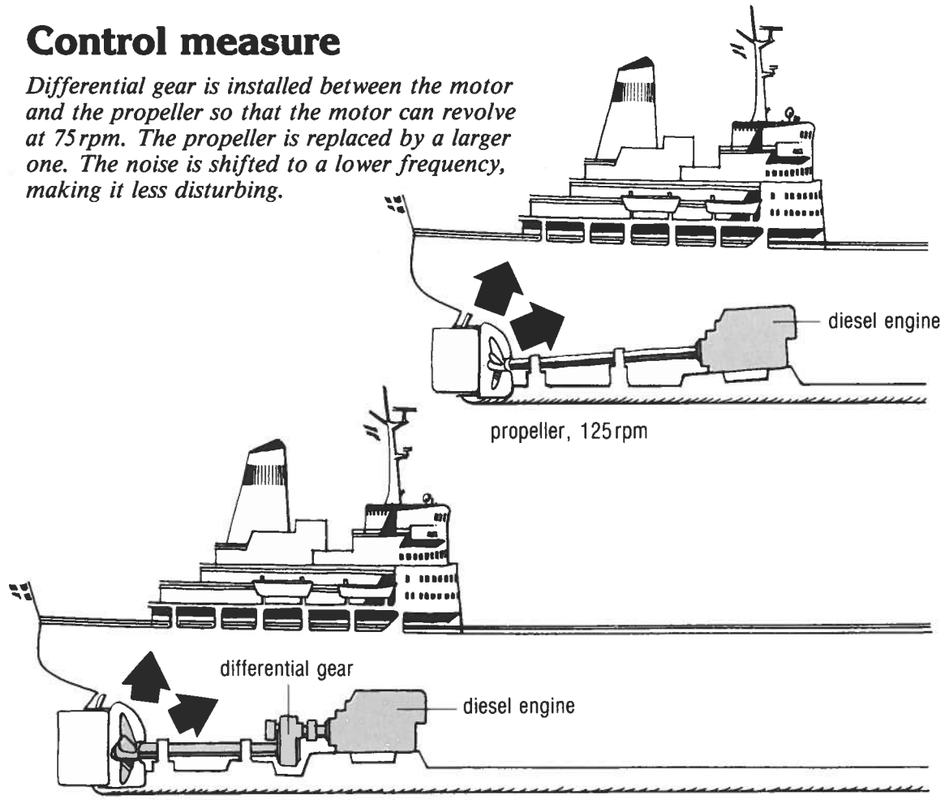
Two passing trains make equal amounts of noise but one is more disturbing because it moves faster, causing more rapid impacts and creating higher frequency noise

Example

The diesel engine in a ship operates at 125 rpm and is directly connected to the propeller. The noise from the propeller is extremely disturbing on board.

Control measure

Differential gear is installed between the motor and the propeller so that the motor can revolve at 75 rpm. The propeller is replaced by a larger one. The noise is shifted to a lower frequency, making it less disturbing.

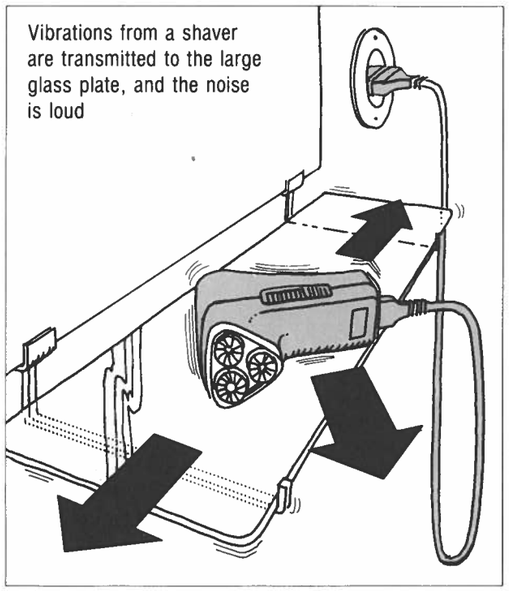


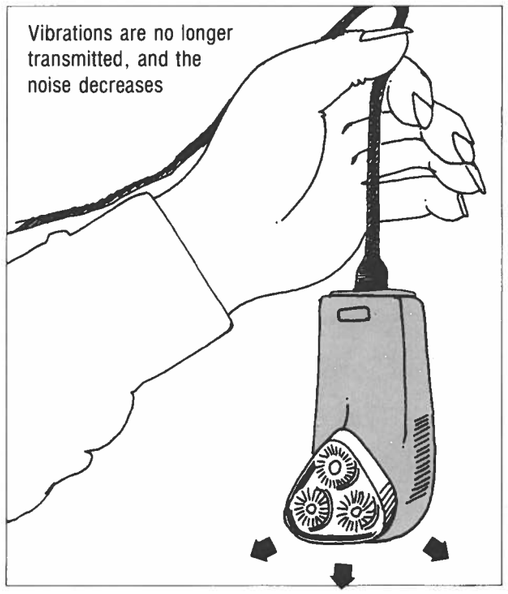
larger propeller, 75 rpm

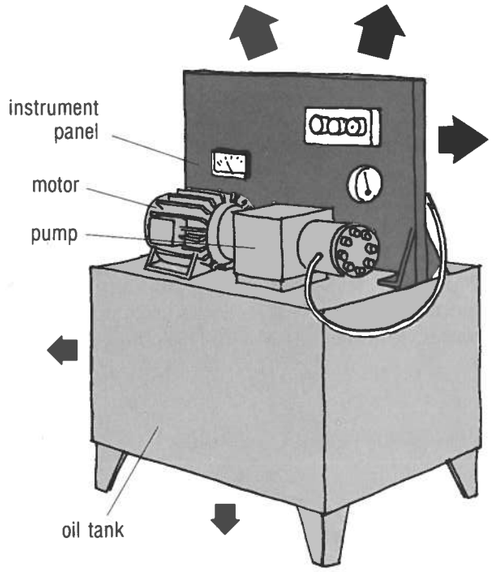
Small vibrating surfaces give off less noise than large ones

An object with a small surface area may vibrate intensely without a great deal of noise radiation. The higher the frequencies, the smaller the surface must be to prevent disturbance. Since machines always will vibrate to some extent, noise control will be aided if the machines are kept as small as possible.

Principle





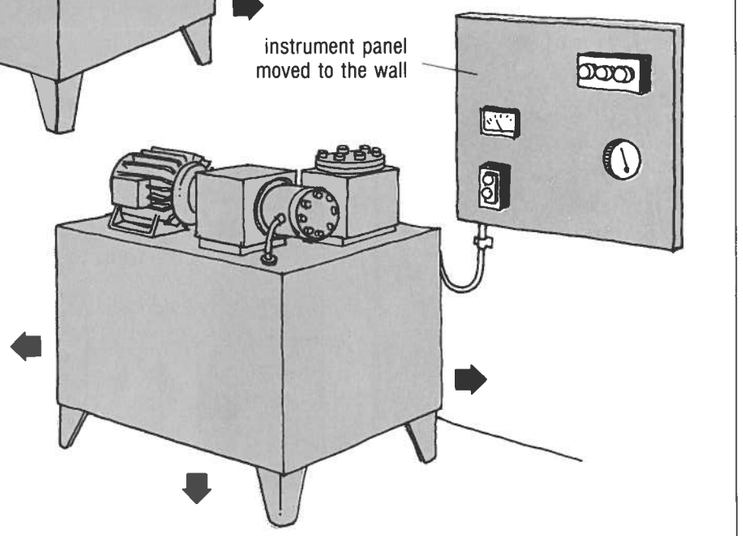


Example

Too much noise is radiated from the control panel of a hydraulic system.

Control measure

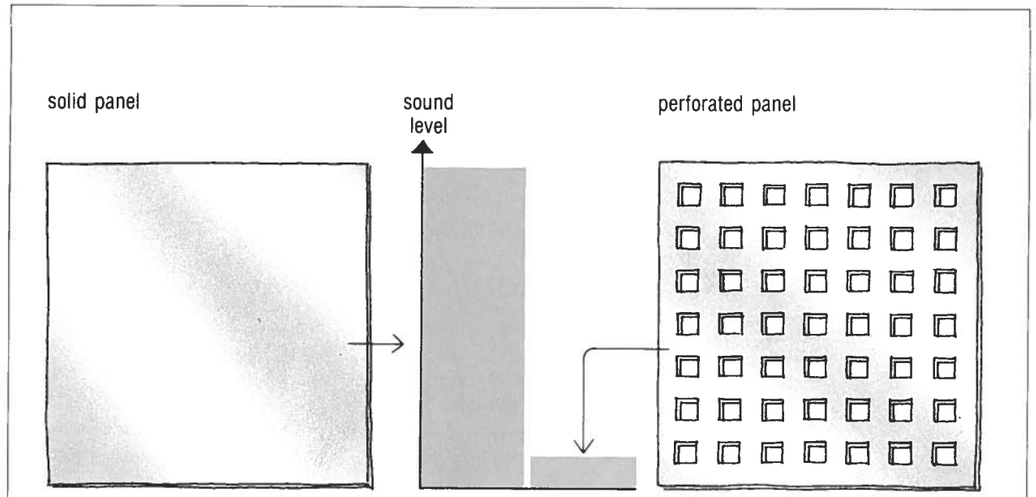
The panel is detached from the system itself, the vibrating surface is reduced, and therefore the noise level is decreased.

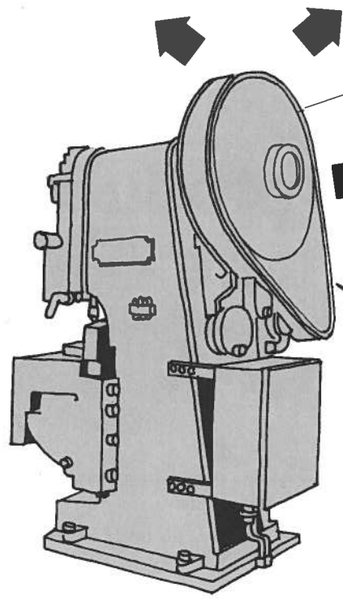


Densely perforated plates produce less noise

Large vibrating surfaces cannot always be avoided. The vibrating surface pumps air back and forth like the piston of a pump, causing sound radiation. If the panel is perforated, the "piston" leaks, and the pumping functions poorly. Alternatives to perforated plates include mesh, gratings and expanded metal.

Principle



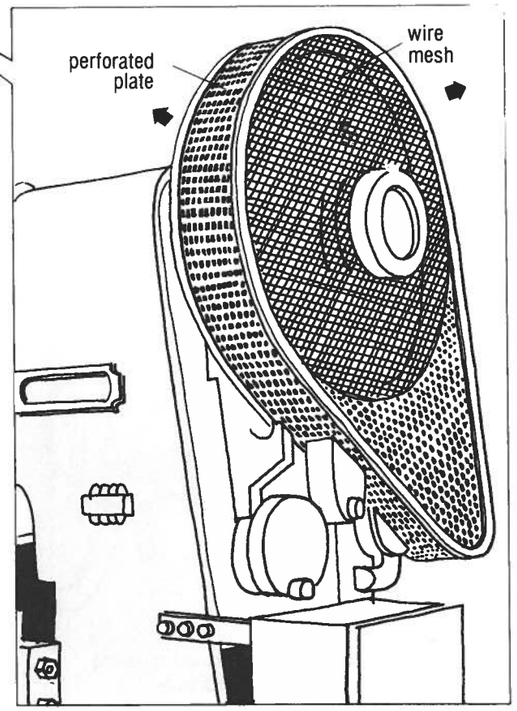


Example

The protective cover over the flywheel and belt drive of a press is a major noise source. The cover is made of solid sheet metal.

Control measure

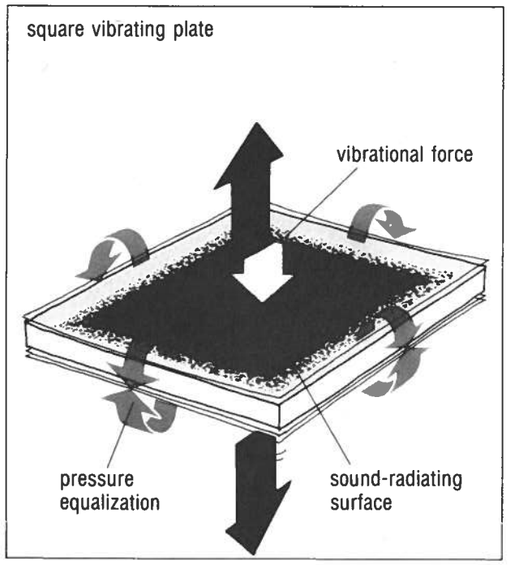
A new cover is made of perforated sheet metal and wire mesh. Sound radiation is reduced.

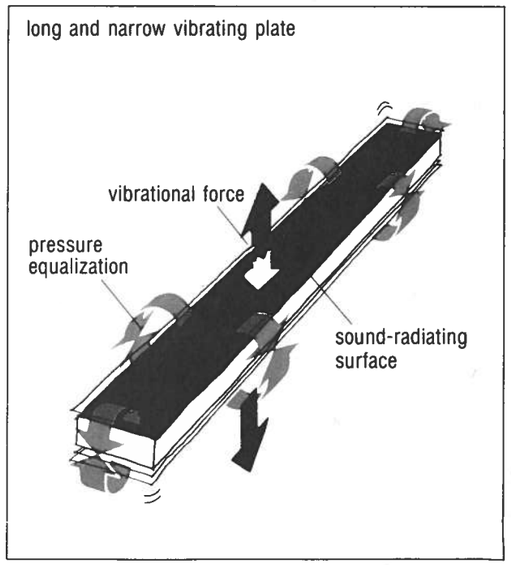


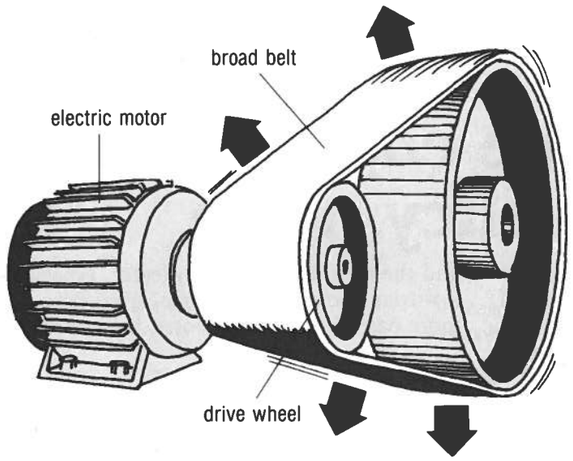
A long, narrow plate produces less sound than a square one

When a plate is set into vibration, excess air pressure forms on one side of the plate and then the other. Sound comes from both sides. The pressure difference balances out close to the edges, so the noise radiation there is slight. Therefore, a long, narrow plate radiates less sound.

Principle

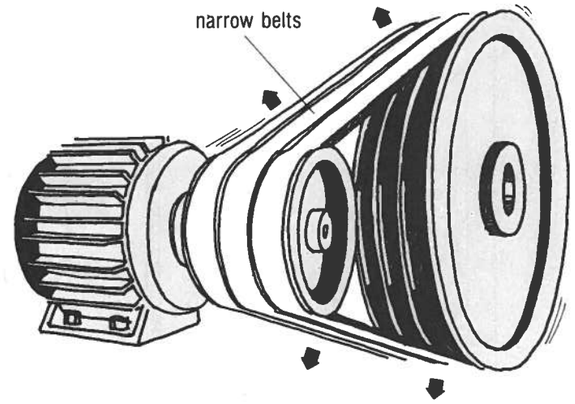






Example

A belt drive provides a large amount of low frequency noise because of the vibration of the broad belt.



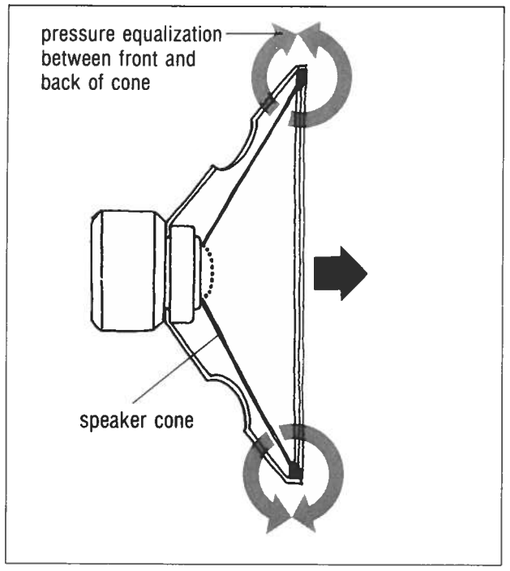
Control measure

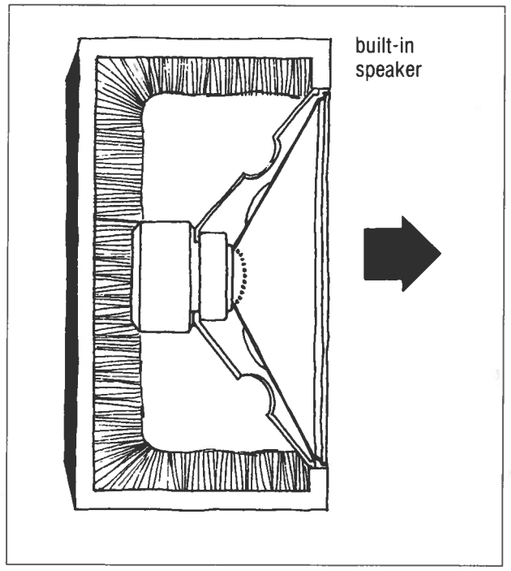
The broad drive belt is replaced by narrower belts, separated by spacers. This reduces the noise problem.

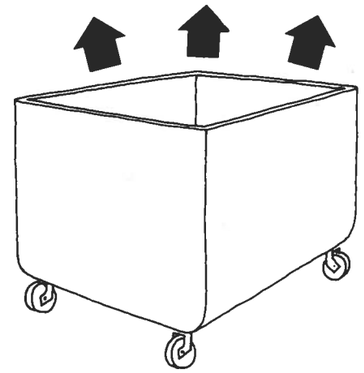
Plates with free edges produce less low frequency noise

If a plate vibrates with free edges, pressure equalization takes place between the two sides of the plate, thus reducing sound emissions. Clamping the corners prevents pressure equalization and the sound emission is greater, especially at low frequencies. For example, speakers produce more bass if they are enclosed in a cabinet.

Principle





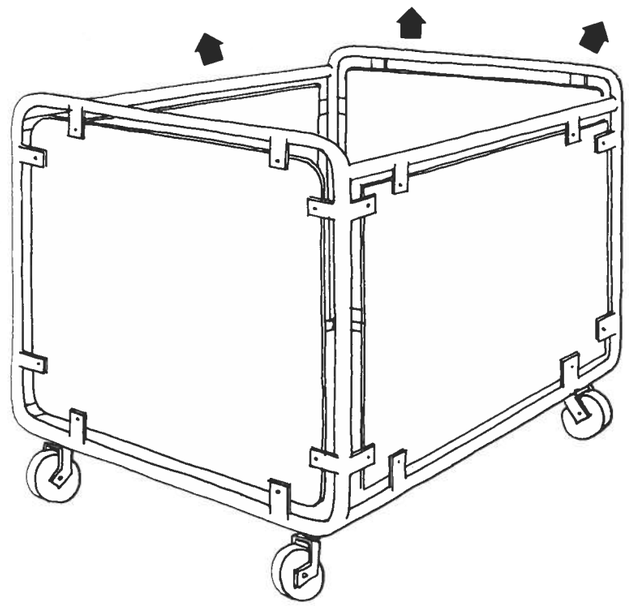


Example

Bumps in the floor produce noise from the bottom and side plates of a cart when the cart is pushed. Sound is also emitted when material is slid down the cart walls. Pressure equalization only takes place at the top edges of the side plates.

Control measure

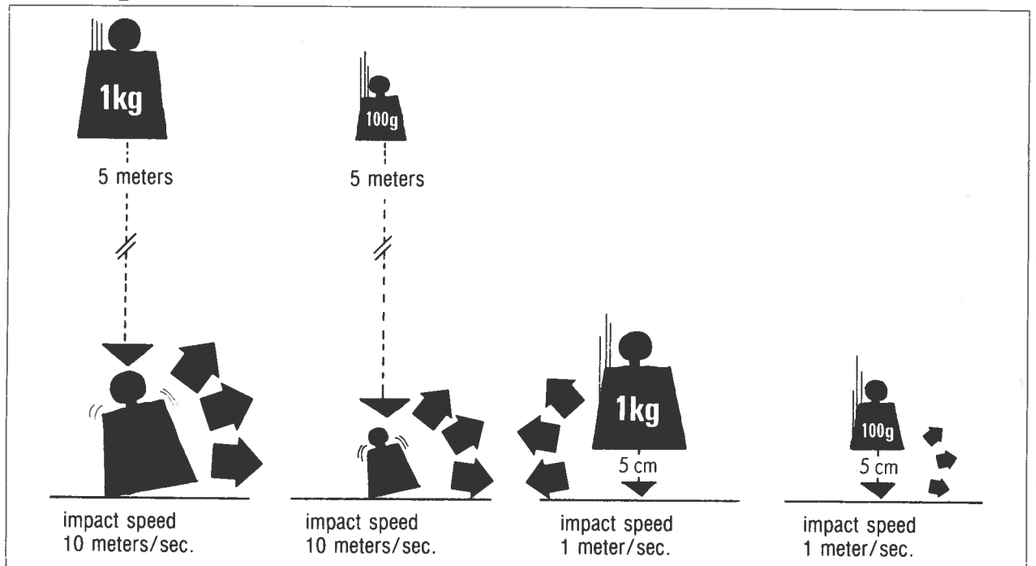
The walls are replaced by new ones, constructed with a pipe frame. Plates are fastened with a gap between the plates and the frame. Pressure equalization takes place along all the edges, and the low frequency noise is reduced.

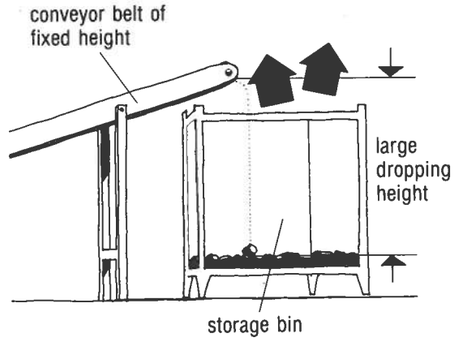


Light objects and low speed produce the least impact noise

When a plate is struck by an object, the plate vibrates and makes noise. The sound level is determined by the weight of the object and its striking speed. If the dropping height of an object is reduced from 5 meters (about 16 feet) to 5 centimeters (2 inches), the sound level drops about 20dB.

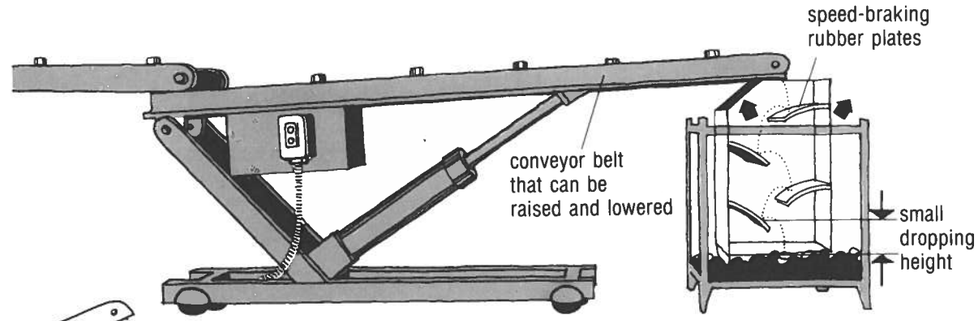
Principle





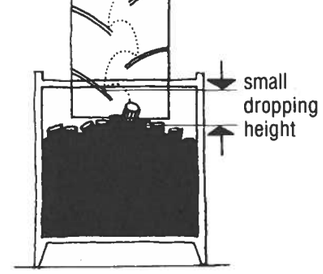
Example

Steel parts are transported from a machine to a storage bin. When the bin is empty, the dropping height is large and the noise is loud.



Control measure

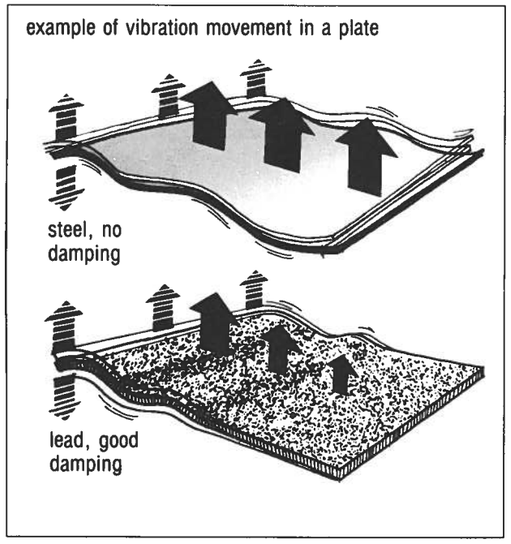
A hydraulic system is installed so that the conveyor belt can be raised and lowered. The belt ends in a drum equipped with rubber plates to break the fall of the parts. The drum is raised automatically.

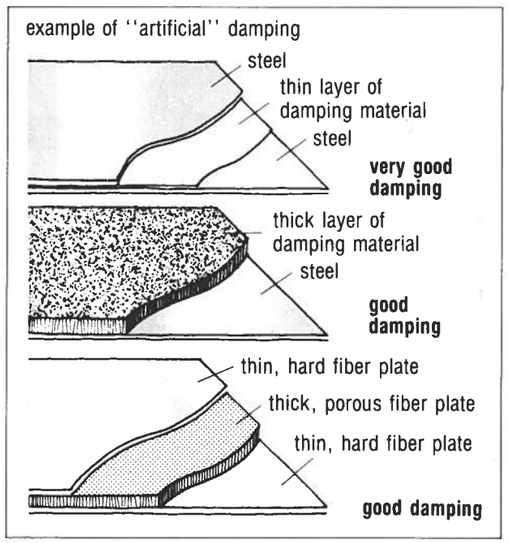


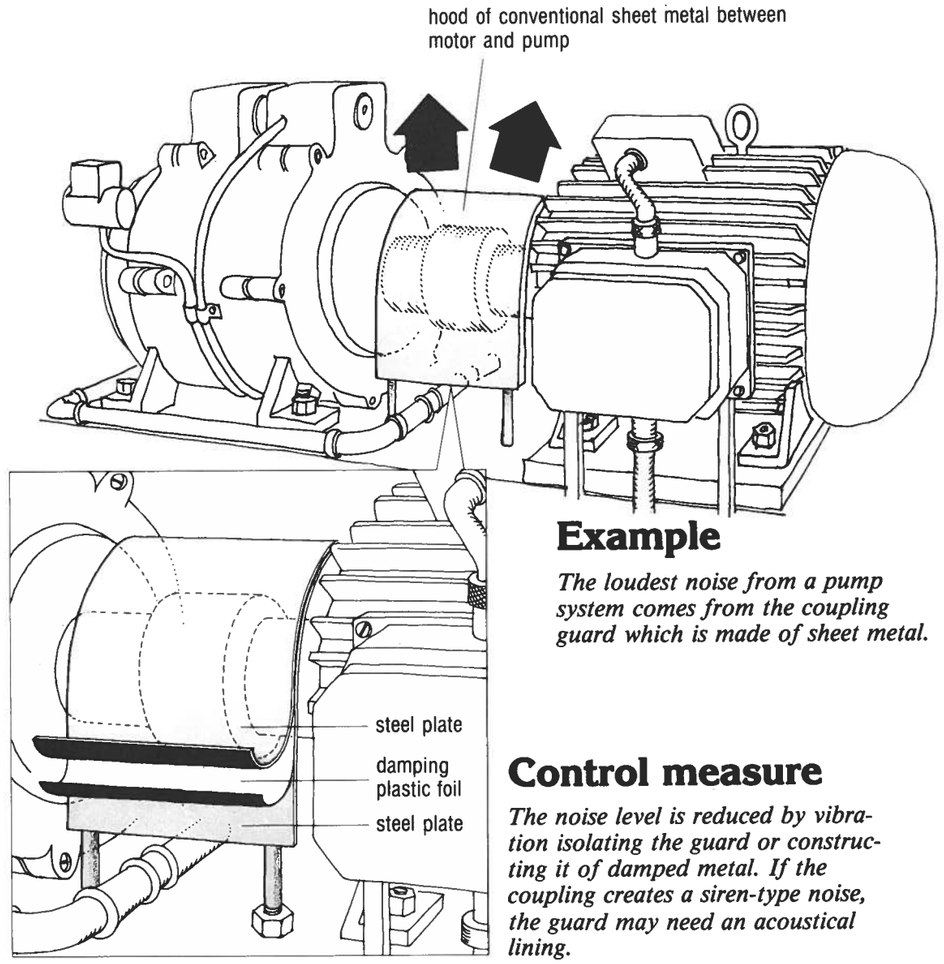
A damped surface gives off less sound

As vibration moves throughout a plate, it gradually decreases as it travels, but in most plates, this reduction is rather small. In such cases, the material is said to have low internal damping. Internal damping in steel, for example, is extremely poor. Good damping can be achieved by adding coatings or intermediate layers with better internal damping.

Principle







Example

The loudest noise from a pump system comes from the coupling guard which is made of sheet metal.

Control measure

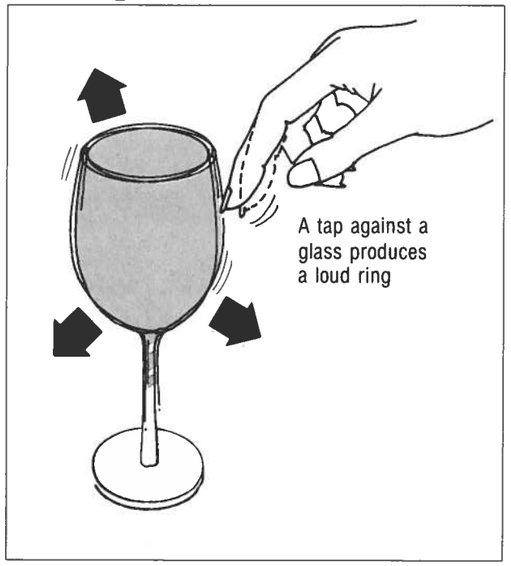
The noise level is reduced by vibration isolating the guard or constructing it of damped metal. If the coupling creates a siren-type noise, the guard may need an acoustical lining.

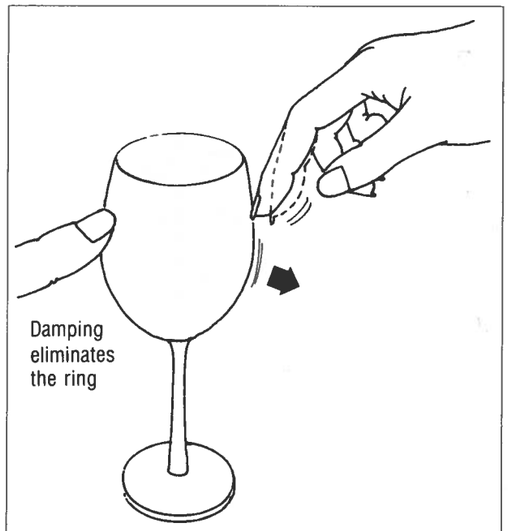
Resonance increases noise but it can be damped

Resonance greatly increases noise from a vibrating plate, but it can be suppressed or prevented by damping the plate.

It may often be sufficient to damp only part of the surface, and, in some rare cases, damping of a single point is effective.

Principle



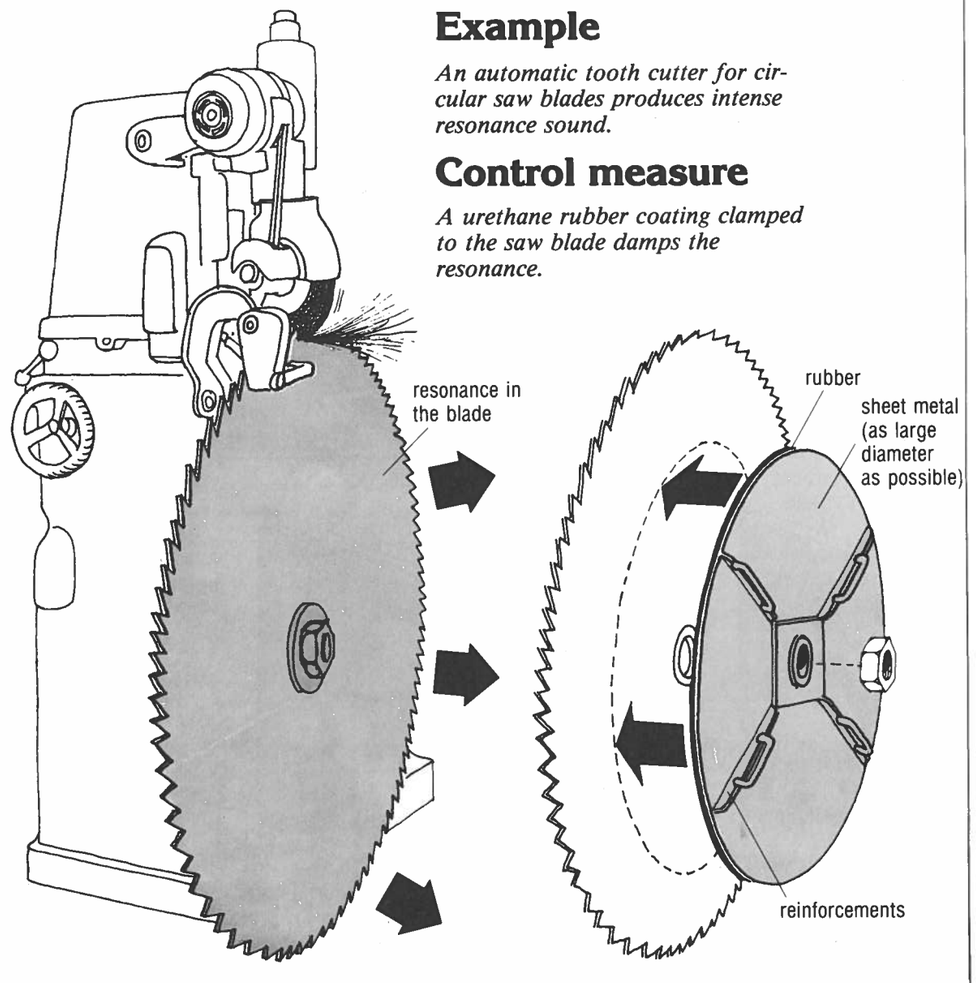


Example

An automatic tooth cutter for circular saw blades produces intense resonance sound.

Control measure

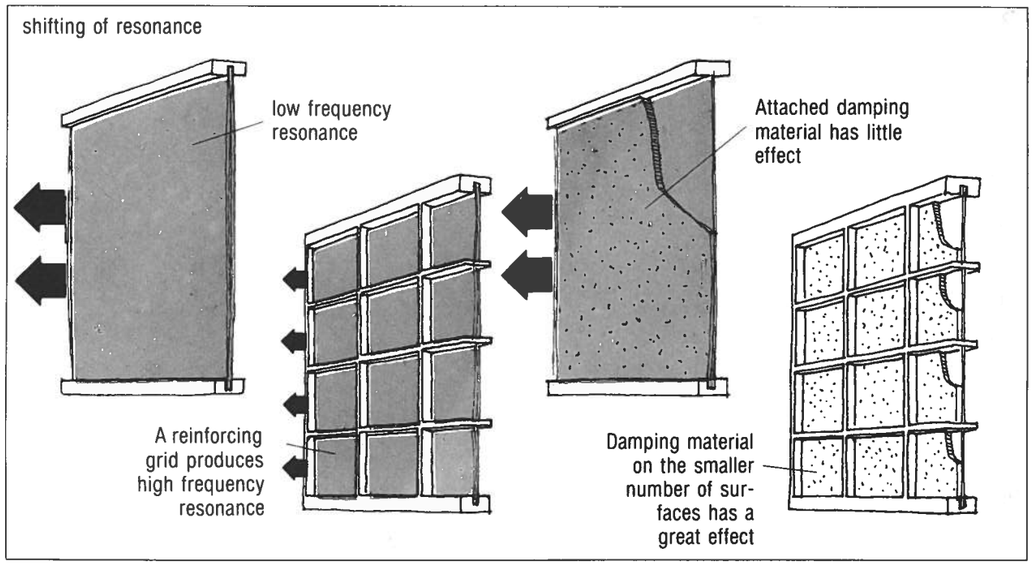
A urethane rubber coating clamped to the saw blade damps the resonance.

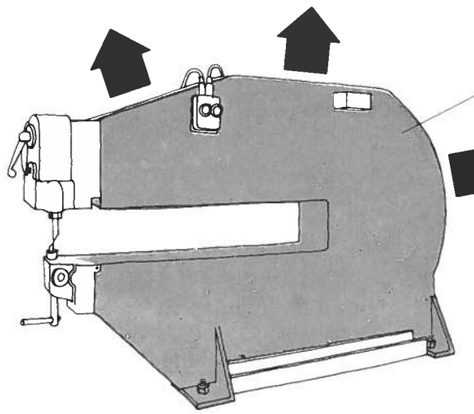


Resonance shifted to higher frequency is more easily damped

Large vibrating plates often have low frequency resonance which can be difficult to damp. If the plate is stiffened, the resonance shifts to higher frequency, which can be more easily damped.

Principle



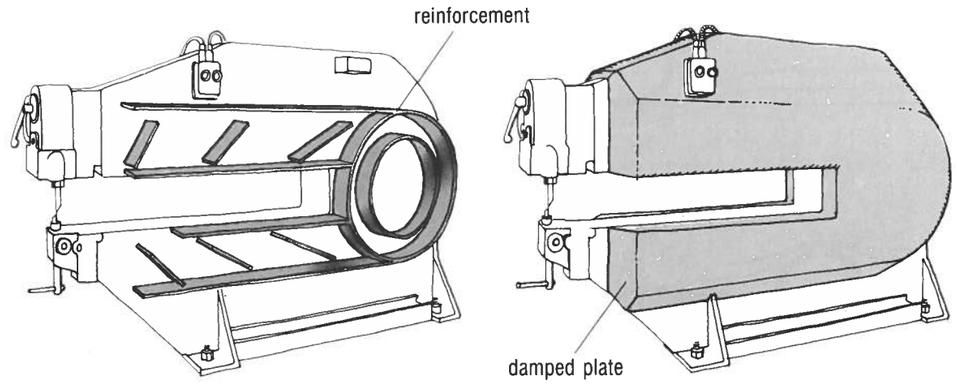


Example

The greatest low frequency sound from this machine comes from the side surfaces of the machine stand.

Control measure

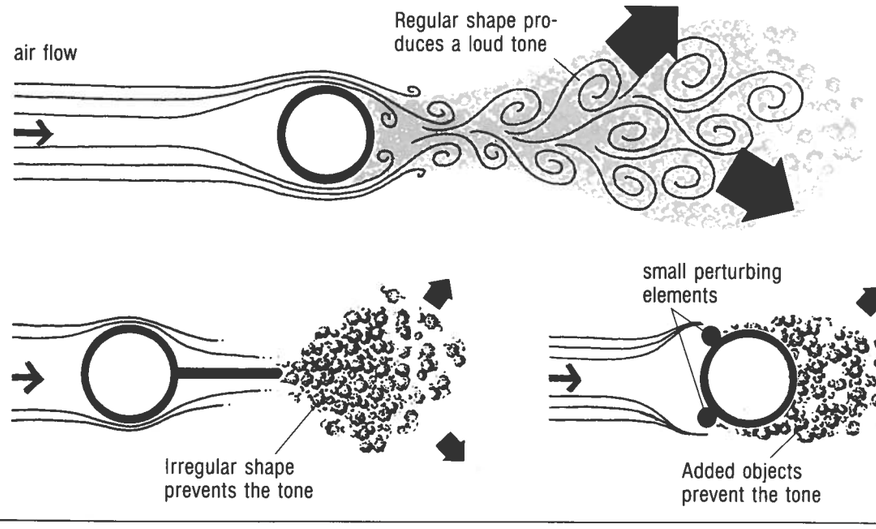
The side plates on the machine are stiffened with iron straps. A damped plate is installed over the braces.

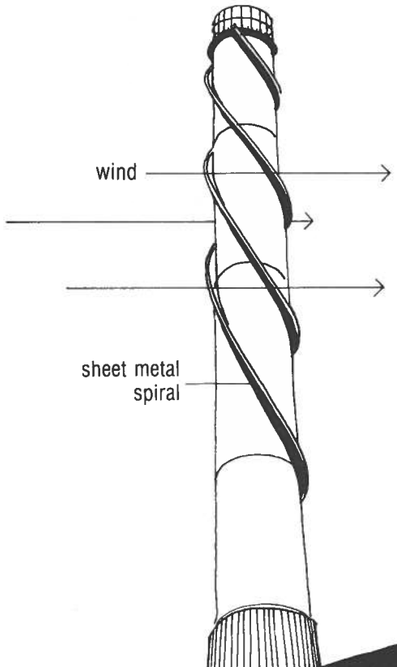


Wind tones can be eliminated

When air passes by an object at certain speeds, a strong pure tone, known as a Karman tone, can be produced. This can be prevented by making the object longer in the direction of flow, such as with a "tail," or by making the object's shape irregular.

Principle



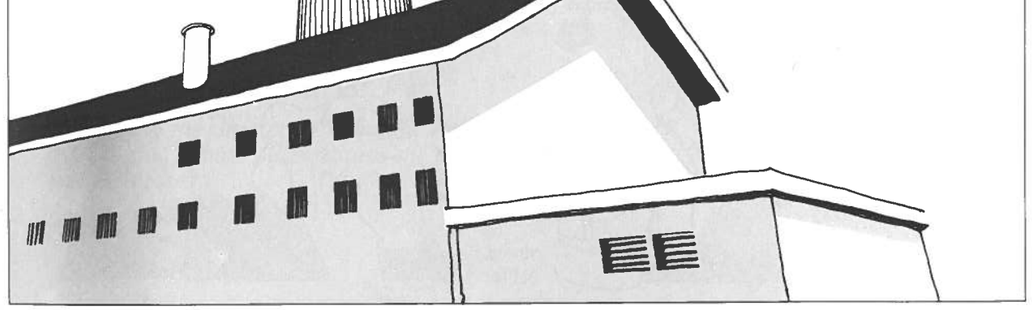


Example

At certain wind speeds, loud sounds can form around smoke stacks, causing disturbances.

Control measure

A strip of sheet metal is mounted on the smoke stack in a spiral. The pitch of the spiral must not be constant. Regardless of the wind's direction, it encounters an irregular object.

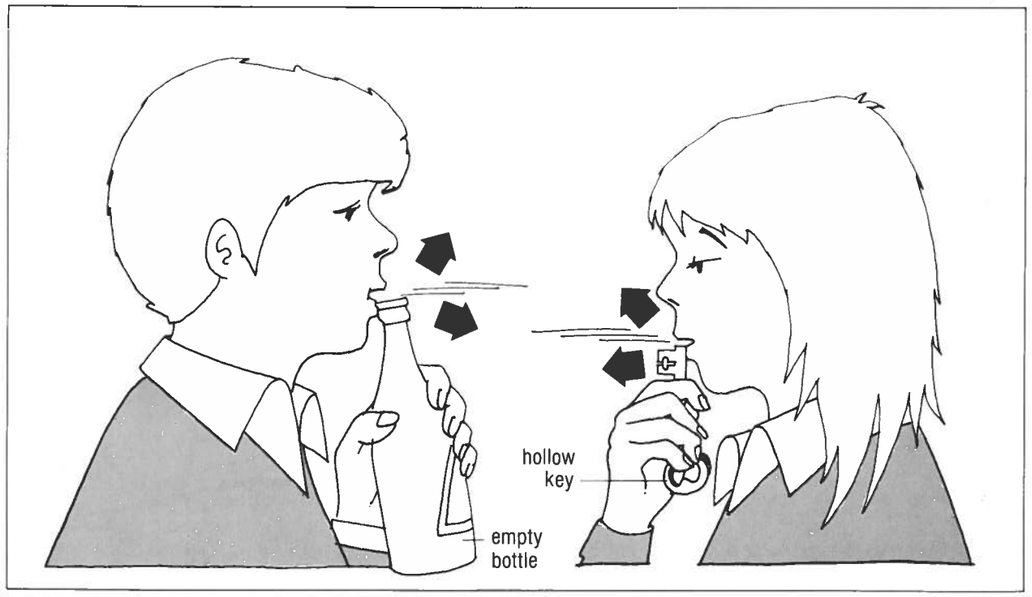


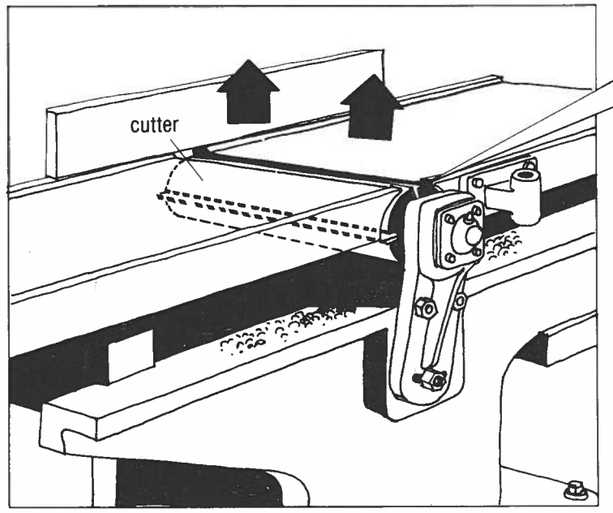
Air flow past hollow openings should be avoided

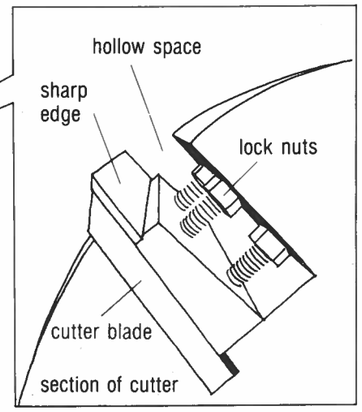
When air or another gas blows across the edges of an opening to a hole, loud, pure tones are formed. This is how a wind instrument operates.

The greater the volume of the hole and the smaller the number of openings, the lower the frequency of the tone will be.

Principle

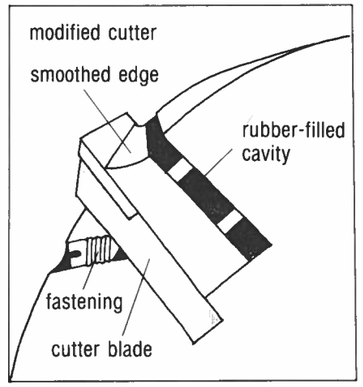






Example

When a cutter wheel revolves under no-load conditions, sound can arise from the track for holding the plane blade. An air stream is being chopped, creating a siren (pure tone) noise.



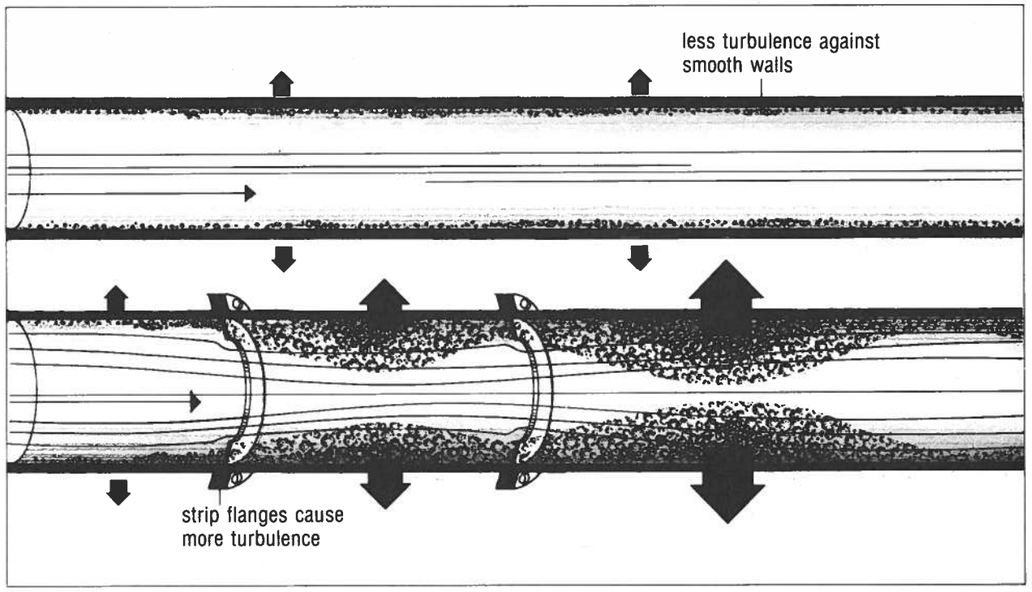
Control measure

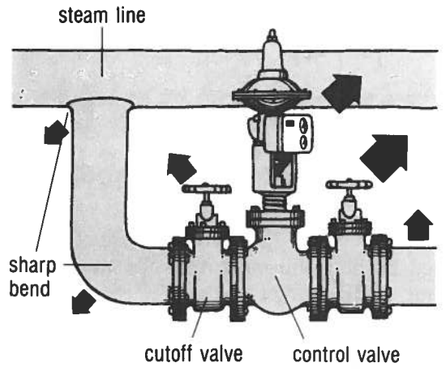
Minimizing the cavities by filling the empty space in the track with a rubber plate reduces the pumping action and the noise.

Ducts without impediments produce the least amount of noise from turbulence

During flow in ducts or pipes there is always some turbulence against the duct walls. The noise from turbulence is increased if the flow must rapidly change direction, if the flow moves at a fast rate, and if objects blocking the flow are close together.

Principle



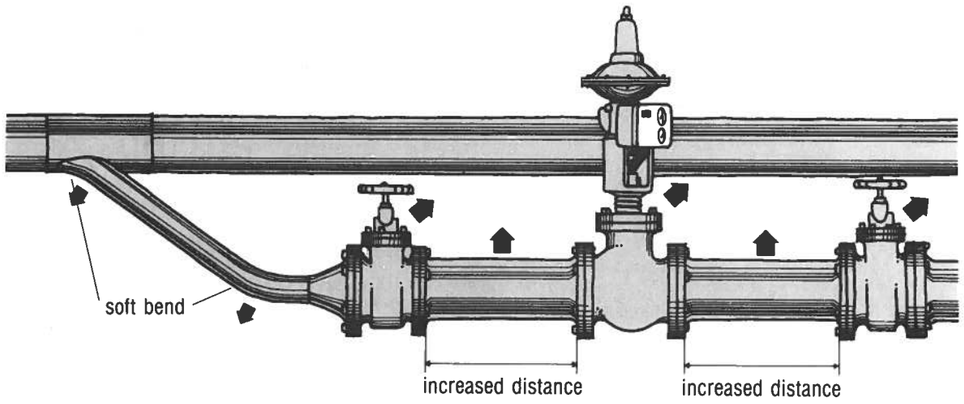


Example

A branch of a steam line has three valves which produce a loud shrieking sound. The branch has two sharp bends which also produce a lot of noise.

Control measure

A new branch is created with softer bends. Tubing pieces are placed between the valves, so that turbulence will be reduced or eliminated before the stream reaches the next valve.

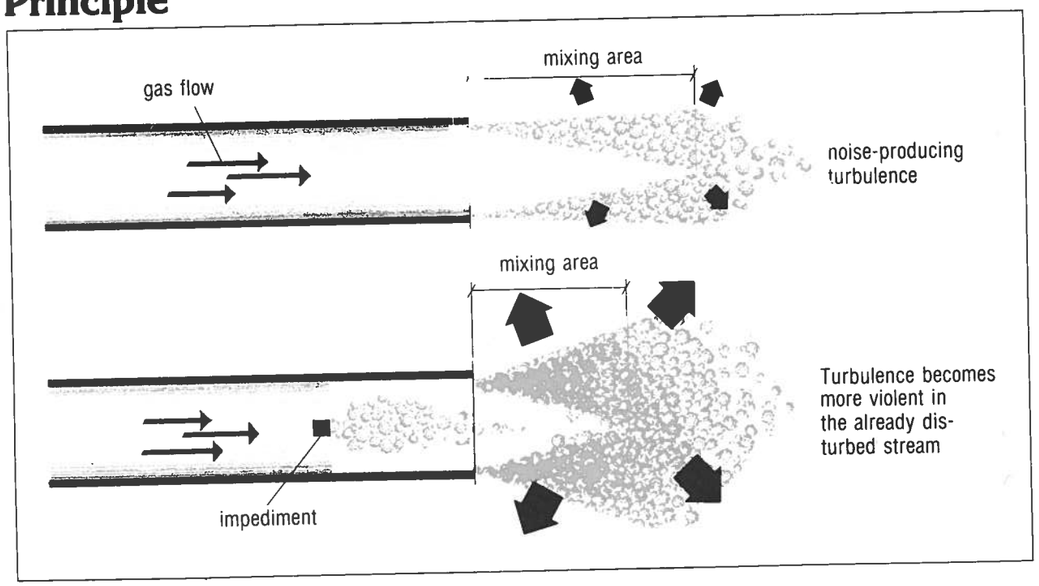


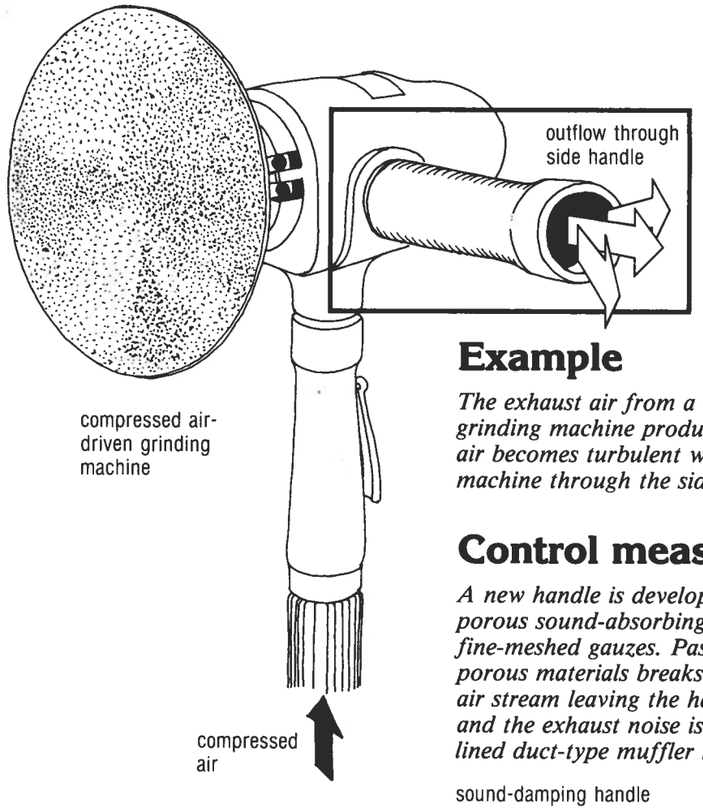
Undisturbed flow produces the smallest amount of exit noise

When a flowing gas mixes with a non-moving gas, noise may be produced, especially if the flow is disturbed before the outlet. A lower outflow speed will produce a lower sound level.

For speeds below 325 feet/sec., reduction of the speed by half will mean that the sound will be about 15 dB weaker.

Principle



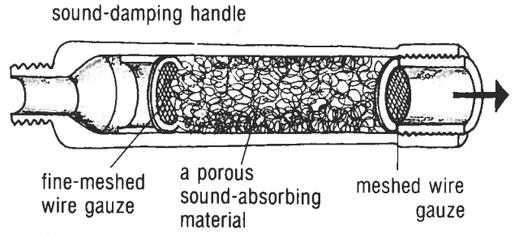


Example

The exhaust air from a compressed air-driven grinding machine produces a loud noise. The air becomes turbulent while leaving the machine through the side handle.

Control measure

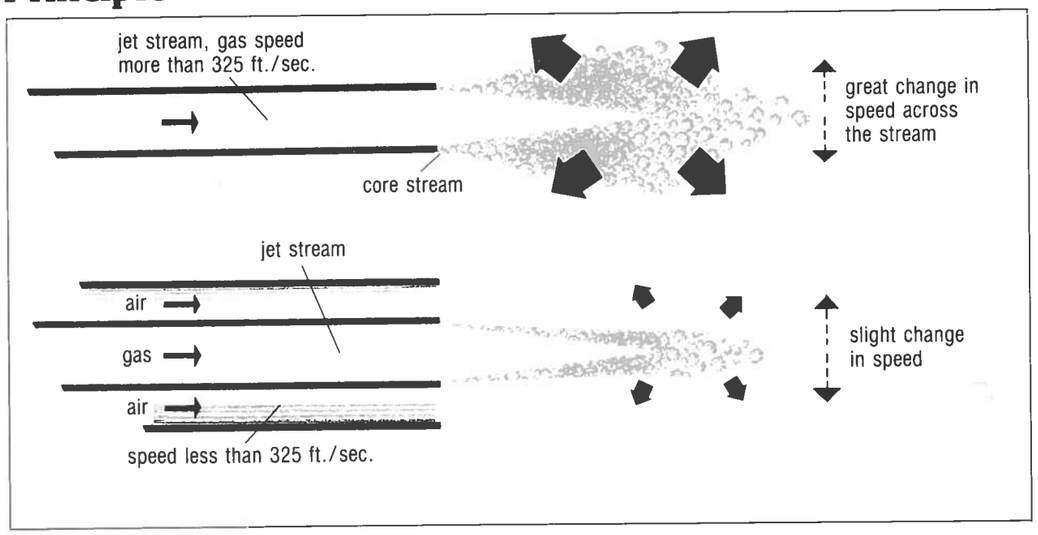
A new handle is developed, filled with a porous sound-absorbing material between two fine-meshed gauzes. Passage through the porous materials breaks up the turbulence. The air stream leaving the handle is less disturbed, and the exhaust noise is weaker. A straight lined duct-type muffler may also be used.

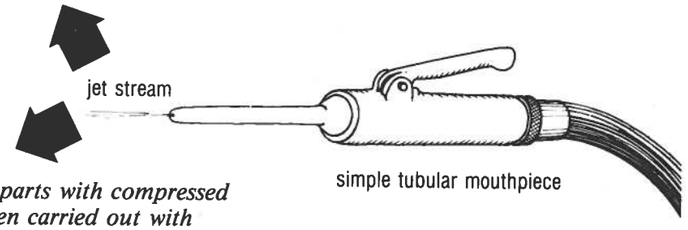


Jet noise can be reduced by using an extra air stream

The term "jet stream" applies at flow speeds in excess of 325 ft/sec. Turbulence outside the outlet is great. Reducing the outflow speed by half may decrease the noise level by as much as 20 dB. Since the noise level is determined by the speed of the jet stream in relation to the speed of the surrounding air, noise production can be greatly reduced by using an air stream with a lower speed outside the jet stream.

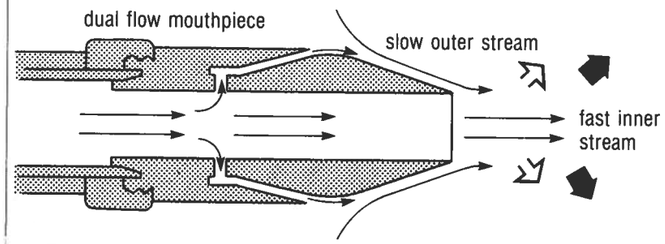
Principle





Example

The cleaning of machine parts with compressed air after processing is often carried out with simple tubular mouthpieces. Very high exit speeds are required, and a strong high frequency noise develops.



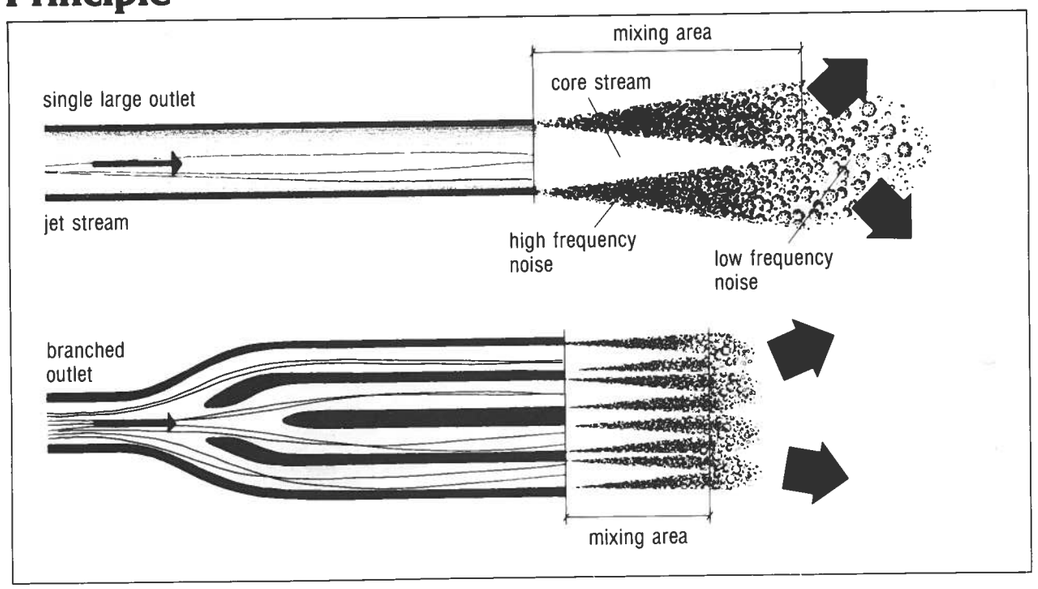
Control measure

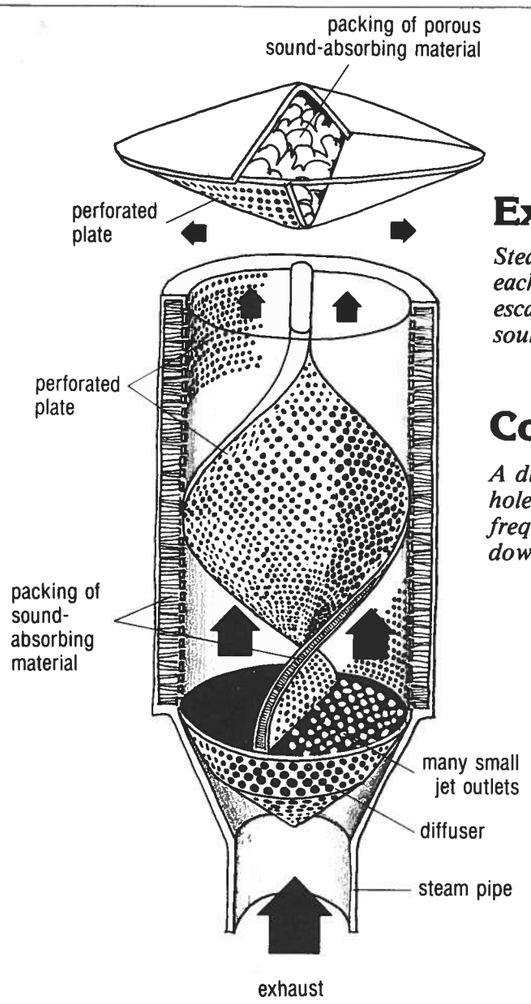
The simple tubular mouthpiece can be replaced by mouthpieces which produce less noise, such as a dual flow mouthpiece. In this mouthpiece, part of the compressed air moves at a lower speed outside the central stream.

Low frequency jet noise is easier to reduce if converted to high frequency

If the diameter of a gas outlet is large, the noise will peak at the low frequency. If the diameter is small, the noise will peak at high frequency. The low frequency noise can be reduced by replacing a large outlet with several small ones. To some extent this will increase the high frequency noise, but this is more easily controlled.

Principle





Example

Steam safety valves may discharge many times each day. Sound production during steam escape can produce high level, low frequency sound.

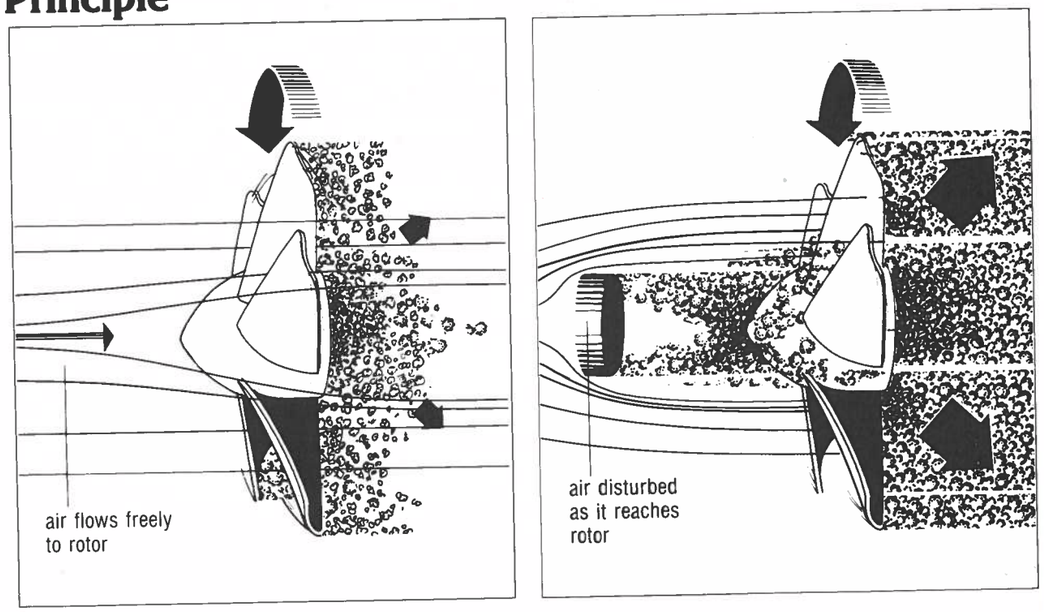
Control measure

A diffuser is formed as a perforated cone. The holes produce many small jet streams and high frequency noise which is absorbed in the down-stream pack.

Fans make less noise if placed in smooth, undisturbed flow streams

A fan produces turbulence in air, which causes noise. If turbulence is already present in the incoming air, the sound will be more intense. The same principle applies, for example, to propellers in water.

Principle

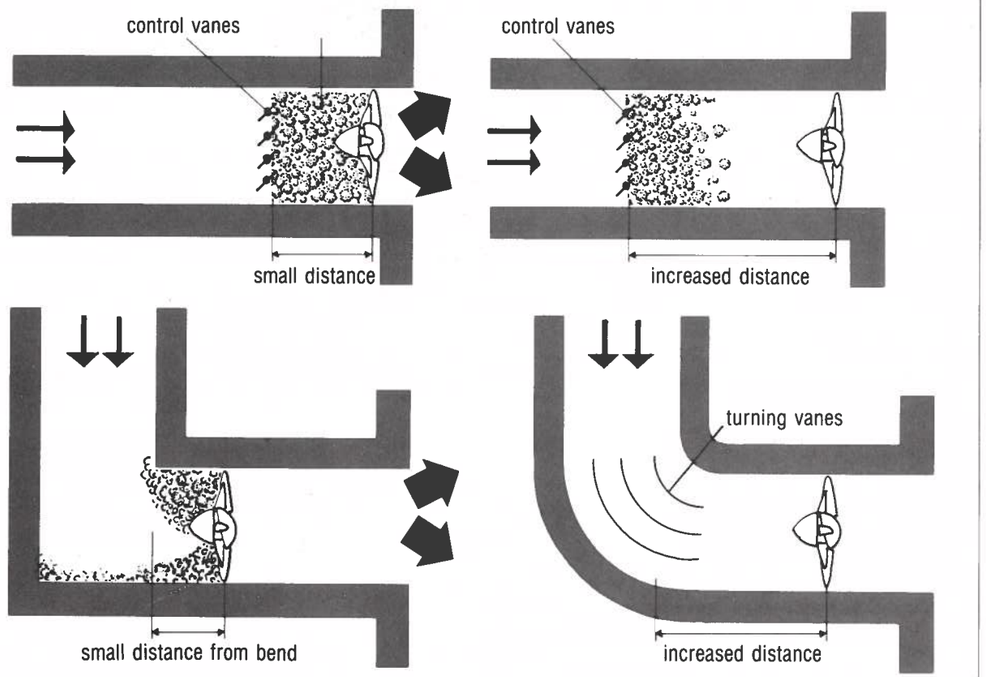


Example

In one case the fan is located too close to a barrier, and in the other case too close to a sharp bend. The flow is disturbed and the noise at the outlet is intense.

Control measure

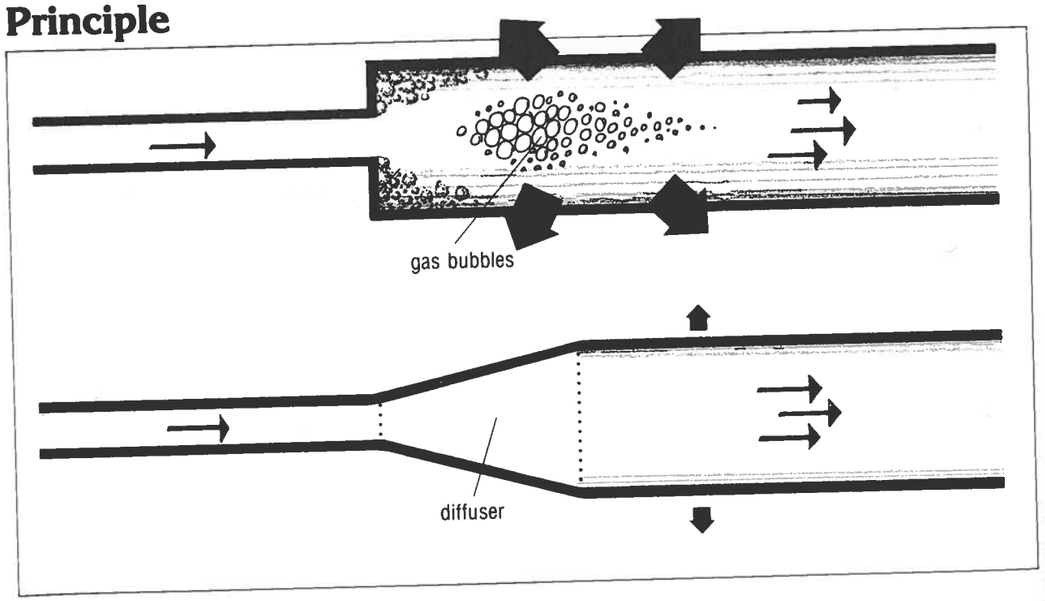
The control vanes are moved farther from the fan so that the turbulence has time to die down. In the other case, the bend is made smoother, and the fan is moved away from the bend. Turning vanes could also be used.

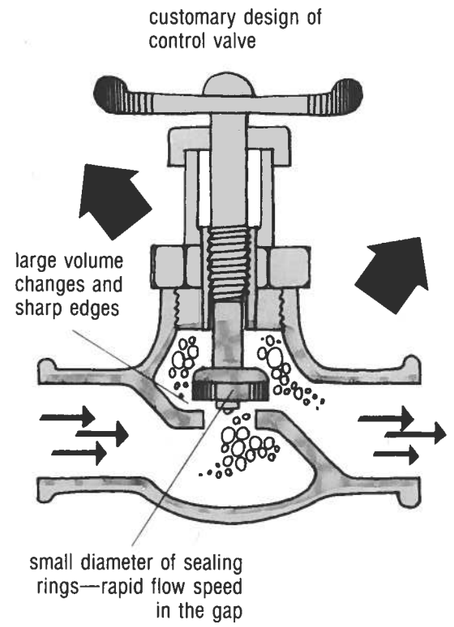


Rapid pressure changes produce more noise

Turbulence will form if the pressure in a liquid system drops rapidly. Gas is released in the form of bubbles and produces a roaring noise. The pressure drop can be produced by a large, rapid change in volume. Noise is avoided by a slow change in volume.

Principle



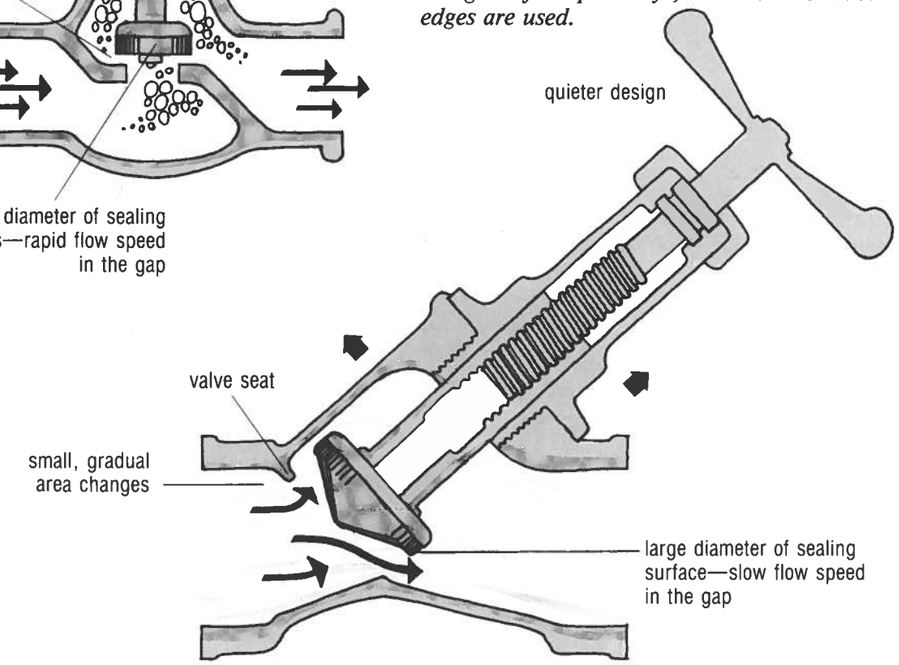


Example

Control valves in liquid systems often have small valve seats, resulting in large flow speeds with large pressure changes. Twisted flow pathways and sharp edges produce intense turbulence. Sound radiates directly from valves and pipes, and solid sound is conducted to walls.

Control measure

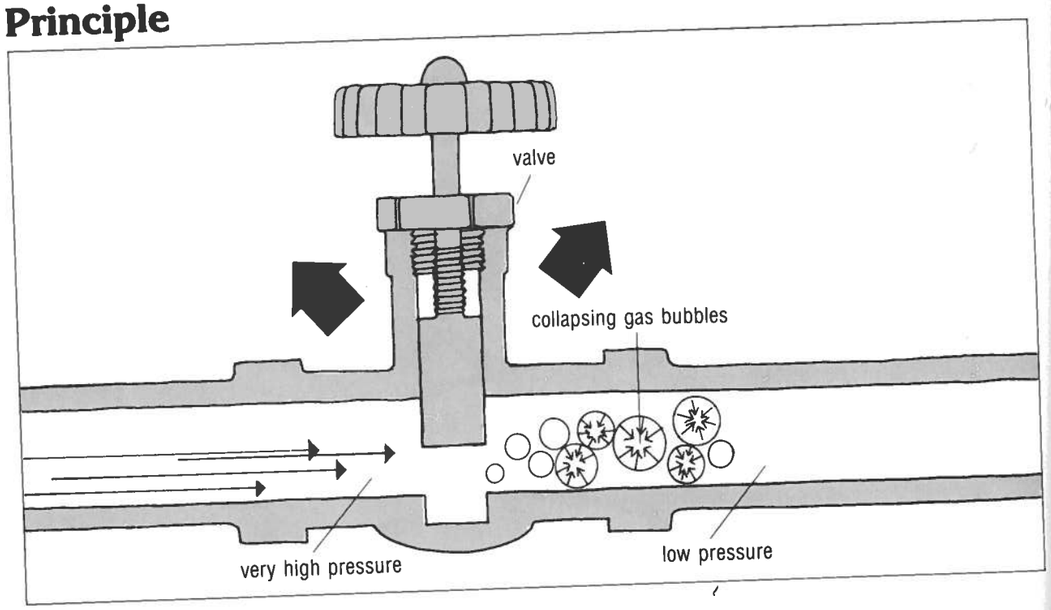
Control valves with larger cone diameters, straighter flow pathways, and more rounded edges are used.

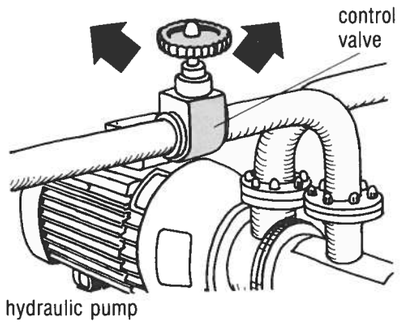


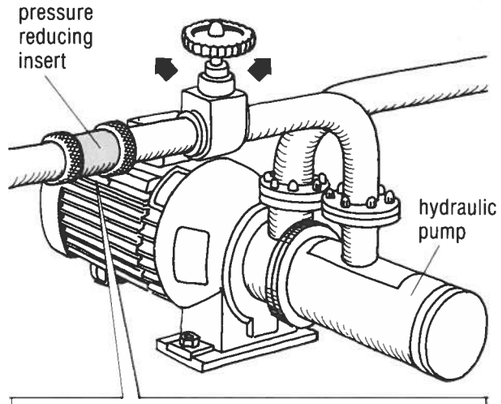
Large and rapid changes in pressure produce "cavitation" sound

Noise production takes place at control valves, at pump pistons, and at propellers when large and rapid pressure drops occur in liquids. This so-called "cavitation" noise is most common in hydraulic systems. Cavitation can be reduced by bringing about the pressure reduction in several smaller steps.

Principle





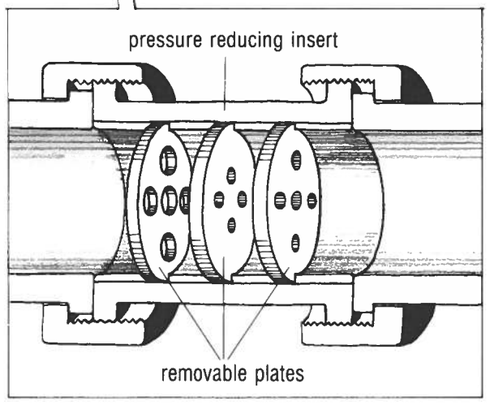


Example

In a hydraulic system, the full pump capacity is employed only in exceptional cases. The pressure is generally greatly reduced using a control valve. Cavitation can then arise, producing loud noise from the valve. The noise is conducted as solid-borne sound to connected machines and building structures.

Control measure

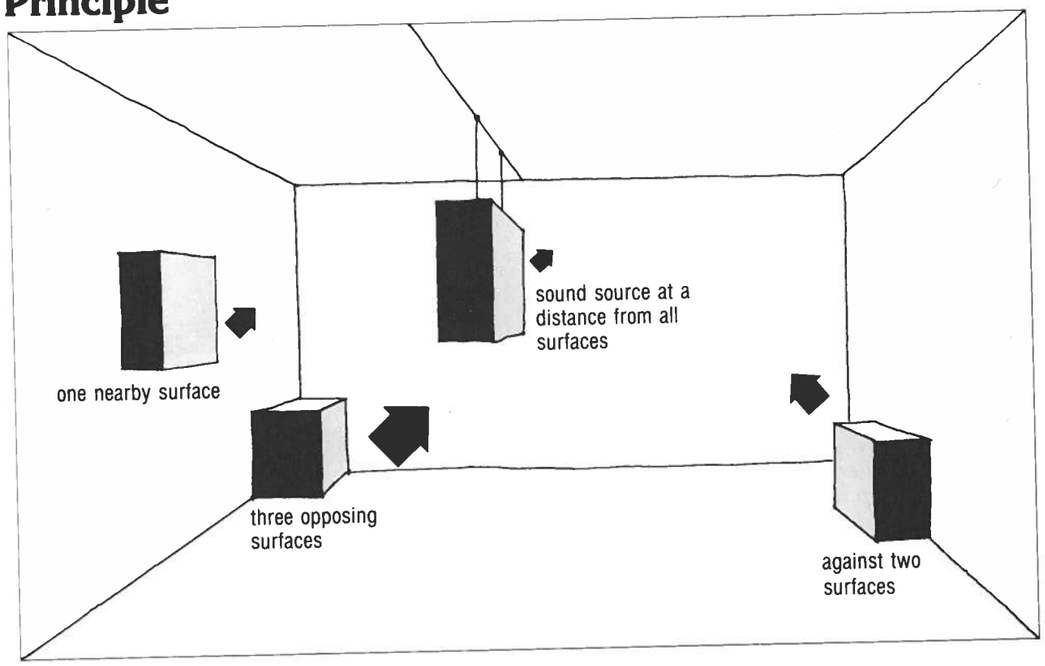
A pressure reducing insert is placed in the same pipe as the control valve. The inset has removable plates with different perforations. The plates are selected so that the inset will not produce a greater pressure drop than that required to prevent cavitation.



Sound sources should not be placed near corners

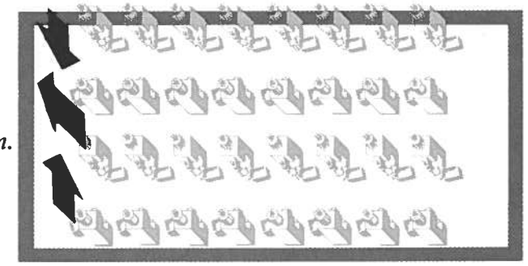
The closer to reflecting surfaces a sound source is placed, the greater the noise it will radiate to a given distance. The worst placement is in corners near three surfaces. The best placement is away from the walls.

Principle



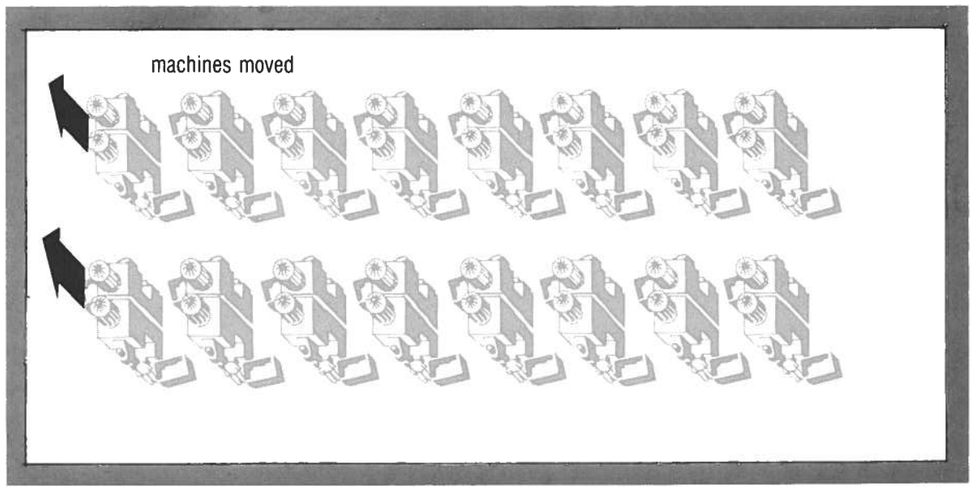
Example

In an industrial shop, machines are placed in four rows with three aisles between them. This arrangement increases the noise from the machines in the two outermost rows.



Control measure

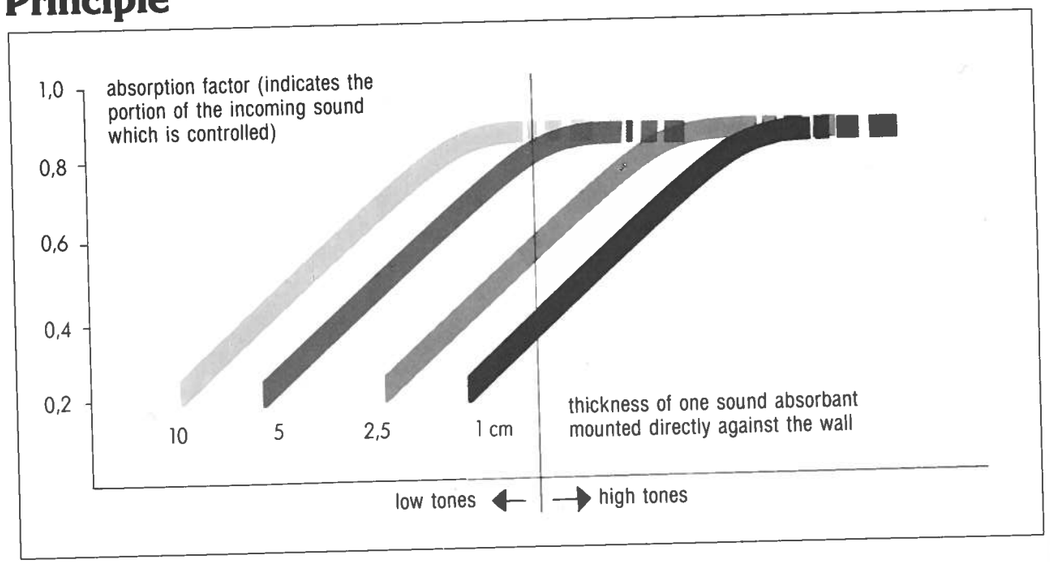
The machines are placed together, two by two, away from the walls, and new aisles are set up along the walls.



Thick, porous layers absorb both high and low frequency sound

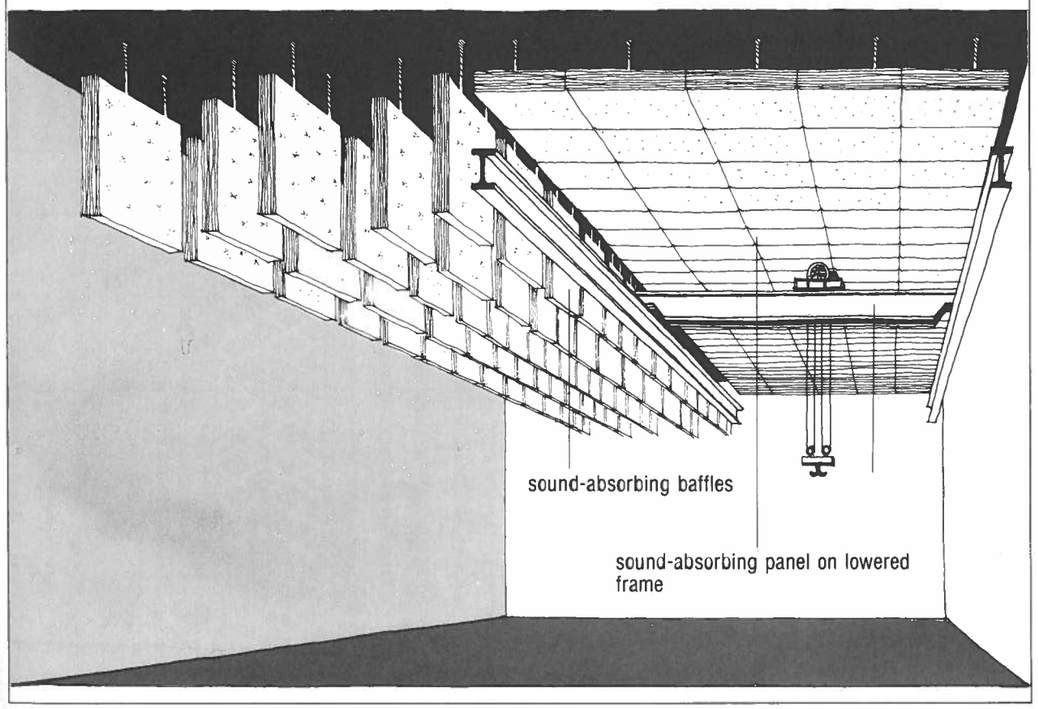
Porous material through which air can be pressed often makes a good sound absorbant. Examples of such materials include felt, foam rubber, foamed plastic, textile fibers and a number of sintered metals and ceramic materials. If the pores are closed, the absorption is slight. Thin porous absorbants handle high tones. For good effects below 100 Hz, the thicknesses required may become impractical. Low frequency absorption is improved with the aid of an air gap behind the absorbant.

Principle



Example

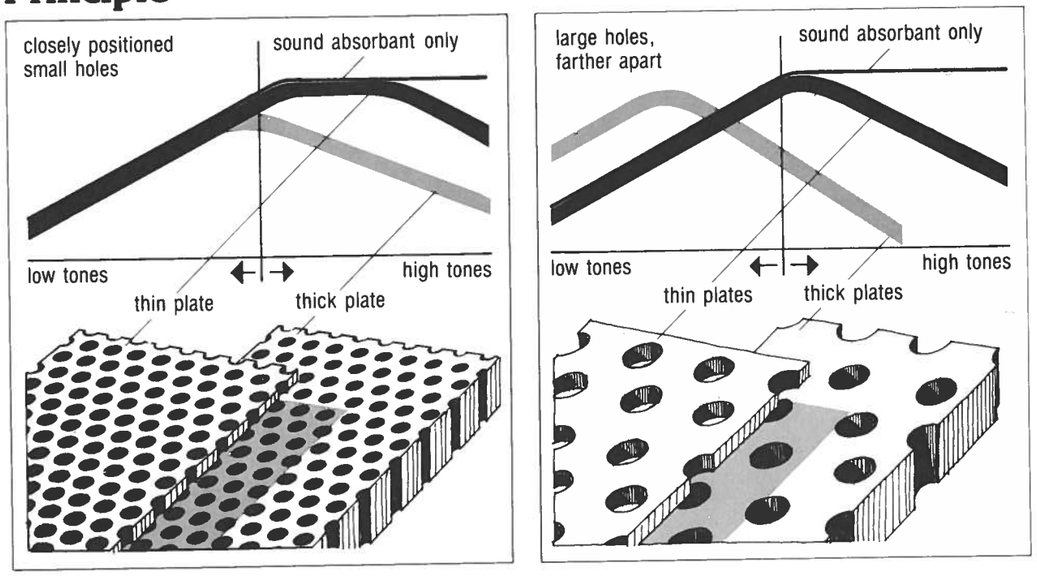
A workshop with intense low frequency noise is provided with absorbants that are effective for low tones. One part of the shop contains space for hanging absorption baffles, which provide good low frequency absorption and are easily installed. A traverse leaves no room for baffles in the other part of the shop. Instead, horizontal absorbant panels are installed above the traverse, 8 inches from the ceiling, to improve the low frequency absorption.



Cover layers with large perforations may be used without reducing absorption

For a variety of reasons, a covering material may be needed to protect a porous absorbant. This can be done without reducing the effectiveness of the absorbant if the cover material has a sufficient number of openings. The thicker the cover layer, the larger the number of perforations that will be required.

Principle

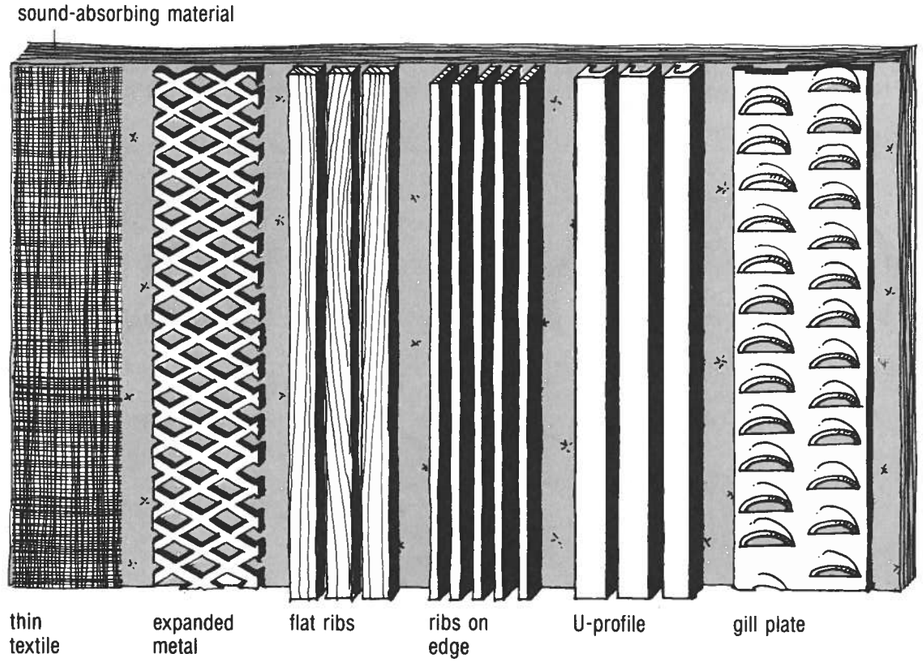


Example

Sound-absorbing material is required on many wall and ceiling surfaces in a building. To provide a more attractive environment, it is desirable to have many absorbants with different appearances.

Control measure

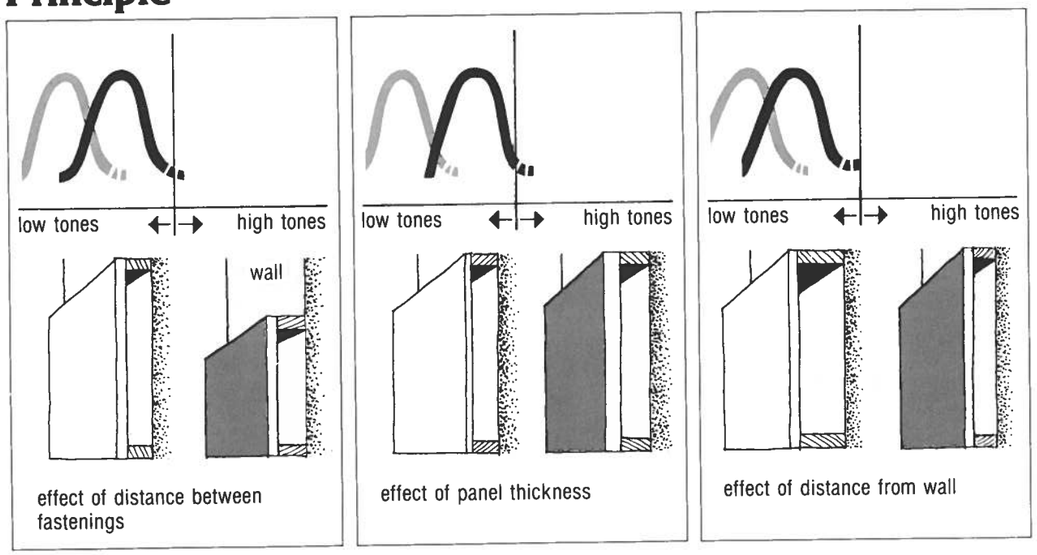
One material is used on all surfaces, with varying thicknesses. Different covering materials provide the desired variation in appearance.



Panels on studs absorb low frequencies

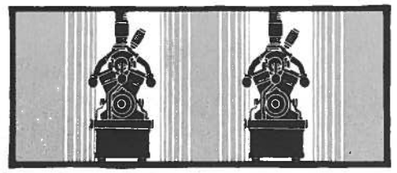
Thin panels, fastened to a system of studs, absorb low frequencies. The absorption is effective in a narrow frequency range. This range is determined by the stiffness of the panels and the distance between the fastenings. If the panels are fastened to studs on a wall, the distance from the wall also has an effect. A panel with large internal damping absorbs in a larger frequency range. If a porous absorbing material is used at these low frequencies, it must be very thick.

Principle



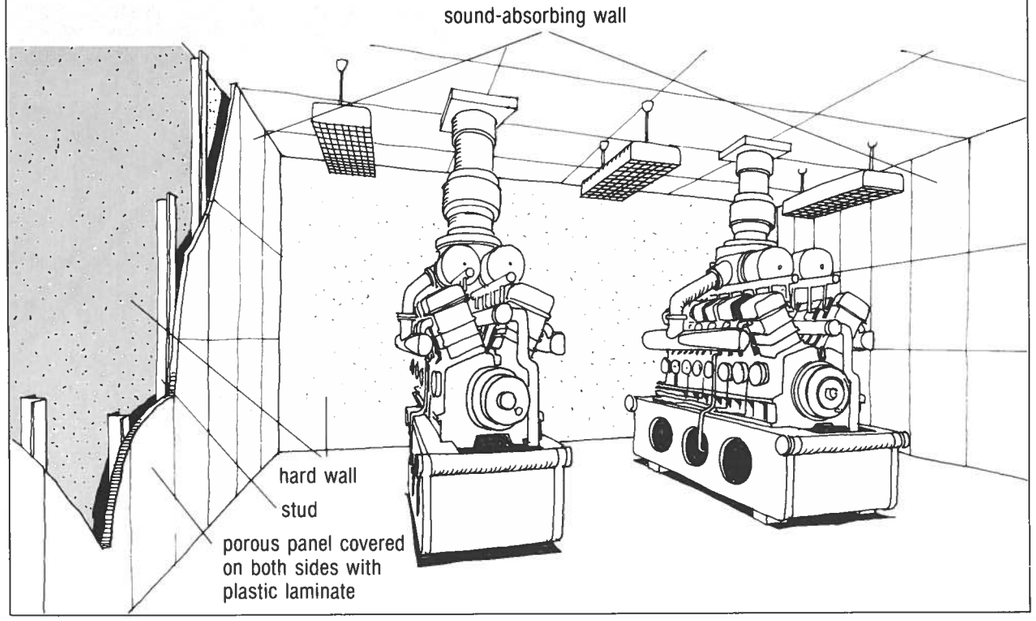
Example

Low frequency resonance in an engine room produced a very loud hum near the walls and in the center of the room. When the revolution speed was significantly changed, the hum disappeared completely.



Control measure

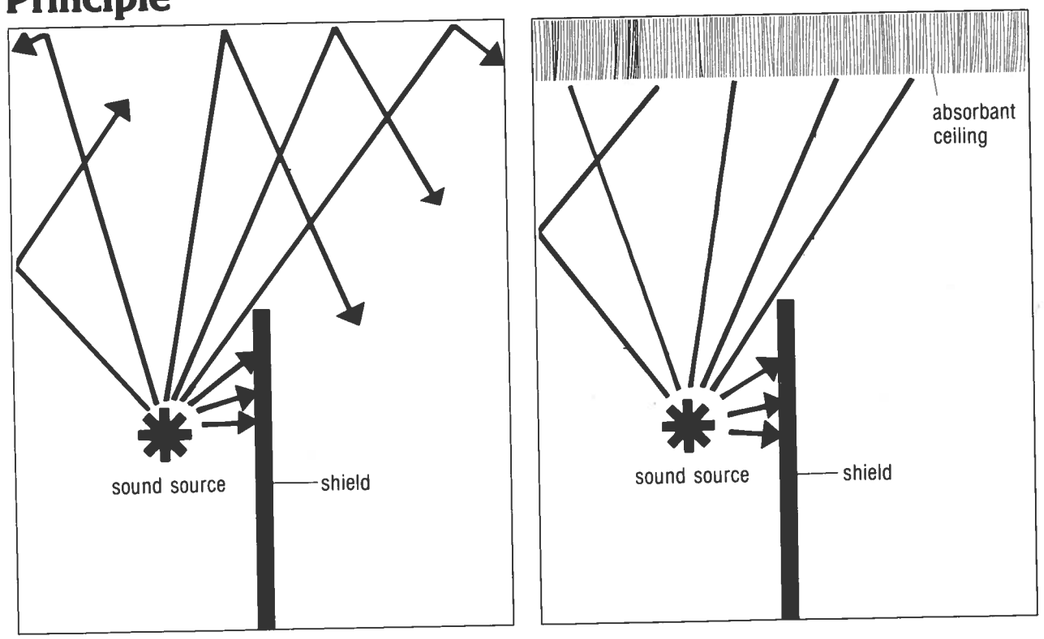
The walls were coated with panels on studs to provide the greatest absorption in the range of the loudest tone. In order for the absorbant to continue to function even in the case of slight deviations from the normal rotation speed, a layer with good internal damping was used, which provided a more extensive range with good absorption. As a result, the resonance and the loud hum disappeared.

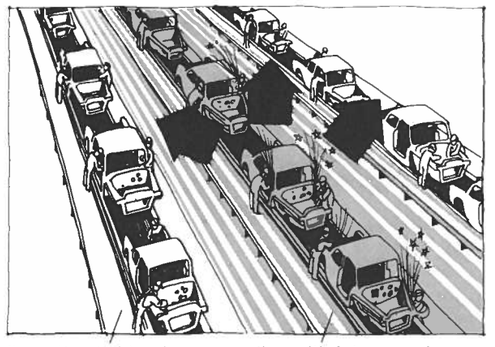


Sound shields may be combined with sound absorbing ceilings

High frequency noise can be reduced by using a shield. The shield is more effective the taller it is and the closer it is placed to the source. The effect of a shield is considerably reduced if the ceiling is not sound absorbant.

Principle



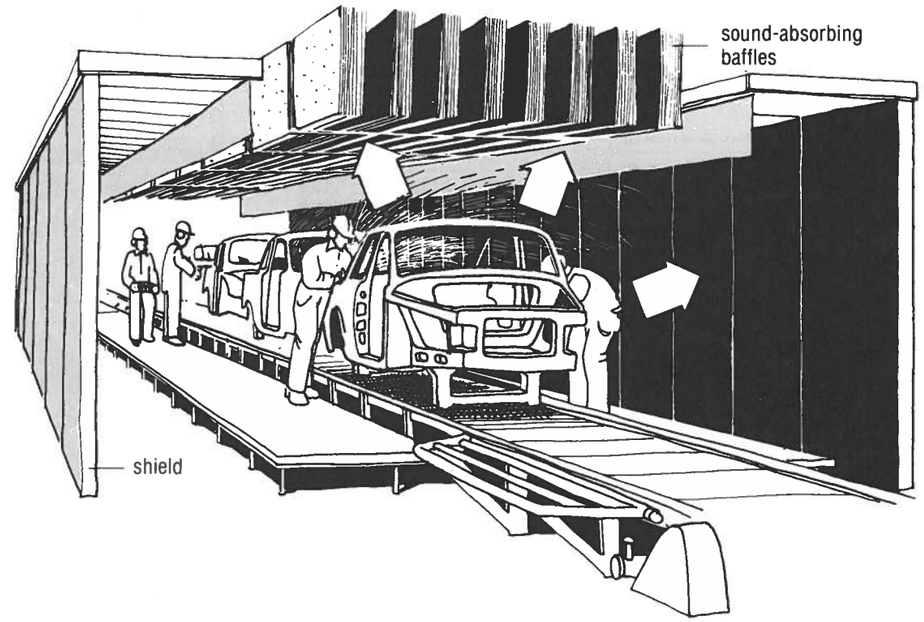


Example

In an auto plant with several assembly lines, the work on one line is noisier than the other. Grinding work on the bodies produces a shrieking, high frequency sound, disturbing everyone in the plant.

Control measure

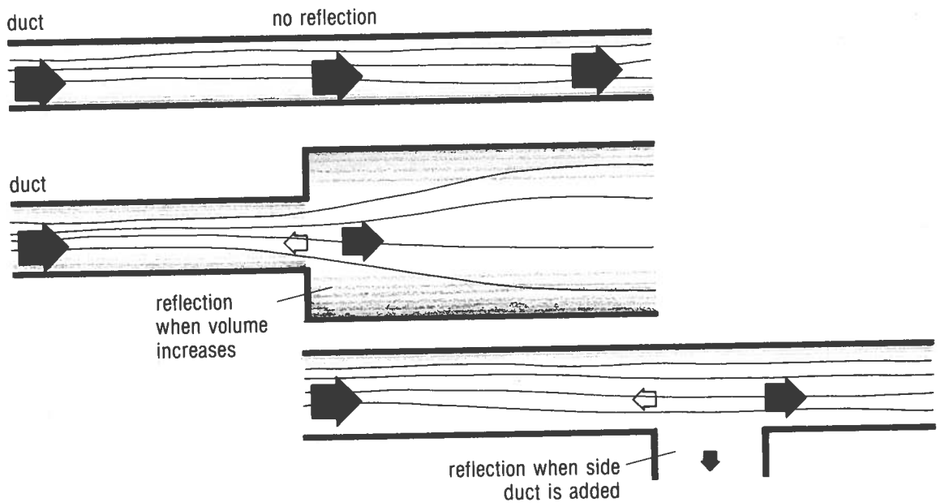
The other lines are protected from the grinding noise by means of shields on both sides of the line and sound-absorbing baffles suspended above the open area.



All duct changes reduce sound transmission

With all changes in pathway, some sound energy is reflected back. In a duct this may apply to bends, branches, and changes in volume, shape, or wall materials.

Principle

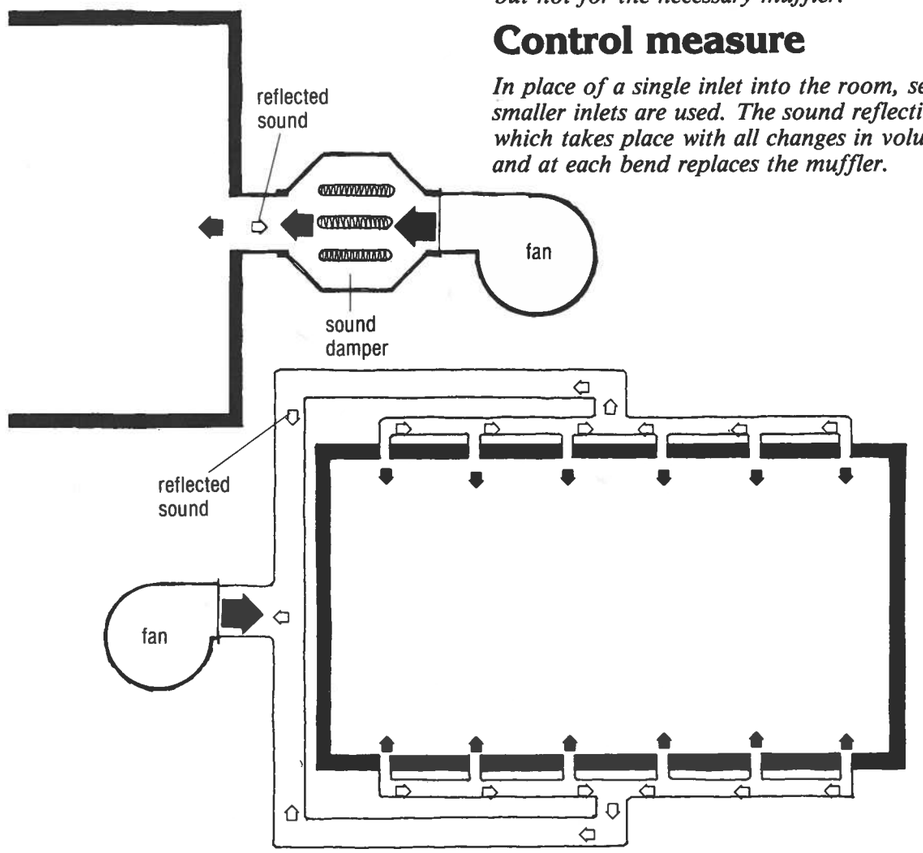


Example

An area is to be provided with mechanical ventilation. There is sufficient space for the fan, but not for the necessary muffler.

Control measure

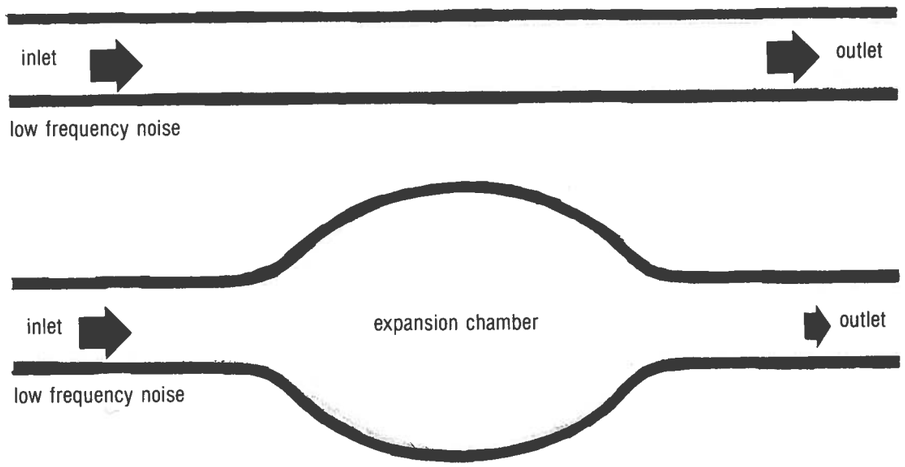
In place of a single inlet into the room, several smaller inlets are used. The sound reflection which takes place with all changes in volume and at each bend replaces the muffler.

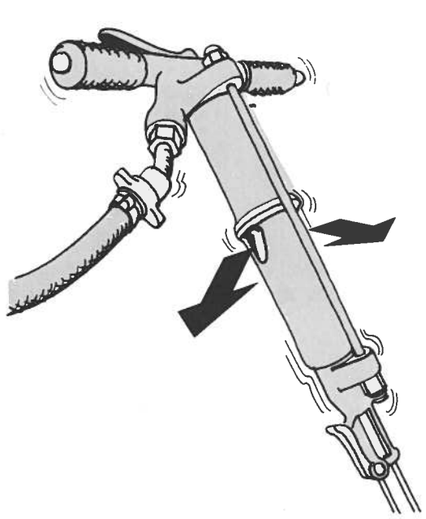


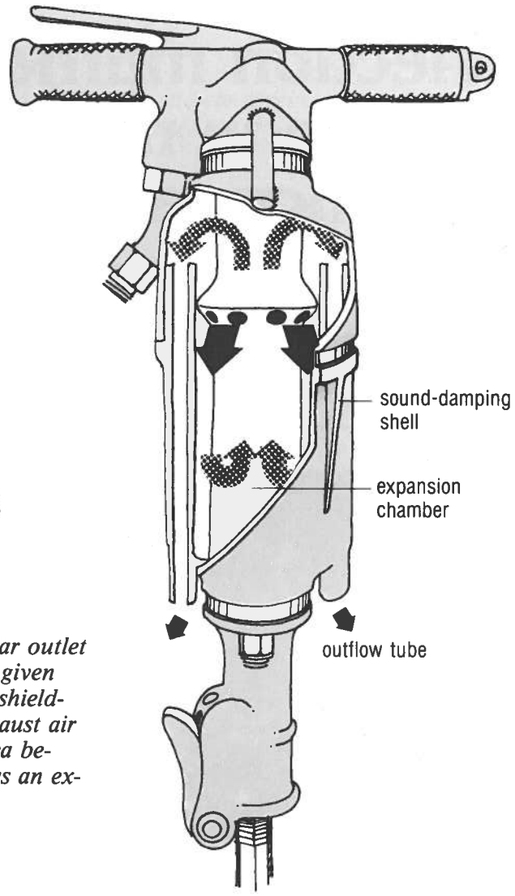
Expansion chambers are useful for reducing low frequency noise

If a duct is provided with an expanded section or chamber, the low frequency pressure variations in the duct are reduced. The lower the frequency which must be reduced, the greater the space required in the chamber.

Principle







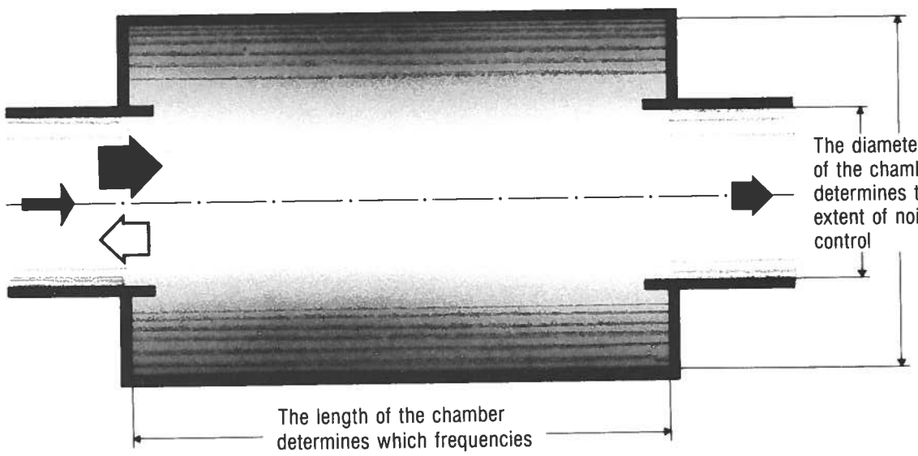
Example

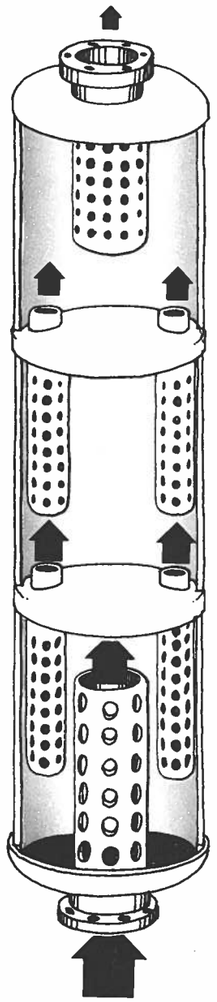
Using a jacket over the tip and a tubular outlet in the jacket, the high frequency noise given off by a jack hammer can be partially shielded. The low frequency noise in the exhaust air is effectively reduced. The enlarged area between the barrel and jacket functions as an expansion chamber.

Reflection mufflers are effective in narrow frequency ranges

If noise is present in a limited frequency range, a reactive muffler may take up the least space. These are generally used at low frequencies. A large frequency range can be covered using several reactive chambers in succession. Perforated tubes are also employed in reflection dampers.

Principle





Example

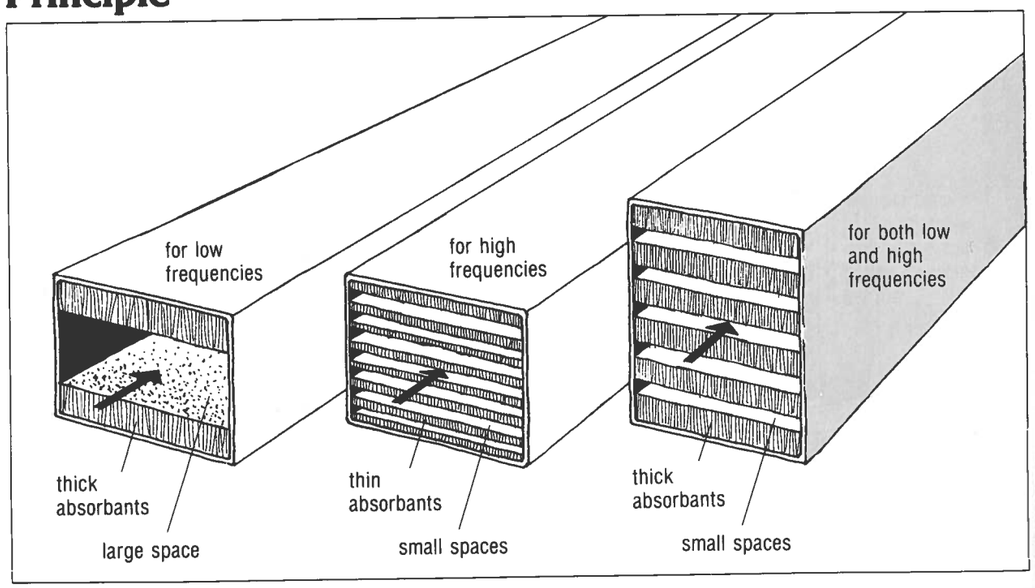
The muffler shown here is primarily used in large piston engines.

reactive muffler
with three stages

Absorption mufflers are effective over a broad range of frequencies

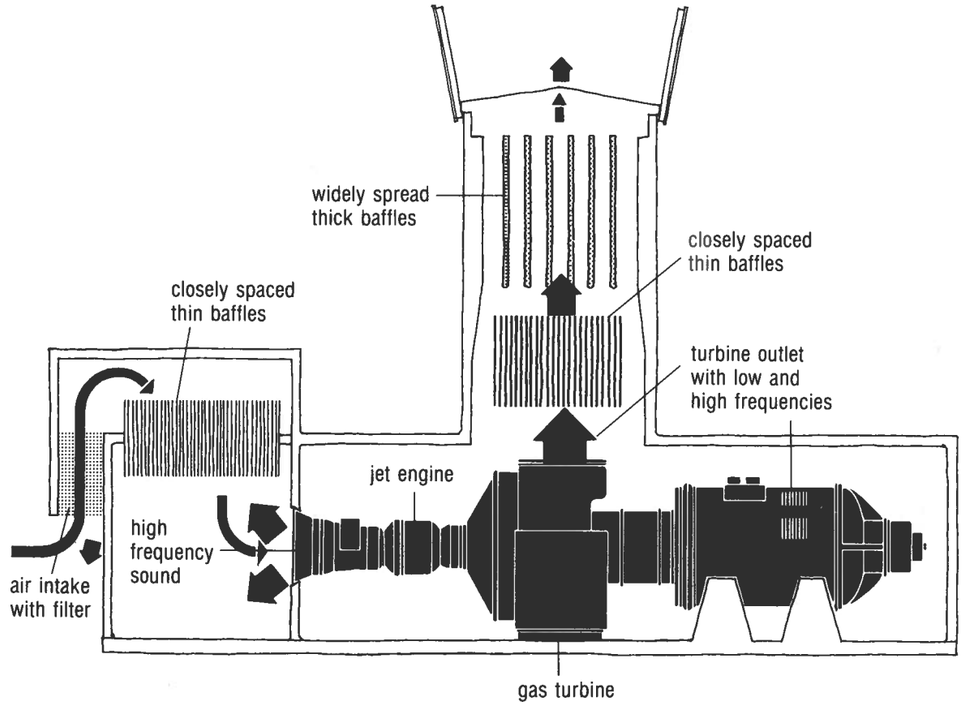
The simplest form of absorption muffler is a duct with sound-absorbing material on the walls. The thicker the material, the lower the frequency that can be reduced. For higher frequencies, the space between the absorbing walls must be made smaller. A large duct must therefore be subdivided into many smaller ones.

Principle



Example

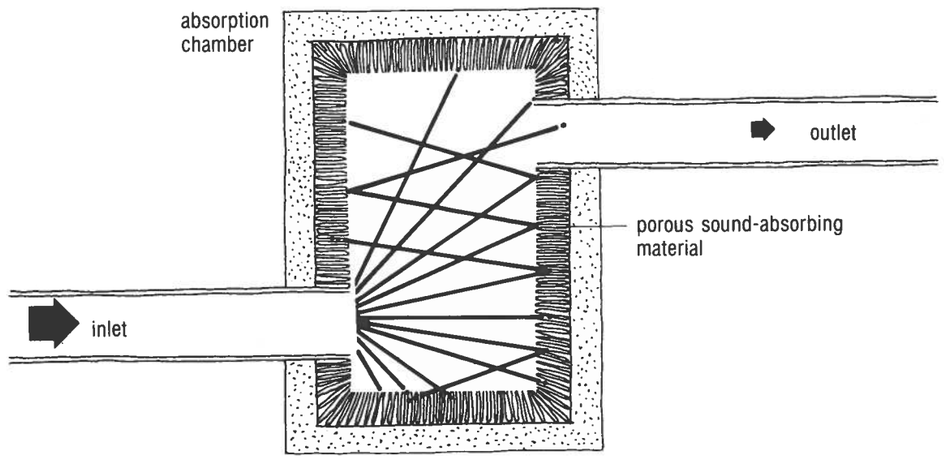
If a very large frequency range is to be reduced, it is generally necessary to employ absorption mufflers with thick and thin baffles.



Unused areas can be absorption chambers

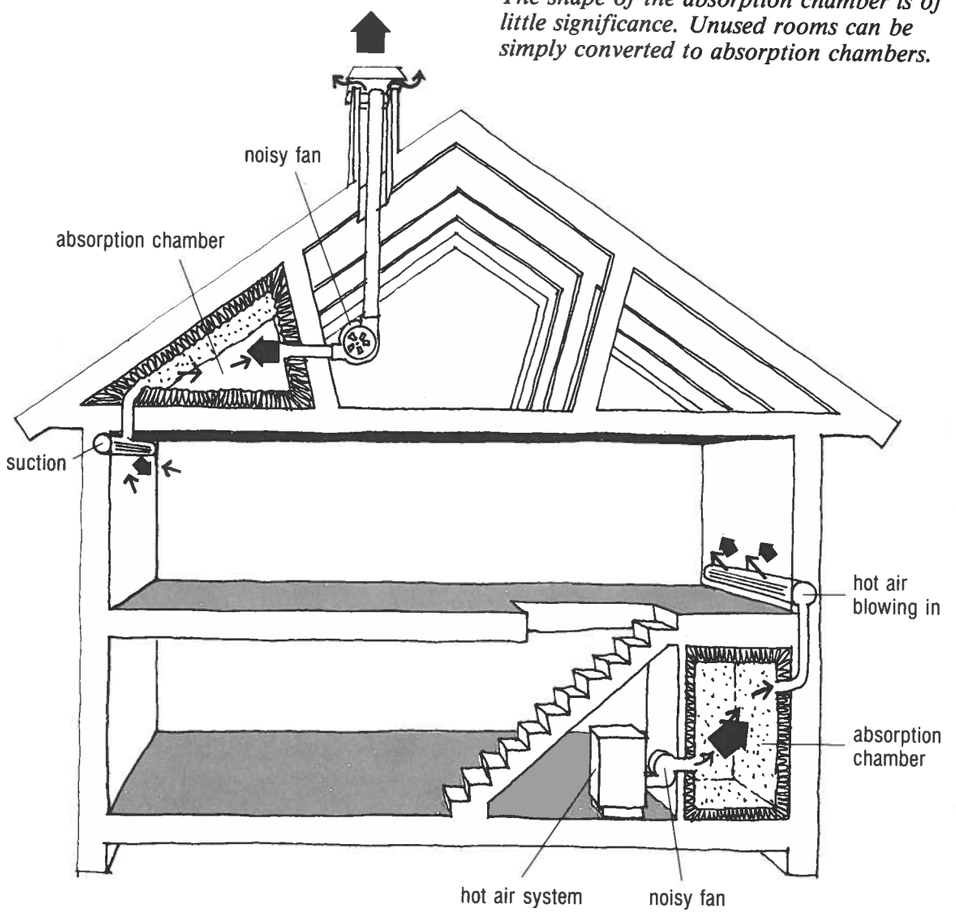
The absorption chamber is a simple muffler. One section of the duct is made up of a room whose walls are covered with a sound-absorbing material. When the sound is reflected against the chamber walls, sound energy is absorbed. To prevent the direct passage of high frequency, directed sound, the inlet and the outlet should not be located opposite one another. The greater the chamber volume and the thicker the absorbant used, the lower the frequency at which the muffler is effective.

Principle



Example

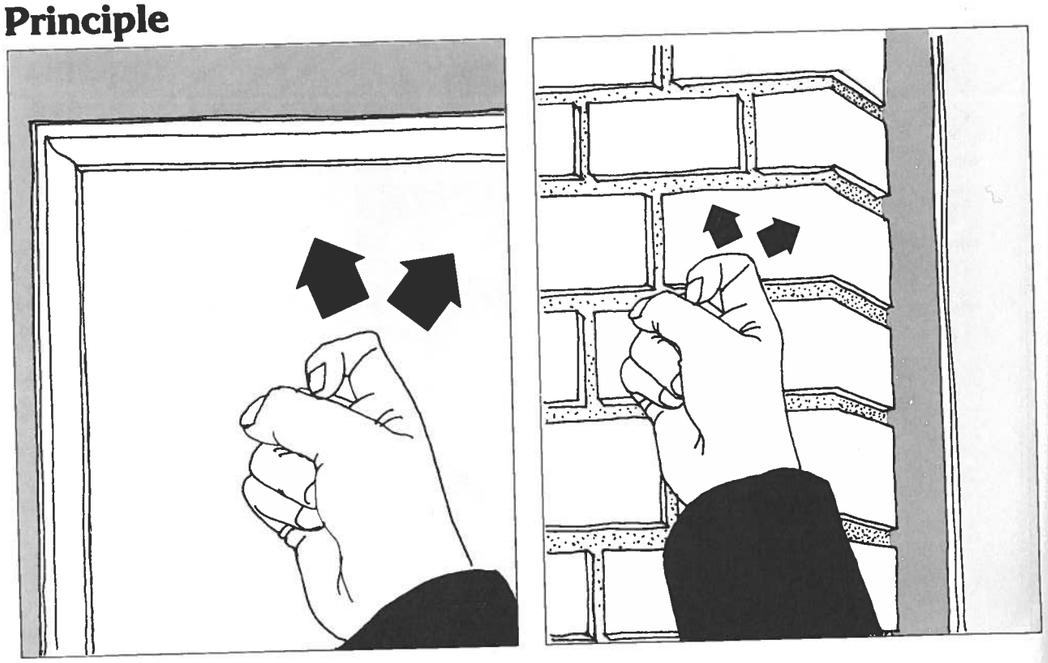
The shape of the absorption chamber is of little significance. Unused rooms can be simply converted to absorption chambers.

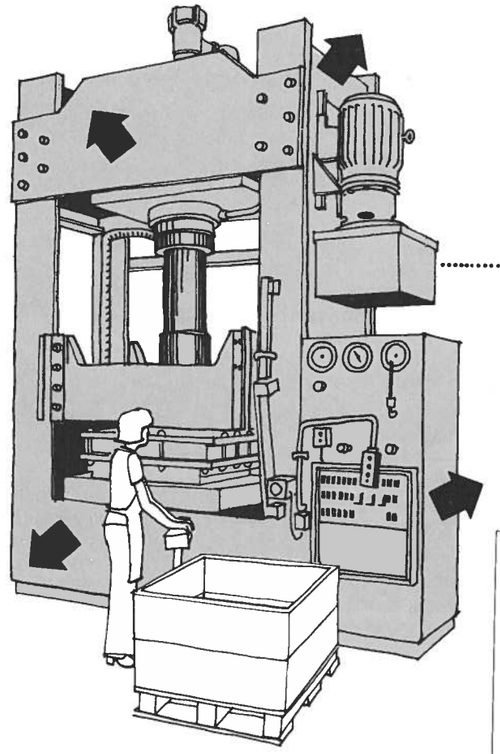


Machines which vibrate should be mounted on heavy, rigid bases

Knocking on a thin door produces more sound than knocking on a thick wall. For the same reason, noise sources should be mounted on heavy or rigid bases.

Principle



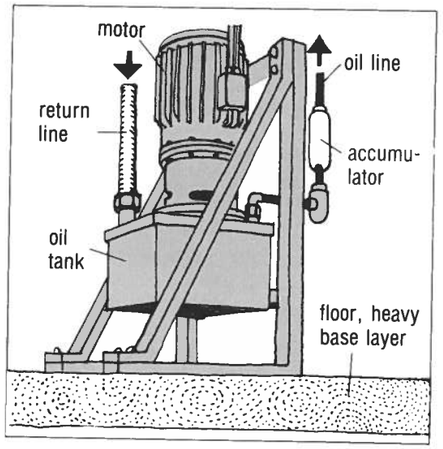


Example

A motor-driven oil pump is placed on the side wall of a hydraulic press. The vibrations are transmitted to all plates, which convert the solid-borne sound to loud airborne sound.

Control measure

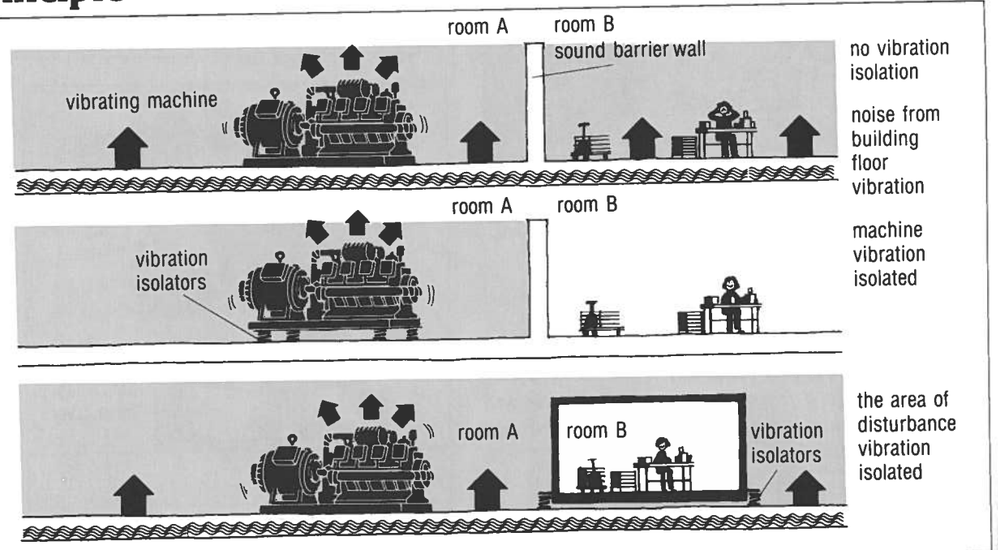
The oil system is removed from the press and installed in a frame on a heavy base. Sound transmission in the oil line is controlled with an accumulator.



Machines should be vibration isolated

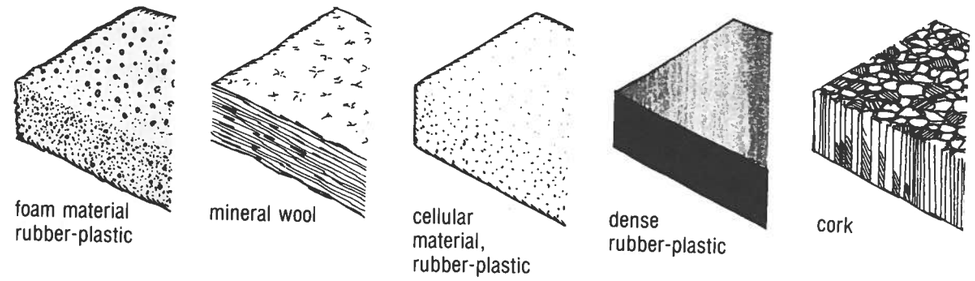
Vibration isolation of machines can reduce the area of excessive noise as shown below. Either the machine or the working area can be isolated.

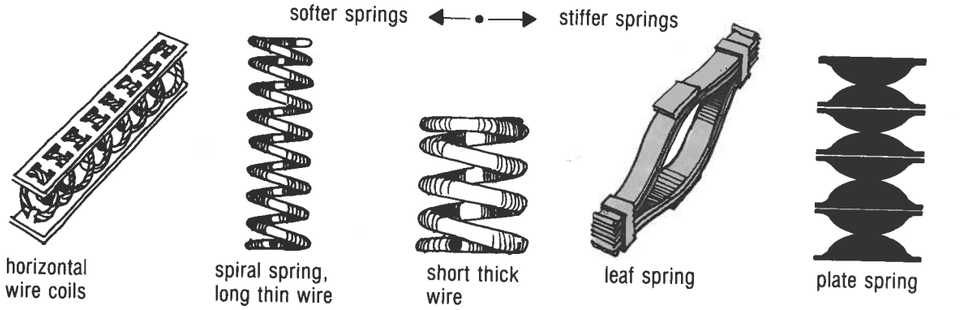
Principle



Example

Vibration isolators are made of various materials and in various shapes.

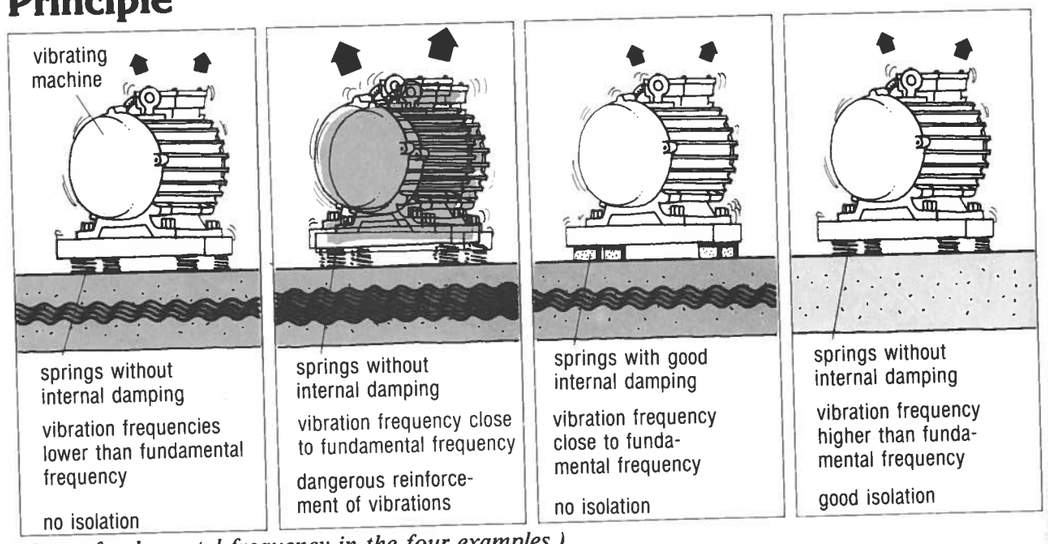




Improperly selected springs can increase vibrations

A machine placed on springs has a so-called "fundamental frequency." Vibrations at or close to the fundamental frequency are greatly intensified. The machine may even break away from its fastenings. Vibrations with lower frequency than the fundamental frequency are not blocked. If the base is very heavy or very rigid, the fundamental frequency is determined entirely by the machine and base weights together with the rigidity of the spring. The lighter the machine and the more rigid the spring, the higher is the fundamental frequency. This reinforcement of vibrations can be avoided by using springs with good internal damping.

Principle



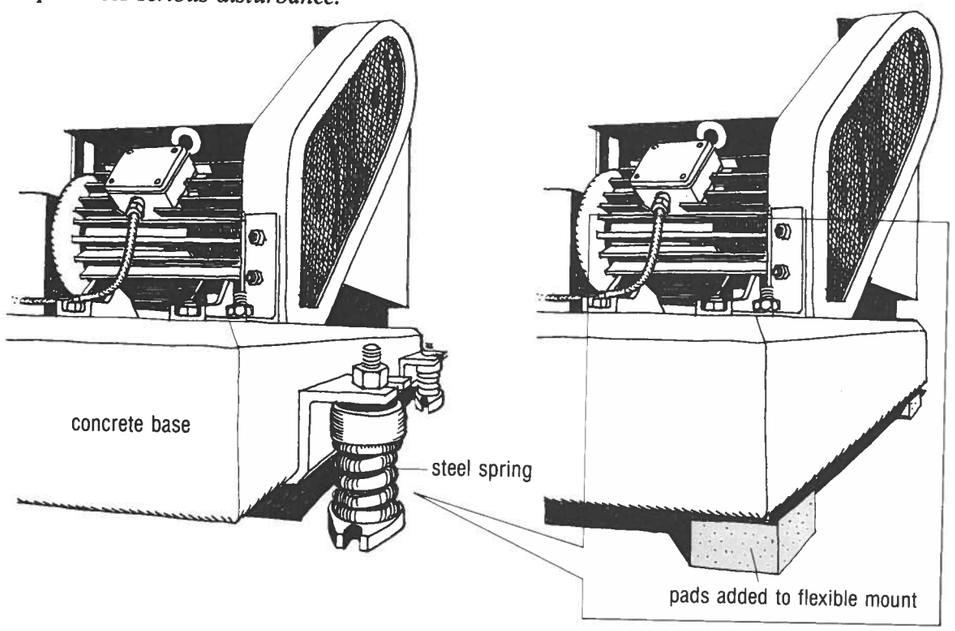
(Same fundamental frequency in the four examples.)

Example

Two fans are used in the same building. Both are vibration isolated with steel springs which have very poor internal damping. The isolation functions well for both fans during constant operation, but one of the fans is started and stopped frequently. When this happens, the vibration frequency corresponds for a short time with the fundamental frequency, which produces serious disturbance.

Control measure

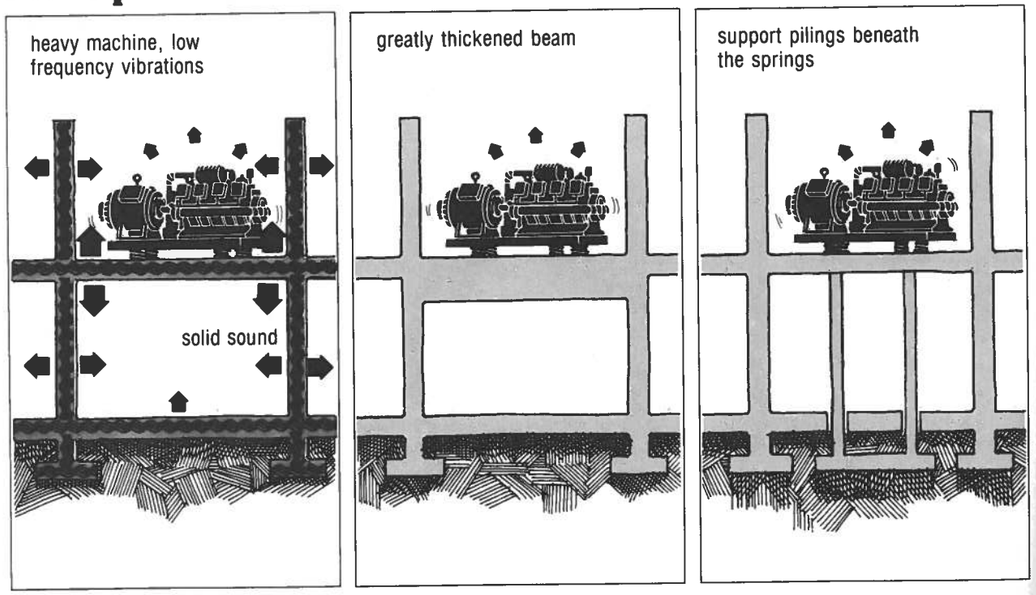
On the fan with irregular operation, steel dampers are installed with pads which have good internal damping. The isolation is somewhat less, but the disturbance from starting and stopping disappears.



Isolating machines with low natural frequency may require a rigid floor

A machine and mount with low natural frequency are difficult to vibration isolate unless the floor is very rigid. As shown below, an extra heavy (stiff) or pile-reinforced floor might be necessary.

Principle

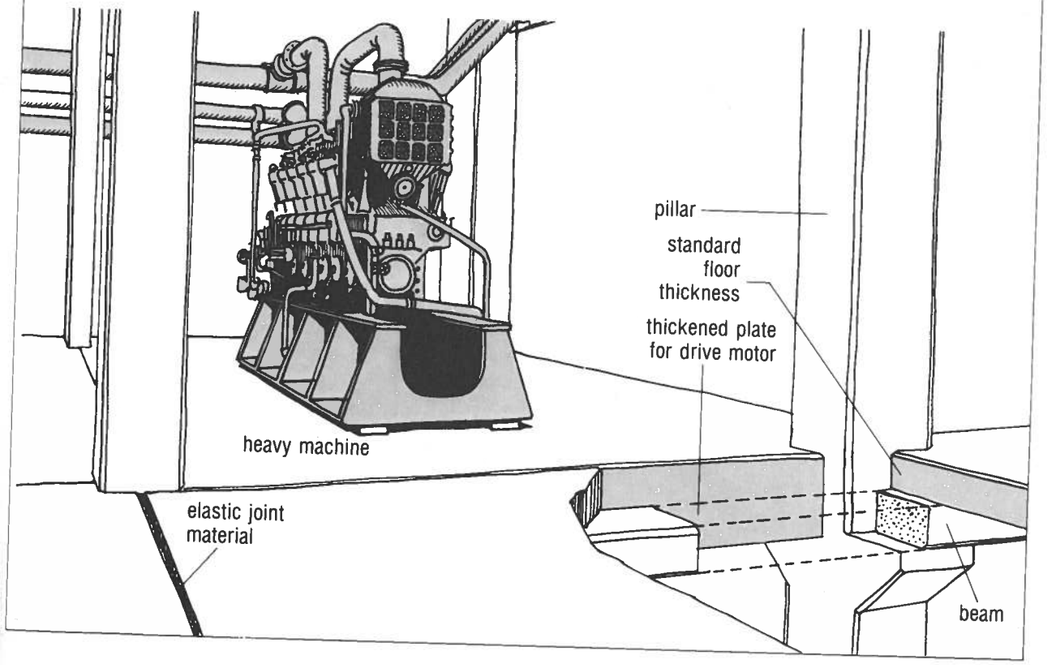


Example

A company is planning a building where a need for freedom from vibration and noise is great. It should also be possible to remove and interchange the machines.

Control measure

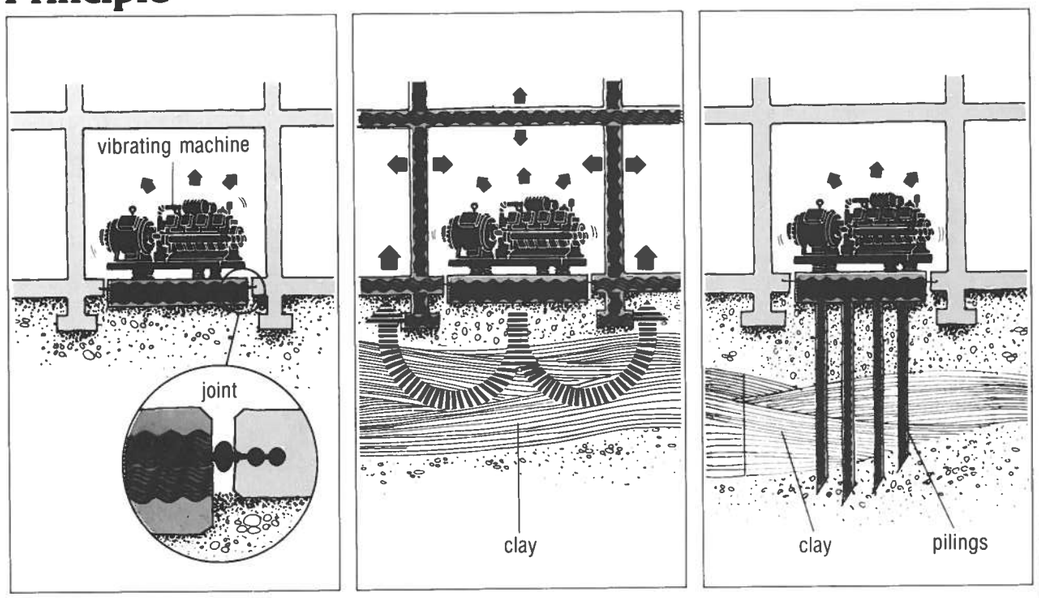
The building is constructed with large concrete plates on a pillar and beam system. The concrete plates which are expected to carry heavy machines are provided with strong reinforcements. If heavy machines are added later, the normal concrete plate is removed and replaced with a thicker one.



A separate base layer provides the best solid-borne sound barrier

A good way to isolate very heavy machines with low natural frequency vibration is to place them on a concrete base plate which rests directly on the ground. Even more effective protection is achieved if the base plate is separated from the remainder of the building by means of a joint. If the ground has a clay layer, it may be necessary to place pilings beneath the plate.

Principle

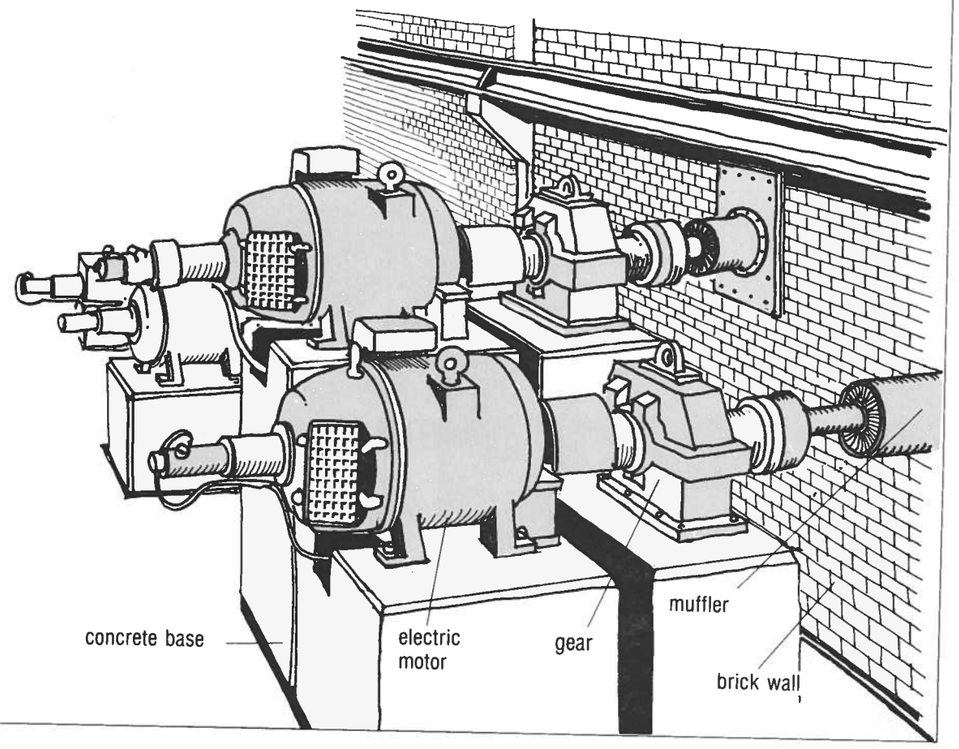


Example

Drive motors with gears and differentials connected to a paper-making machine cause both loud air noise and vibrations in the machines. They require only occasional maintenance which can generally be performed with the machines turned off. Therefore, the machines can be permitted to make large amounts of noise if the noise is prevented from entering the rest of the factory.

Control measure

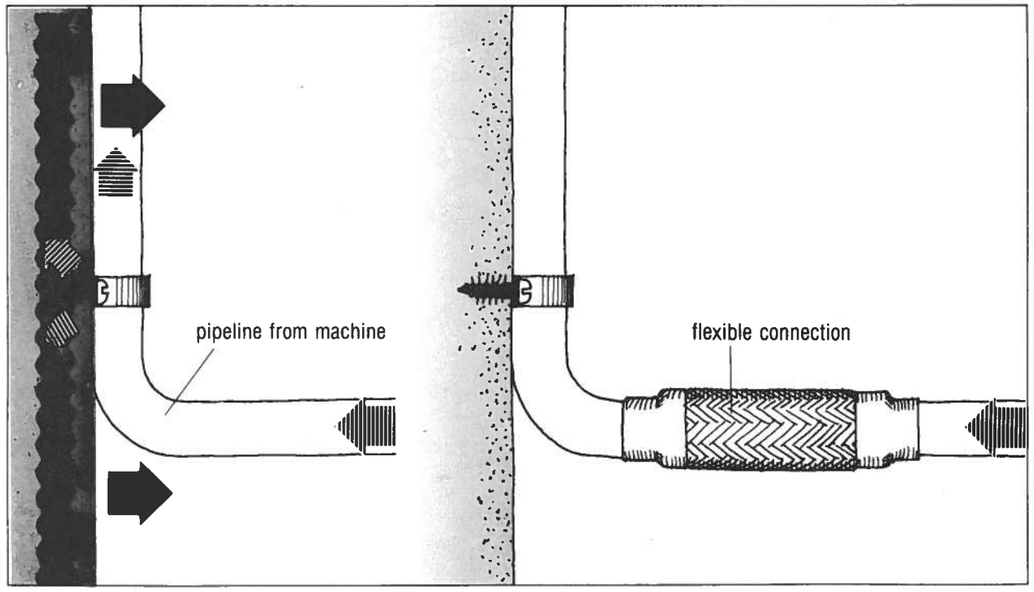
The engine room has its own thick base plate which is in good contact with the solid ground. The large base plate is also vibration isolated with corrugated rubber mats. Sound is prevented from entering other rooms by means of a brick wall. Holes in the wall for the axles to pass through are sealed with mufflers.



Sound through solid connections can be blocked

Vibration isolation of a machine may be ineffective if sound is transferred through connections for oil, electricity, water, etc. These connections must be made very flexible. The machine movements will be reduced if a heavy base is selected, and more rigid springs can be used.

Principle

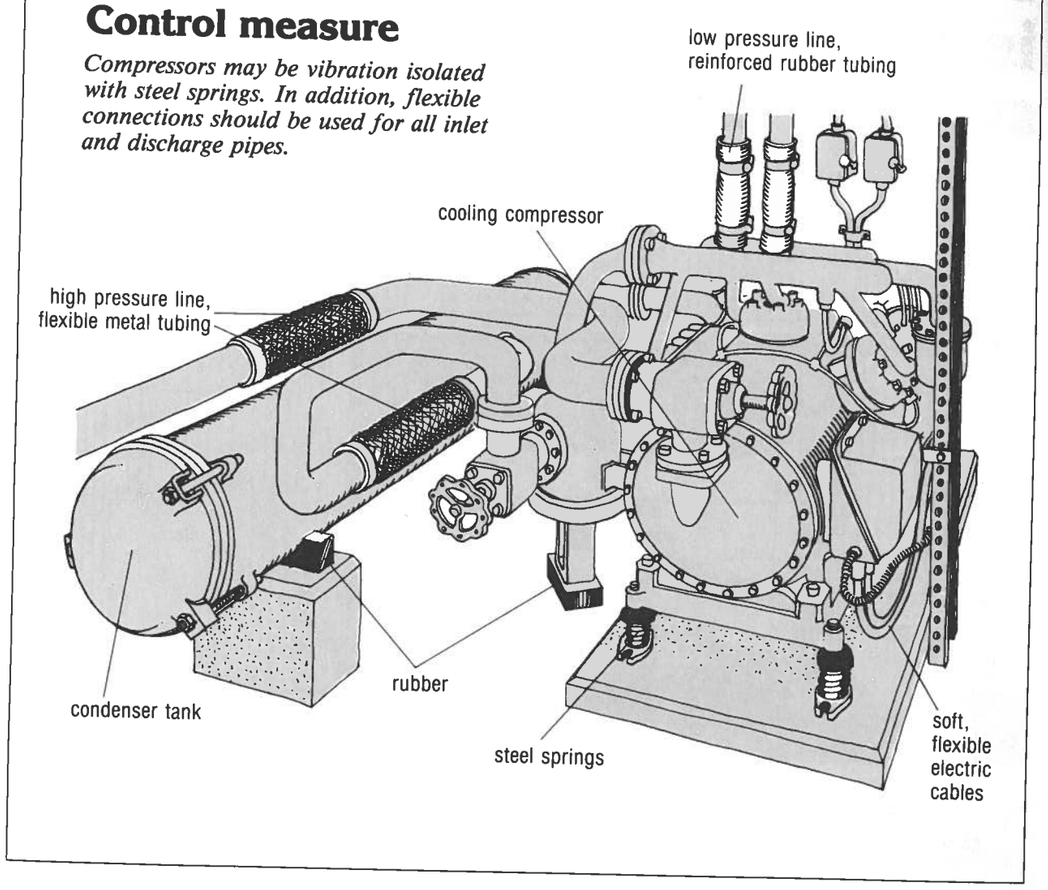


Example

Cooling systems may be serious sources of noise as a result of intense pressure shocks in the liquid from compressors.

Control measure

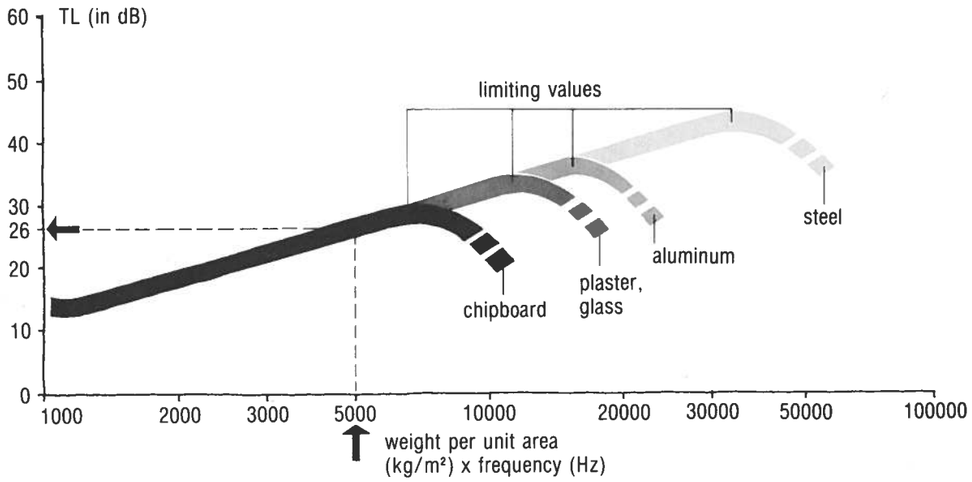
Compressors may be vibration isolated with steel springs. In addition, flexible connections should be used for all inlet and discharge pipes.



The TL of a single wall is estimated from its surface weight

"Transmission loss" (TL) indicate a wall's ability to absorb sound-producing vibrations. TL is expressed in decibels (dB). The TL of a homogeneous single layer wall can be estimated by its surface weight, that is, kilograms per square meter or pounds per square inch.

Principle



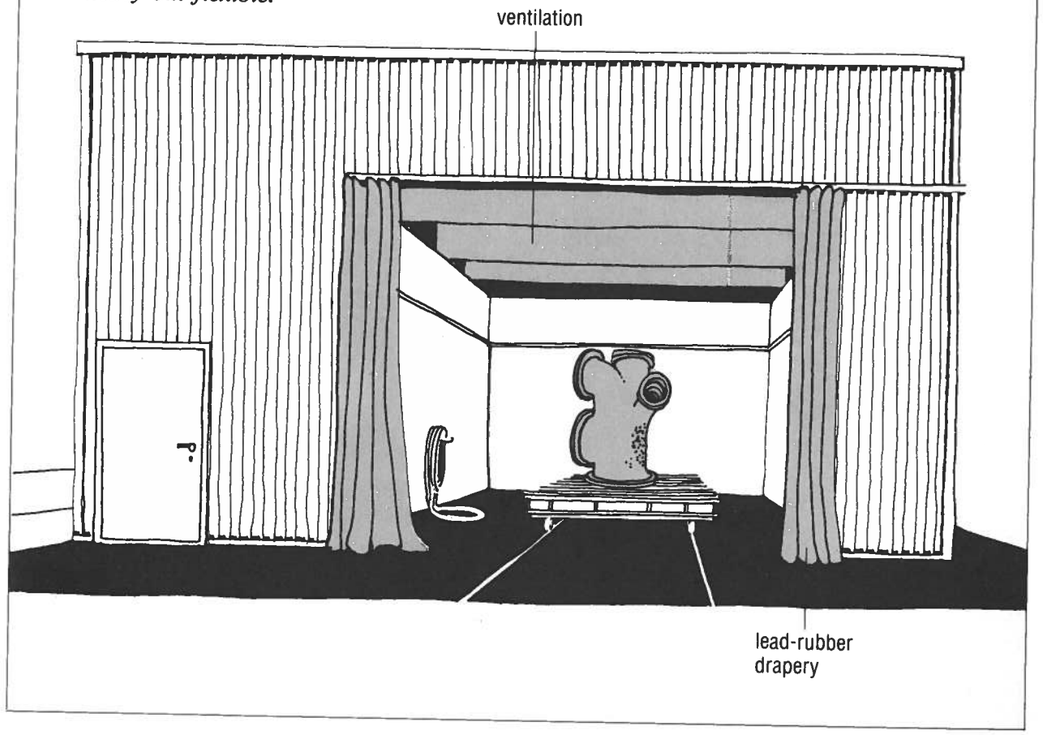
Example: What TL will be provided by a 15mm thick chipboard panel at 500 Hz? The panel weighs 10kg/m².
10 x 500 = 5000. Thus the TL will amount to 26 dB.

Example

A sand blast operation creates excess noise. A separate room is available, with a thin drape as a barrier.

Control measure

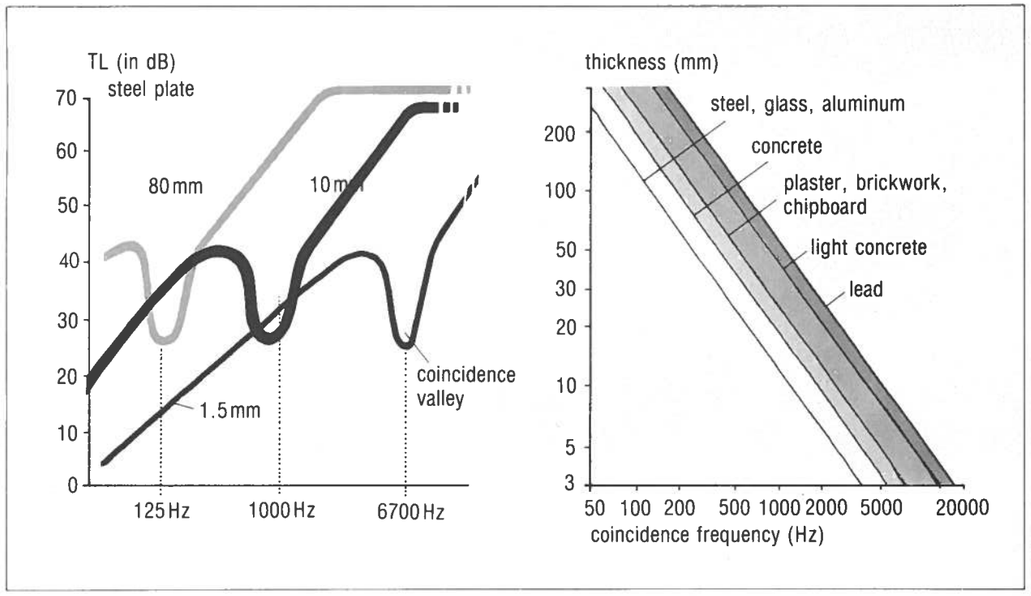
A separate room is constructed for this operation. The blasting equipment is separated from other work areas with a drapery of lead-rubber fabric, which is heavy but flexible.



A single wall will provide poor sound isolation at a certain frequency

A single wall has a "resonant frequency" at which the TL will be less than the figure indicated by the weight per unit of surface. This "coincidence valley" will disappear only if the wall has good internal damping.

Principle

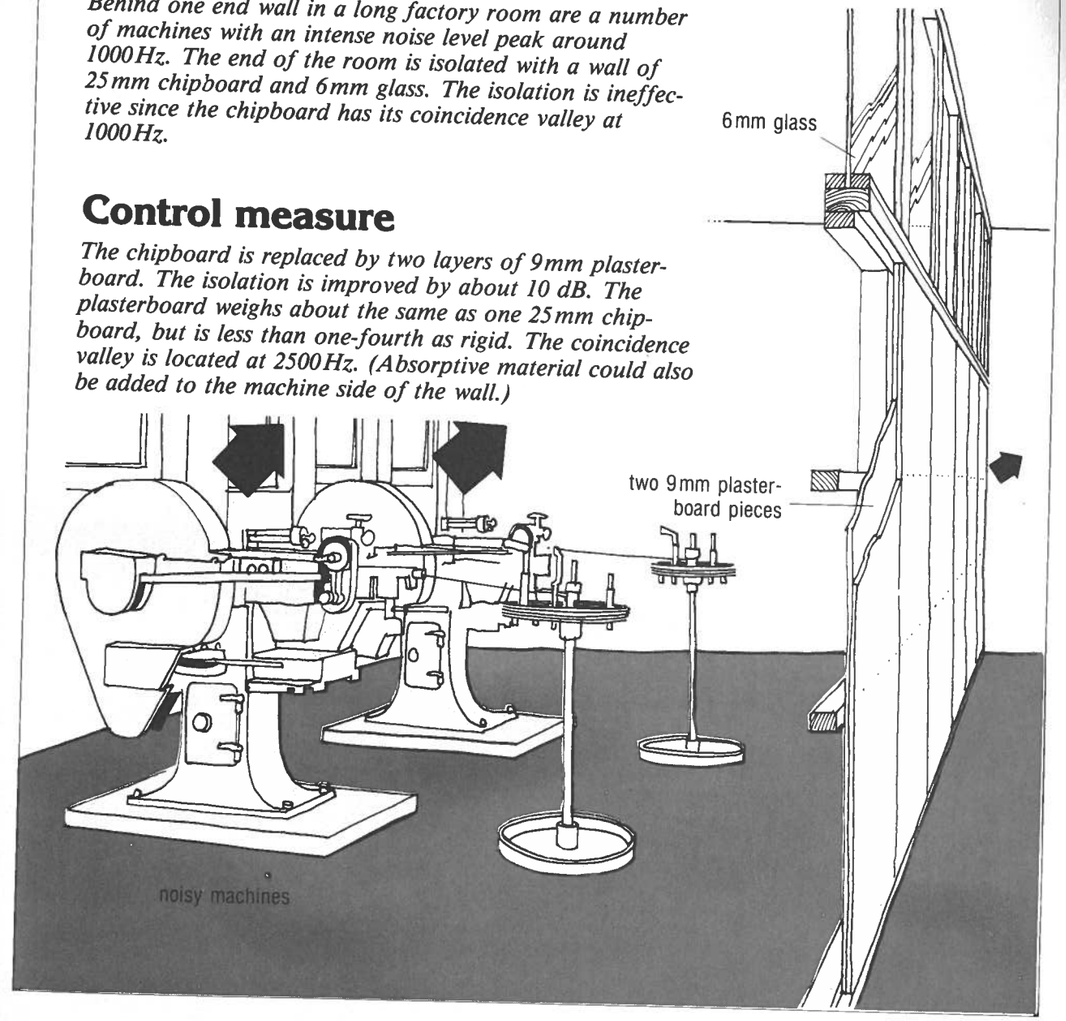


Example

Behind one end wall in a long factory room are a number of machines with an intense noise level peak around 1000 Hz. The end of the room is isolated with a wall of 25 mm chipboard and 6 mm glass. The isolation is ineffective since the chipboard has its coincidence valley at 1000 Hz.

Control measure

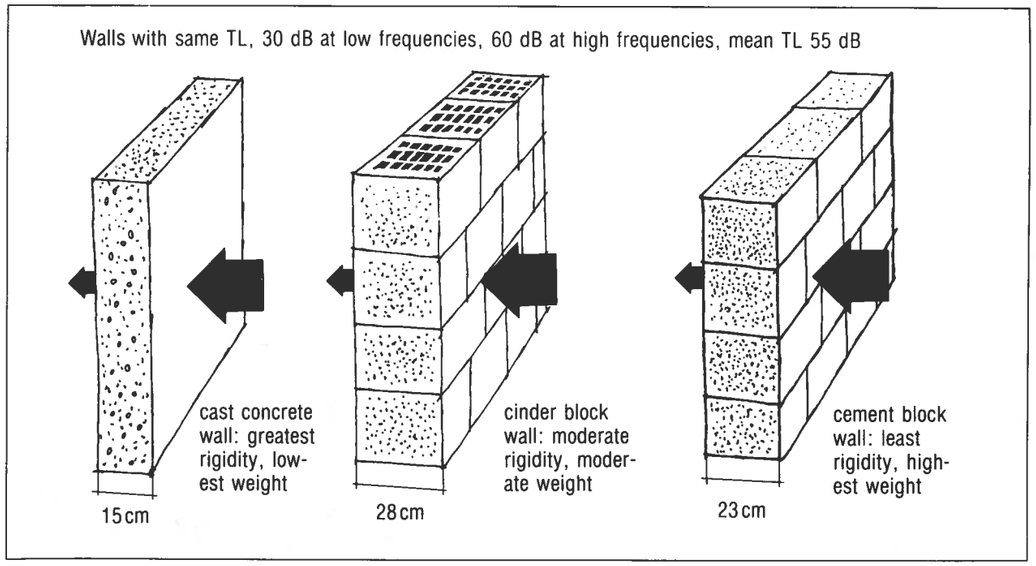
The chipboard is replaced by two layers of 9 mm plasterboard. The isolation is improved by about 10 dB. The plasterboard weighs about the same as one 25 mm chipboard, but is less than one-fourth as rigid. The coincidence valley is located at 2500 Hz. (Absorptive material could also be added to the machine side of the wall.)



Rigidity and weight are both important in thick walls

In most single layer walls, the coincidence valley is close to 100 Hz for a thickness of about 20 cm. At higher frequencies, both increased weight and increased rigidity produce greater TL. A cast concrete wall has greater rigidity than a brick wall, and therefore provides greater TL if the two wall weights are equal.

Principle

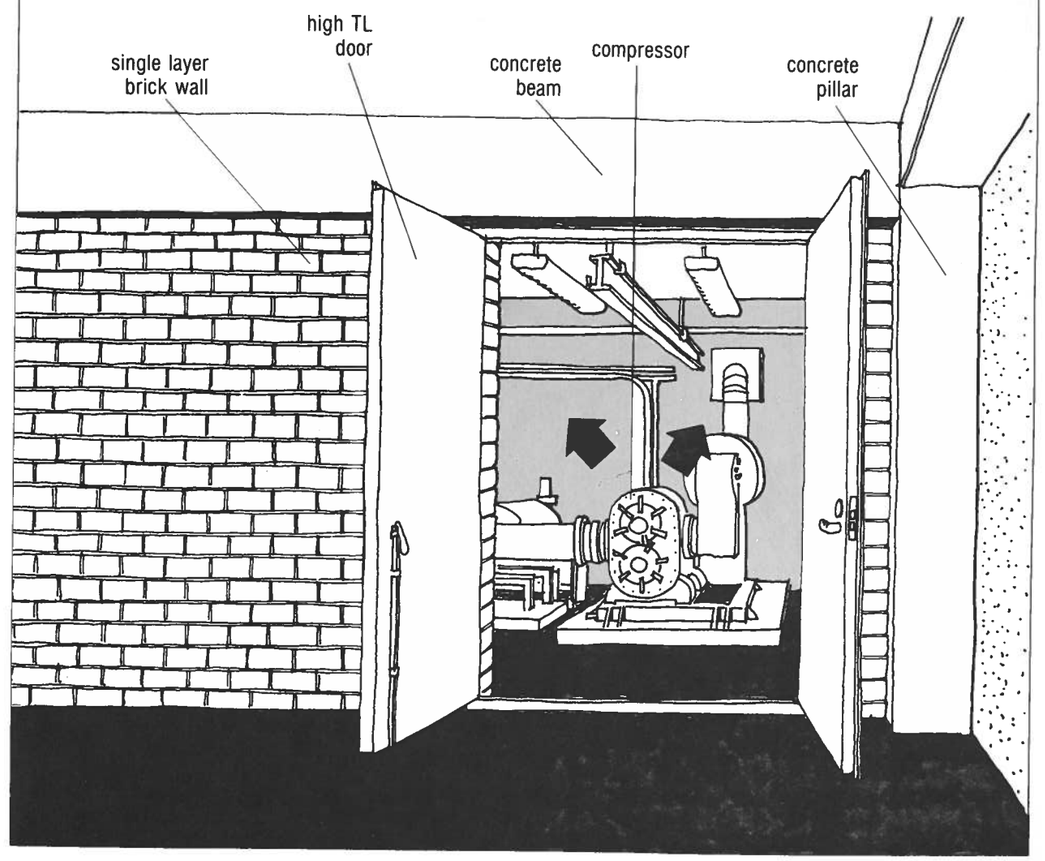


Example

Machines in a large open area in an industrial building create a noise hazard.

Control measure

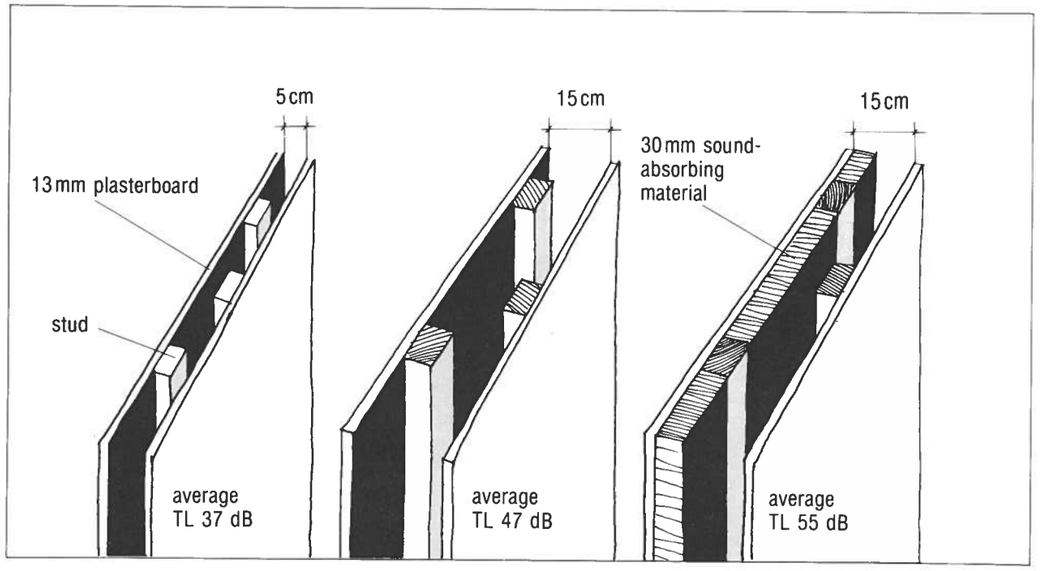
The area containing the machines is surrounded by a brick wall.



Light double walls provide good TL

Two light walls separated by an air gap provide good TL, increasing with the distance between them up to about 15 cm. With sound-absorbing material in between, the TL further increases as the distance between increases. Double walls may provide the same TL as single walls that are five to ten times as heavy.

Principle

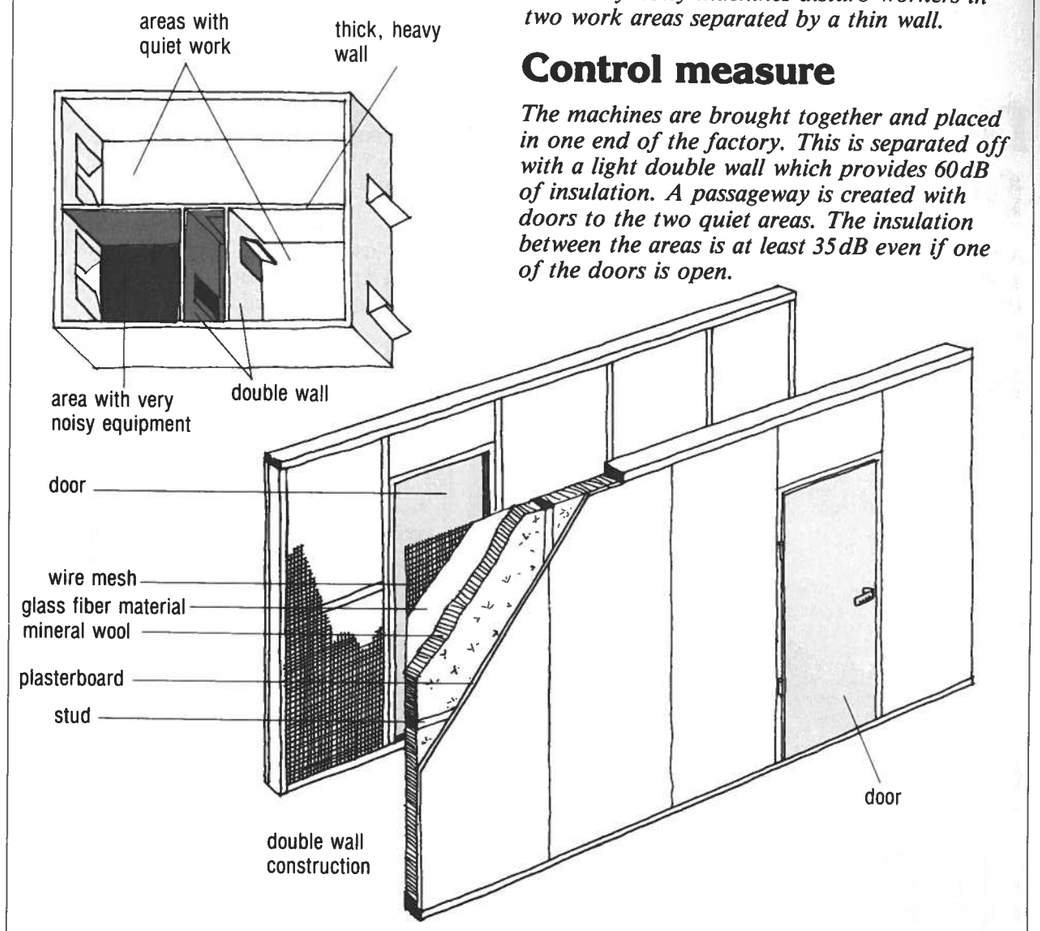


Example

Extremely noisy machines disturb workers in two work areas separated by a thin wall.

Control measure

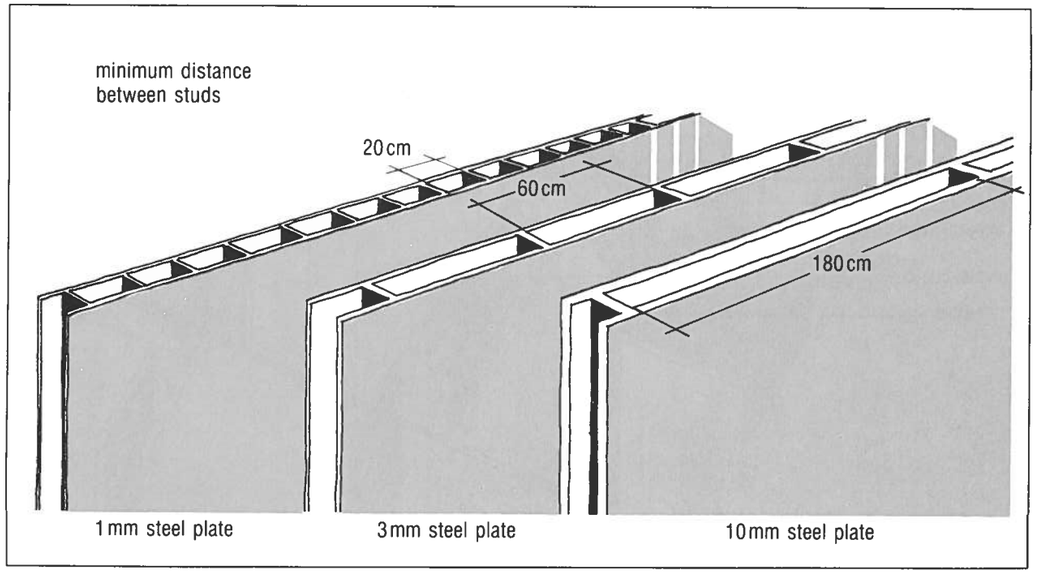
The machines are brought together and placed in one end of the factory. This is separated off with a light double wall which provides 60 dB of insulation. A passageway is created with doors to the two quiet areas. The insulation between the areas is at least 35 dB even if one of the doors is open.



Double walls should have few connections

A double wall provides the best TL if each layer is connected to heavy walls or if there are open joints on both ends. If the layers are fastened to shared studs, the TL is greatly reduced if the studs are close together. The thicker the layers, the farther apart the studs must be in order to avoid substantial reduction of TL.

Principle

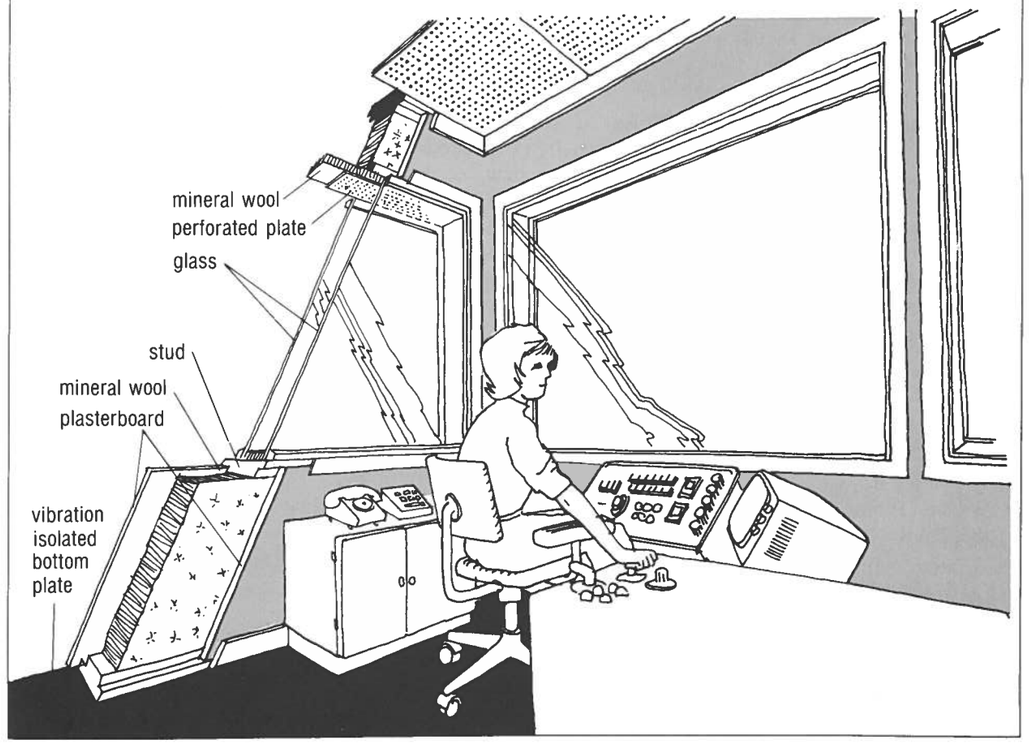


Example

The control room for a machine in a paper factory is noisy, and telephone conversation is practically impossible.

Control measure

A well-insulated room is created with thin panels on common studs. The floor plate of the room is isolated from vibration from the floor of the factory.



Noise control measures

The following is a survey of noise control methods which have been applied with good results in various types of workplaces. Many noise sources produce airborne sound and sound from vibrating surfaces at the same time, so in many cases several noise control measures must be applied.

Changes in machinery and equipment

The machines or machine parts to be controlled must be identified. Methods of maintenance and servicing must be taken into account in noise control design. Attempts should be made to:

- prevent or reduce impact between machine parts.
- reduce speeds gently between forward and reverse movements.
- replace metal parts with quieter plastic parts.
- enclose especially noisy machine parts.

Designers should be encouraged to:

- select power transmission which permits the quietest speed regulation; for example, rotation-speed-controlled electric motors.
- isolate vibration-related noise sources within machines.
- provide proper TL and seals for doors for machines.
- provide machines with effective cooling flanges which reduce the need for air jet cooling.

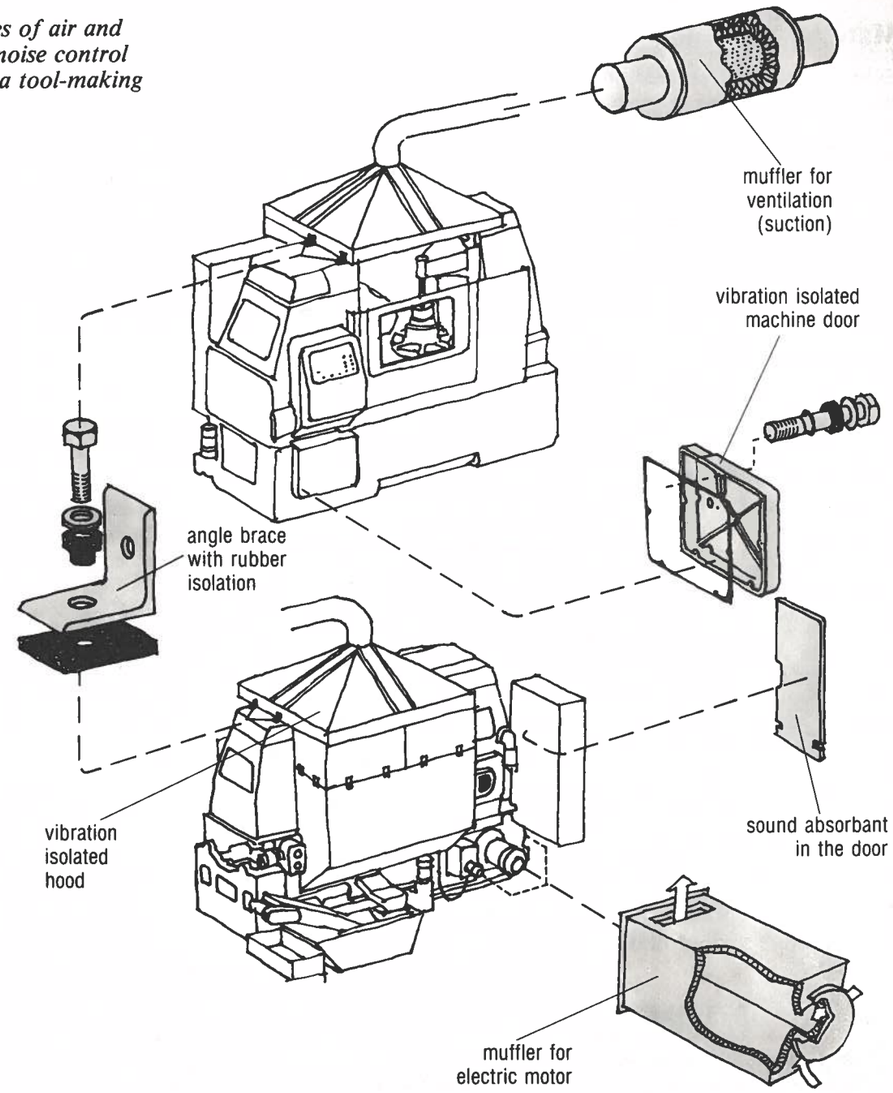
Noise of existing equipment can often be controlled as effectively as new equipment without complicated procedures. Common control measures include:

- providing mufflers for the air outlets of pneumatic valves.
- changing the pump type in hydraulic systems.
- changing to quieter types of fans or placing mufflers in the ducts of ventilation systems.
- providing mufflers for electric motors.
- providing mufflers for intakes of air compressors.

In a new plant, it is sometimes possible to make more extensive changes, such as:

- installing quiet electric motors and transmissions.
- selecting hydraulic systems which have remote oil tanks and accumulators at pump discharges, and designing pipelines for low flow speeds (maximum 5 m/sec.).
- designing ventilation ducts with fan inlet mufflers and other mufflers to prevent noise transfer in the duct between noisy and quiet rooms.

Various types of air and solid-borne noise control measures in a tool-making machine



Materials handling

Existing workplaces may be changed to prevent impact and collision during manual and mechanical materials handling.

- Reduce the dropping height of goods being collected in bins and boxes.
- Increase the rigidity of containers receiving impact from goods, or damp them with damping materials.
- Use soft rubber or plastic to receive hard impacts.

If new transportation equipment is being purchased, consideration should be given to creating a system for quiet materials handling.

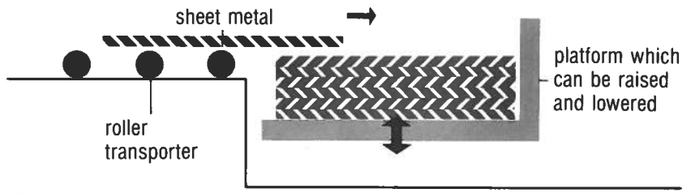
The following may be considered:

- selecting belt conveyors, which generally are quieter than roller conveyors.
- regulating the conveyors or other transportation systems so that their speed is adjusted to the required amount of material. In this way, it is possible to avoid some noise produced by vibrations and colliding objects.

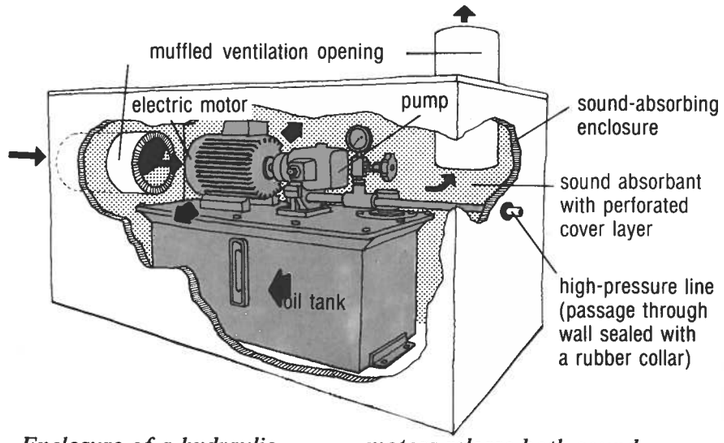
Enclosure of machines

If it is not possible to prevent noise, it may be necessary to enclose the machines.

- Use a dense material, such as sheet metal or plasterboard, on the outside.
- Use a sound absorbant material on the inside. A single hood of this type can reduce the sound level by 15-20 dB(A).
- Install mufflers on cooling air openings during enclosure of electric motors, etc.
- Install easily opened doors as required for machine adjustment and service.



Plates dropping from a great height off of a roller belt onto a stacking platform produce loud noise. By using a board whose height can be raised and lowered, the drop can be reduced and the noise decreased.

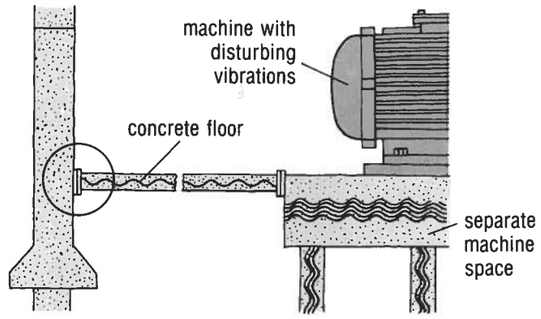


Enclosure of a hydraulic system requires muffled ventilation openings. Electric motors release both sound and heat, as do the pump and the oil tank.

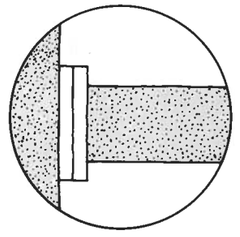
Control of noise from vibrating surfaces

Vibration in machines often results from slippage or loosened bolts. In such cases, the disturbance can be reduced by repair or replacement.

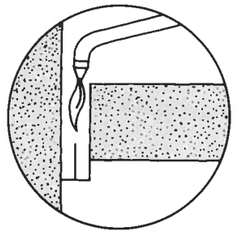
- Isolate the floor from machine vibrations.
- Place large and heavy machines which will not be vibration isolated on separate bases. They may be put on a separate piece of ground without contact with the remainder of the building.
- Provide vibration isolation of machine surfaces to reduce sound emission. Fasten plates to the machine face by flexible means in order to reduce the vibrations of the surfaces. Plates with special damping design may be used.



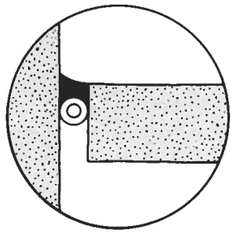
In the case of heavily vibrating machines, a separate machine base may be used as well as a separating joint to prevent the spread of sound. Here, two joints are used for separation.



All joints are equipped with double 10mm layers of cellular plastic projecting shields prior to concrete pouring.



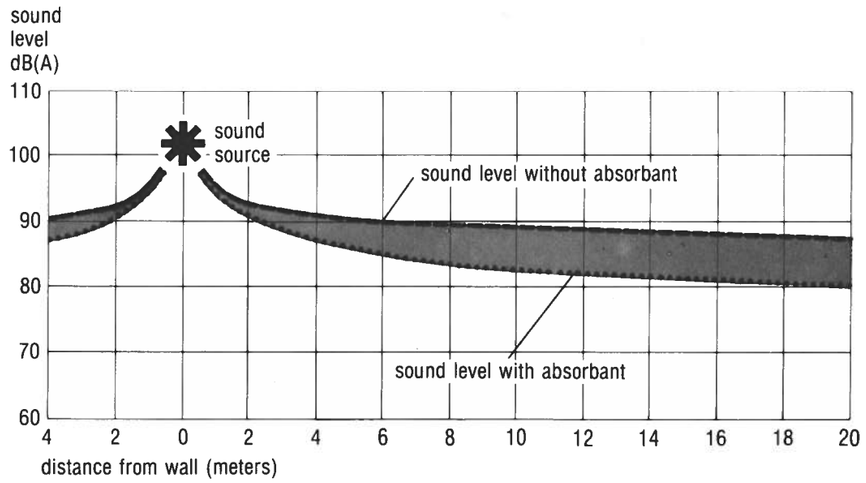
After pouring, clean or burn out the joints, inspect, and reclean if necessary. No pieces of stone or the like should be present in the joints.



Seal the joint with a piece of rubber tubing, etc., which is pressed down. Then close off the surface with elastic sealing compound.

Damping with absorbants

In a workplace with hard materials on the ceiling, walls, and floor, almost all the sound which strikes the surfaces is reflected. The sound level goes down at first as you move away from the machine, but after a certain point it remains practically unchanged. A better sound environment can be obtained by coating the ceilings and walls with effective sound-absorbing material.



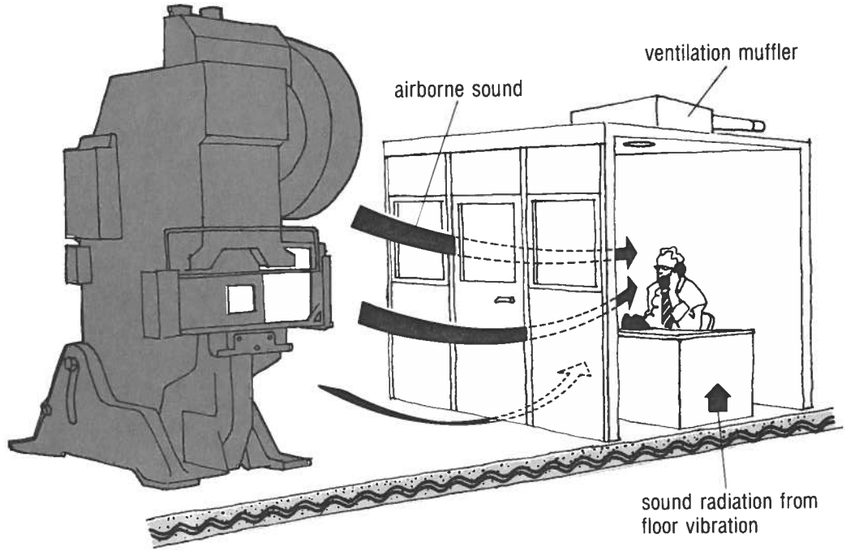
How sound levels vary at different distances from a sound source before and after application of absorbant materials to the entire ceiling surface.

Sound insulating separate rooms

With automation of machines and processes, remote control from a separate room may become desirable.

Some control measures may include:

- constructing the control rooms with materials having adequate TL.
- providing good sealing around doors and windows.
- providing openings for ventilation with passages for cables and piping equipped with good seals. The control room will need adequate ventilation and possibly air conditioning in hot working areas. Otherwise, there is a risk that the doors will be opened for ventilation, which would spoil the effectiveness of the room in reducing the noise level.



Sound disturbances in an operating room or shop office may be caused by direct transmission (leakage through the door opening, etc.) from the machine or by radiation from the common floor.

Maintenance

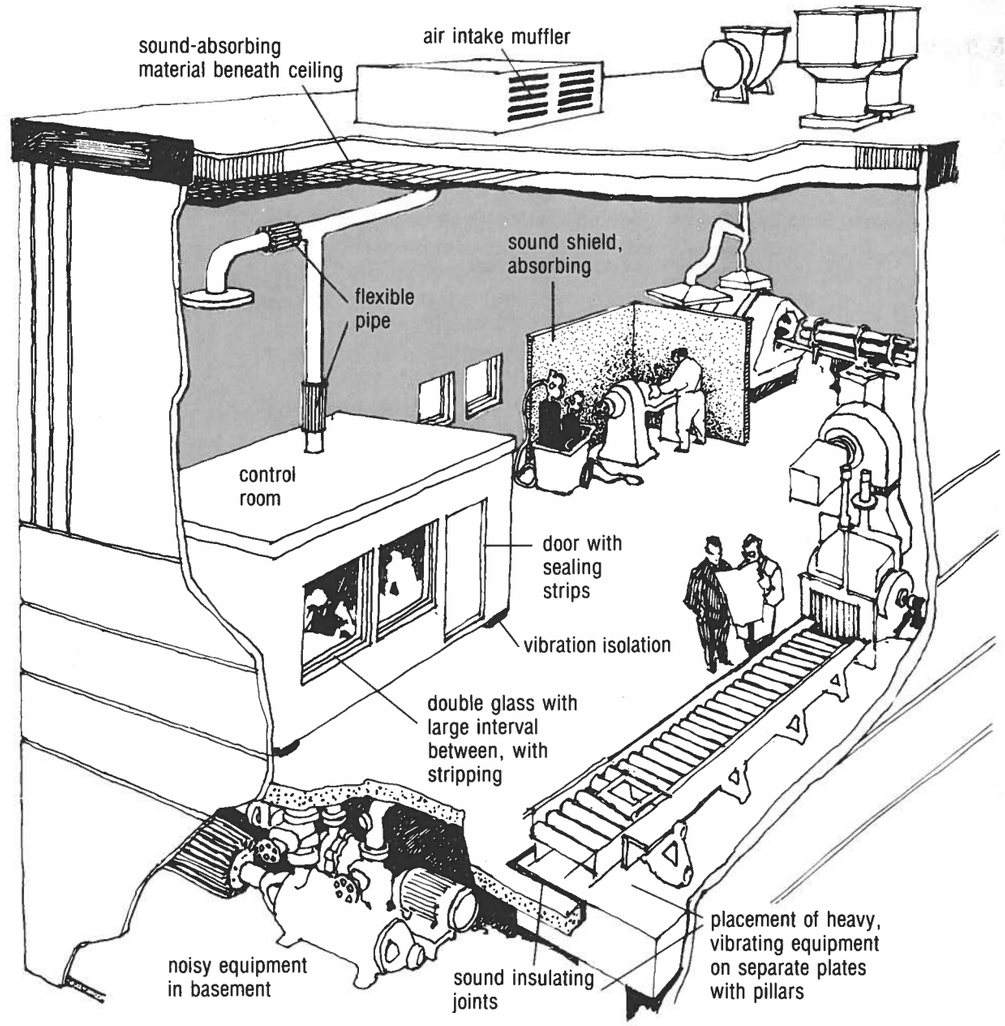
In some cases, a noise hazard will be created or made worse by a lack of maintenance. Parts may become loose, creating more noise because of improper operation or scraping against other parts. Grinding noises may also occur as the result of inadequate lubrication.

It is especially important to provide proper maintenance of noise control devices which are added or built into machinery. If a muffler becomes loose or worn out, for example, it should be fixed or replaced as soon as possible.

Planning for noise control

Noise control should be taken into account from the beginning of the planning process for a new building:

- The frame, floor, and machine bases should be selected so that all sources of disturbance can be provided with effective vibration isolation. Heavy equipment requires rigid, heavy bases. It is also possible to prevent the machine bases from making direct contact with the rest of the building frame.
- Important noise sources may be surrounded with constructions which supply sound isolation. Special attention should be paid to portholes, observation windows, and other building parts which involve a risk of sound leakage.
- Noisy areas where the workers must spend time should be provided with ceiling coverings (and wall coverings as well in the case of very high ceilings) to absorb incoming sound. The sound absorption ability varies greatly for various materials, so the materials must be selected in relation to the type of noise. Good sound absorption properties can often be combined with good thermal insulation.
- Office areas should be separated by means of a joint from building areas where vibration-producing equipment is installed.
- Wall and floor constructions as well as windows, doors, etc., should be constructed to provide the necessary sound TL.
- Fastening of noisy equipment to light separate structures should always be avoided because vibration isolation requires a rigid base to be effective.
- For office areas and storerooms where there are many functions in the same area, ceiling surfaces which provide good sound absorption and floors covered with soft textile material may be needed.



Example of noise control measures which can be carried out in an industrial building to avoid the spread of noise.

How OSHA can help employers and employees

Legal limits on noise

Under the Occupational Safety and Health Act, every employer is legally responsible for providing a workplace free of such hazards as excessive noise.

OSHA regulations require every employer to limit workers' noise exposure to 90 "decibels," or dB(A), averaged over an 8-hour period. There are shorter time limits for higher noise levels (see chart). Measurements must be made under normal working conditions.

If noise exposure rises above these levels, the employer must use "engineering controls"—changes in the physical work environment—or "administrative controls"—limits on individual employees' exposure time—in order to comply with the law. While such controls are being implemented, workers must be provided with personal protective equipment, such as earmuffs or plugs, to protect their hearing.

Personal protective devices are generally not a good permanent solution for a number of reasons. They may cause infections or discomfort. They may not work effectively because of the difficulty in getting an acceptable fit for each individual. In some cases—particularly when noise is intermittent and below 85 dB(A)—they may make communication more difficult, which can contribute to accidents and make jobs more difficult to perform. If ear protection equipment is not effective or comfortable, the worker should discuss the problem with his or her employer. Other devices may be more satisfactory, and perhaps permanent noise control measures may be installed more quickly.

If sound levels are above the OSHA limits, it is a serious violation of OSHA standards if the employer does not maintain an adequate hearing conservation program. The program must include periodic hearing tests (audiograms) for each overexposed employee and retesting or referral to a qualified physician if an employee's hearing ability is reduced by 20 decibels at any frequency.

Hours of exposure	Sound level, dB(A)
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

OSHA standards establish limits on workplace noise exposure for given time periods. The limit for average exposure during an 8-hour shift is 90 decibels, or dB(a). Exposure to impulse noise should never exceed 140 decibels.

When insert ear plugs or custom-molded hearing protection devices other than self-fitted, malleable plugs are being used, OSHA requires that individual employee fitting be conducted by a trained person, and that employees be instructed in the care and use of the devices.

More information about OSHA requirements and procedures for enforcing noise standards is contained in OSHA's Industrial Hygiene Field Operation Manual.

If an employer fails to comply with OSHA standards, and the problem cannot be resolved at the workplace, workers should contact the nearest OSHA area office.

Consultation for employers

In all states, free consultation services are available to help employers identify job safety and health hazards, such as excessive noise exposure, and to recommend solutions.

All information gathered by the consultant, including the employer's identity, is completely confidential and is not made available to OSHA enforcement personnel—with one very rare exception. If a consultant observes a *serious* violation of OSHA standards and the employer fails to correct it within the time period recommended by the consultant, OSHA or the responsible state agency will be notified.

Employers may on an anonymous basis contact the nearest OSHA office to find out how to take advantage of the free consultation services.

Loans for small businesses

The Small Business Administration (SBA), in cooperation with OSHA, provides loans to small businesses which are "likely to suffer substantial economic injury" in meeting OSHA safety and health standards.

Small business employers can obtain more information from the nearest SBA office or may write for a copy of *SBA Loans for OSHA Compliance* (OSHA 2005) from OSHA Office of Publications, Room S-1212, Department of Labor, Washington, D.C. 20210.

Workers' rights under OSHA

With its small staff of inspectors, OSHA obviously cannot prevent every hazard in every workplace. It is essential that workers and employers cooperate on job safety and health programs.

In particular, OSHA encourages the formation of workplace health and safety committees. Health and safety committees can keep on top of job hazards such as noise, day in and day out. And if properly set up, they can make sure both employers and workers are involved in eliminating hazards.

(For more information on health and safety committees and the workers' rights described below, contact the nearest OSHA office.)

Whenever possible, safety and health problems should be resolved at the workplace. If they can't be, here are some ways workers can use the laws:

- If your employer fails to correct a hazard causing an imminent danger, contact the nearest OSHA area office. If an OSHA inspector finds that an imminent danger exists, and your employer still fails to fix it,

OSHA can seek an order from a federal court.

- If other types of hazards exist at your workplace, discuss them with other workers, your union representative, if any, and your employer. If you cannot get the hazard corrected, you can ask OSHA to make an inspection.
- OSHA will not tell your employer who requested an inspection if you ask that your name be kept confidential.
- During an OSHA inspection, a workers' representative may accompany the inspector, and must be paid by your employer.
- You (or your representative) may give OSHA information which could affect OSHA actions against your employer, such as proposed penalties and orders setting proposed dates for correcting hazards.
- If you disagree with the amount of time OSHA has given your employer to correct a hazard, you can ask for review by the Occupational Safety and Health Review Commission, an independent agency. If your employer asks the Commission to review OSHA actions, you can become a participant in the case by notifying the Commission. The address is: Occupational Safety and Health Review Commission, 1825 K Street, N.W., Washington, D.C. 20006.
- You can obtain information about safety and health hazards, OSHA standards, and rights provided by OSHA's law from your employer or from any OSHA office, listed in the back of this booklet.
- Any employer with more than 10 employees must keep records of all work-related injuries and illnesses, and you (or your representative) have the right to review those records.
- If there is a potential health hazard in your workplace and you would like to know more about it, contact NIOSH—the National Institute for Occupational Safety and Health. NIOSH will give you information, and, if necessary, may conduct a survey of hazards in your workplace. If NIOSH has already studied hazards in your industry, it will give you the results. The address is: NIOSH, Department of HEW, 5600 Fishers Lane, Rockville, Maryland 20857.
- In some states, OSHA has approved requests by state agencies to take over job safety and health enforcement. The state agencies must provide workers effective protection and the same rights that OSHA does. If you are not satisfied with any aspect of your state agency's performance, you may file a complaint with federal OSHA.

Workers' right to insist on job safety and health

Section 11(c) of OSHA's law says an employer cannot punish or discriminate against an employee for job safety and health activities, such as:

- complaining to the employer, union, OSHA, or any other government agency about job safety and health hazards.
- filing safety or health grievances.
- participating in a workplace health and safety committee or union activities concerning job safety and health.
- participating in OSHA inspections, conferences, hearings, or other OSHA-related activities.

If you are exercising these or other safety and health rights, your employer cannot discriminate against you in any way, such as through firing, demotion, taking away seniority or benefits you've earned, transferring you to an undesirable job or shift, or threatening or harassing you.

If you believe you have been punished for using your safety and health rights, contact OSHA. You should do so *within 30 days* of the time you find out you've been discriminated against. If you want, your union representative can file your 11(c) complaint for you.

If a state agency has been approved by OSHA to take over job safety and health enforcement, you may file your 11(c) complaint with either federal OSHA or the state agency.

U.S. Department of Labor Regional Offices for Occupational Safety and Health Administration

Region I
(CT, ME, MA, NH, RI, VT)
16-18 North Street
1 Dock Square, 4th Floor
Boston, MA 02109
Telephone: (617) 223-6710

Region II
(NY, NJ, PR, VI, CZ)
Room 3445, 1 Astor Plaza
1515 Broadway
New York, NY 10036
Telephone: (212) 944-3426

Region III
(DE, DC, MD, PA, VA, WV)
Gateway Bldg., Suite 2100
3535 Market Street
Philadelphia, PA 19104
Telephone: (215) 596-1201

Region IV
(AL, FL, GA, KY, MS, NC, SC, TN)
1375 Peachtree Street, N.E.
Suite 587
Atlanta, GA 30309
Telephone: (404) 881-3573

Region V
(IL, IN, MN, MI, OH, WI)
230 South Dearborn Street
32nd Floor, Room 3263
Chicago, IL 60604
Telephone: (312) 353-2220

Region VI
(AR, LA, NM, OK, TX)
555 Griffin Square, Room 602
Dallas, TX 75202
Telephone: (214) 767-4731

Region VII
(IA, KS, MO, NE)
911 Walnut Street, Room 3000
Kansas City, MO 64106
Telephone: (816) 374-5861

Region VIII
(CO, MT, ND, SD, UT, WY)
Federal Bldg., Room 1554
1961 Stout Street
Denver, CO 80294
Telephone: (303) 837-3883

Region IX
(CA, AZ, NV, HI)
Box 36017
450 Golden Gate Avenue
San Francisco, CA 94102
Telephone: (415) 556-0584

Region X
(AK, ID, OR, WA)
Federal Office Bldg., Room 6003
909 First Avenue
Seattle, WA 98174
Telephone: (206) 442-5930

U.S. Department of Labor Area Offices for Occupational Safety and Health Administration

Alabama

Birmingham, AL 35216
2047 Canyon Road—Todd Mall
Telephone: (205) 822-7100

Mobile, AL 36602
Commerce Buiding—Room 600
118 North Royal Street
Telephone: (205) 690-2131

Alaska

Anchorage, AK 99501
Federal Bldg.—U.S. Courthouse
701 "C" Street
Telephone: (907) 271-5152

Arizona

Phoenix, AZ 85004
Amerco Towers—Suite 300
2721 North Central Avenue
Telephone: (602) 241-2007

Arkansas

Little Rock, AR 72205
West Mark Bldg.—Suite 212
4120 West Markham
Telephone: (501) 378-6291

California

Long Beach, CA 90802
400 Oceangate—Suite 530
Telephone: (213) 432-3434

San Francisco, CA 94105
211 Main Street
Telephone: (415) 556-7260

Colorado

Lakewood, CO 80204
Tremont Center—1st Floor
333 West Colfax
Telephone: (303) 837-5285

Connecticut

Hartford, CT 06103
555 Main Street
Telephone: (203) 244-2294

District of Columbia

Washington, DC 20215
400 First Street, N.W.—Room 602
Telephone: (202) 523-5224

Florida

Fort Lauderdale, FL 33301
299 East Broward Blvd.—Room 301
Telephone: (305) 527-7292

Jacksonville, FL 32207
Art Museum Plaza—Suite 4
2809 Art Museum Drive
Telephone: (904) 791-2895

Tampa, FL 33602
700 Twiggs Street—Room 624
Telephone: (813) 228-2821

Georgia

Macon, GA 31201
152 New Street
Telephone: (912) 746-5143

Savannah, GA 31405
Enterprise Bldg.—Suite 210
6605 Abercorn Street
Telephone: (912) 354-0733

Tucker, GA 30084
Building 10—Suite 33
La Vista Perimeter Office Park
Telephone: (404) 221-4767

Hawaii

Honolulu, HI 96850
300 Ala Moana Blvd.—Suite 5122
Telephone: (808) 546-3157

Idaho

Boise, ID 83706
1315 West Idaho Street
Telephone: (208) 384-1867

Illinois

Aurora, IL 60542
344 Smoke Tree Business Park
Telephone: (312) 896-8700

Calumet City, IL 60409
1400 Torrence Ave.—2nd Floor
Telephone: (312) 891-3800

Niles, IL 60648
6000 W. Touhy Avenue
Telephone: (312) 631-8200

Peoria, IL 61603
228 N.E. Jefferson—3rd Floor
Telephone: (309) 671-7033

Indiana

Indianapolis, IN 46204
U.S. Post Office and Courthouse
46 East Ohio Street—Room 423
Telephone: (317) 269-7290

Iowa

Des Moines, IA 50309
210 Walnut Street—Room 815
Telephone: (515) 284-4794

Kansas

Wichita, KS 67202
216 N. Waco—Suite B
Telephone: (316) 267-6311, Ext. 644

Kentucky

Louisville, KY 40202
600 Federal Place—Suite 554-E
Telephone: (502) 582-6111

Louisiana

Baton Rouge, LA 70806
2156 Wooddale Blvd.
Hoover Annex, Suite 200
Telephone: (504) 923-0718, Ext. 474

New Orleans, LA 70130
600 South Street—Room 337
Telephone: (504) 589-2451

Maine

Augusta, ME 04330
U.S. Federal Bldg.—Room 120
40 Western Avenue
Telephone: (207) 622-6171

Maryland

Baltimore, MD 21201
Federal Bldg.—Room 1110
Charles Center, 31 Hopkins Plaza
Telephone: (301) 962-2840

Massachusetts

Springfield, MA 01103
1200 Main Street—Suite 513
Telephone: (413) 781-2420, Ext. 522

Waltham, MA 02154
400-2 Totten Pond Road
Telephone: (617) 890-1239

Michigan

Detroit, MI 48226
231 West Lafeyette—Room 628
Telephone: (313) 226-6720

Minnesota

Minneapolis, MN 55403
100 North 6th Street—Room 801
Telephone: (612) 725-2571

Mississippi

Jackson, MS 39201
Federal Bldg.—Suite 1445
100 West Capitol Street
Telephone: (601) 969-4606

Missouri

Kansas City, MO 64106
1150 Grand Avenue—6th Floor
12 Grand Bldg.
Telephone: (816) 374-2756

St. Louis, MO 63101
210 North 12th Blvd.—Room 520
Telephone: (314) 425-5461

Montana

Billings, MT 59101
Petroleum Bldg.—Suite 525
2812 1st Avenue North
Telephone: (406) 657-6649

Nebraska

Omaha, NE 68106
Overland-Wolf Bldg.—Room 100
6910 Pacific Street
Telephone: (402) 221-9341

Nevada

Carson City, NV 89701
1100 East William Street—Suite 222
Telephone: (702) 883-1226

New Hampshire

Concord, NH 03301
Federal Bldg.—Room 334
55 Pleasant Street
Telephone: (603) 224-1995

New Jersey

Belle Mead, NJ 08502
Belle Mead GSA Depot—Bldg. T3
Telephone: (201) 359-2777

Camden, NJ 08104
2101 Ferry Ave.—Room 403
Telephone: (609) 757-5181

Dover, NJ 07801
2 E Blackwell Street
Telephone: (201) 361-4050

Hasbrouck Heights, NJ 07604
Teterboro Airport Professional Bldg.
377 Route 17—Room 206
Telephone: (201) 288-1700

Newark, NJ 07102
970 Broad Street—Room 1435C
Telephone: (201) 645-5930

New Mexico

Albuquerque, NM 87102
Western Bank Bldg.—Room 1125
505 Marquette Avenue NW
Telephone: (505) 766-3411

New York

Albany, NY 12207
Leo W. O'Brien Federal Building
Clinton Ave. & N. Pearl St.—Room 132
Telephone: (518) 472-6085

Brooklyn, NY 11201
185 Montague Street
Telephone: (212) 330-7667

Buffalo, NY 14202
220 Delaware Ave.—Suite 509
Telephone: (716) 846-4881

Flushing, NY 11354
136-21 Roosevelt Avenue
Telephone: (212) 445-5005

New York, NY 10007
90 Church Street—Room 1405
Telephone: (212) 264-9840

Rochester, NY 14614
Federal Office Bldg.—Room 608
100 State Street
Telephone: (716) 263-6755

Syracuse, NY 13260
100 South Clinton Street—Room 1267
Telephone: (315) 423-5188

Westbury, NY 11590
990 Westbury Road
Telephone: (516) 334-3344

White Plains, NY 10601
200 Mamaroneck Avenue—Room 403
Telephone: (914) 946-2510

North Carolina

Raleigh, NC 27601
Federal Office Bldg.—Room 406
310 New Bern Avenue
Telephone: (919) 755-4770

North Dakota

Bismarck, ND 58501
Federal Bldg.—Room 348
P.O. Box 2439
Telephone: (701) 255-4011, Ext. 521

Ohio

Cincinnati, OH 45202
Federal Office Bldg.—Room 4028
550 Main Street
Telephone: (513) 684-2354

Cleveland, OH 44199
Federal Office Bldg.—Room 847
1240 East Ninth Street
Telephone: (216) 522-3818

Columbus, OH 43215
Federal Office Bldg.—Room 634
200 North High Street
Telephone: (614) 469-5582

Toledo, OH 43604
Federal Office Bldg.—Room 734
234 North Summit Street
Telephone: (419) 259-7542

Oklahoma

Oklahoma City, OK 73118
50 Penn Place—Suite 408
Telephone: (405) 231-5351

Tulsa, OK 74127
717 South Houston—Suite 304
Telephone: (918) 581-7676

Oregon

Portland, OR 97204
1220 S.W. Third Street—Room 640
Telephone: (503) 221-2251

Pennsylvania

Erie, PA 16501
147 West 18th Street
Telephone: (814) 453-4351

Harrisburg, PA 17109
Progress Plaza
49 North Progress Avenue
Telephone: (717) 782-3902

Philadelphia, PA 19106
Wm. J. Green, Jr. Federal Bldg.
600 Arch Street—Room 4256
Telephone: (215) 597-4955

Pittsburgh, PA 15235
400 Penn Center Blvd.—Suite 600
Telephone: (412) 644-2905

Wilkes-Barre, PA 18701
Penn Place—Room 2005
20 North Pennsylvania Avenue
Telephone: (717) 826-6538

Puerto Rico

Hato Rey, PR 00918
U.S. Courthouse & FOB
Carlos Chardon—Room 555
Telephone: (809) 753-4457

Rhode Island

Providence, RI 02903
Federal Bldg. & U.S. Post Office—
Room 204
Telephone: (401) 528-4466

South Carolina

Columbia, SC 29204
Kittrell Center—Suite 102
2711 Middleburg Drive
Telephone: (803) 765-5904

South Dakota

Sioux Falls, SD 57102
Court House Plaza Bldg.—Room 408
300 North Dakota Avenue
Telephone: (605) 336-2980, Ext. 425

Tennessee

Nashville, TN 37203
1600 Hayes Street—Suite 302
Telephone: (615) 251-5313

Texas

Austin, TX 78701
American Bank Tower—Suite 310
221 West 6th Street
Telephone: (512) 397-5783

Fort Worth, TX 76115
Fort Worth Federal Center
4900 Hemphill Bldg. 24—Room 145
Telephone: (817) 334-5274

Harlingen, TX 78550
Riverview Professional Bldg.
1325 South 77 Sunshine Strip—Suite 9
Telephone: (512) 425-6811

Houston, TX 77004
2320 La Branch Street—Room 2118
Telephone: (713) 226-5431

Houston, TX 77058 (Clear Lake City)
1100 NASA Road 1—Suite 505
Telephone: (713) 226-4357

Irving, TX 75061
1425 West Pioneer Drive
Telephone: (214) 767-5347

Lubbock, TX 79401
Federal Bldg.—Room 421
1205 Texas Avenue
Telephone: (806) 762-7681

Tyler, TX 75701
FOB-USPO & Courthouse—Room 208
211 West Ferguson Street
Telephone: (214) 595-1404

Utah

Salt Lake City, UT 84101
U.S. Post Office Bldg.—Room 451
350 South Main Street
Telephone: (801) 524-5080

Virginia

Richmond, VA 23240
Federal Bldg.—Room 6226
400 North 8th Street
Telephone: (804) 782-2864

Washington

Bellevue, WA 98004
121 107th Street, N.E.
Telephone: (206) 442-7520

West Virginia

Charleston, WV 25301
Charleston National Plaza—Room 1726
700 Virginia Street
Telephone: (304) 343-6181, Ext. 420

Wisconsin

Appleton, WI 54911
2618 North Ballard Road
Telephone: (414) 734-4521

Milwaukee, WI 53203
Clark Building—Room 400
633 West Wisconsin Avenue
Telephone: (414) 291-3315

NEWSLETTER

National Board of Occupational Safety and Health · Arbetarskyddsstyrelsen · Sweden
Mailing address: S-171 84 Solna · Telephone: 46-8-730 90 00 Publisher: Gunilla Warnbeck

No. 4 December 1979

Allocations for the fiscal year 1980/81

For the fiscal year 1980/81 the allocations granted to the Board and to the Labour Inspectorate amount to Skr 223 million (US $ 53.6 million). Of this sum Skr 123 million is intended for the Board and Skr 100 million for the Labour Inspectorate. In comparision with the fiscal year 1979/80 this is an increase of Skr 20 million (US $ 4.8 million).

For the same year 10 new appointments were granted to the Board and 28 to the Labour Inspectorate. The Board and the Inspectorate today employ about 1 300 persons with about 700 persons at the Board and 600 at the Inspectorate.

Ordinances issued by the Board

MICROWAVE OVENS

The Board has issued **Ordinance No. 1979:6, Microwave Ovens.** The Ordinance entered into force on 1st October 1979.

The Ordinance provides that microwave ovens for commercial use must be tested for microwave leakage. Ovens of a design approved under current testing procedure (SEMKO 111) are to be checked at least once every three years. Other ovens are to be checked at least once annually.

If a test shows that leakage exceeds 50 W/m^2 at a distance of 5 cm or more from the surface of the oven, the oven must be taken out of service and may not be used again until the leakage has been reduced below the above mentioned level. If a test shows that leakage does not exceed the above mentioned level, a label giving the date of the test and the name of the testing officer is to be affixed to the oven.

Before a new microwave oven is delivered, the manufacture or supplier must measure the microwave leakage. The leakage thus measured must not exceed 20 W/m^2 at a distance of 5 cm or more from the surface of the oven.

For further particulars, reference is made in the Ordinance to the regulations (SIND-FS 1976:6) issued by the National Board of Industry concerning the testing of microwave oven designs.

EPOXY PRODUCTS

The Board has issued **Ordinance No. 1979:7 concerning Amendments to the Board's Directions No 127, Epoxy products.**

New issues of "Arbete och Hälsa"

As a rule the issues of "Arbete och Hälsa" *appear in Swedish with a summary in English.*
Summaries contained in the latest issues follow below.

ARBETE OCH HÄLSA 1979:33

Chromium. Nordic expert group. *In Norwegian.*

Survey of literature on chromates and chromic compounds to be used as background for discussion on occupational exposure limits. Recommendations are given on the biological effects to be used in this discussion. Main emphasis is given on carcinogenic effects and the effects on mucous membranes.

ARBETE OCH HÄLSA 1979:34

Diisocyanates. Nordic expert group. *In Swedish.*

A review of the literature on diisocyanates with relevance to the discussion of occupational exposure limits. This discussion should be based on the acute and chronic reduction of pulmonary function that is observed among exposed individuals. Workers already sensitized to diisocyanates are not supposed to be protected by a exposure limit based on these effects. They should not be further exposed.

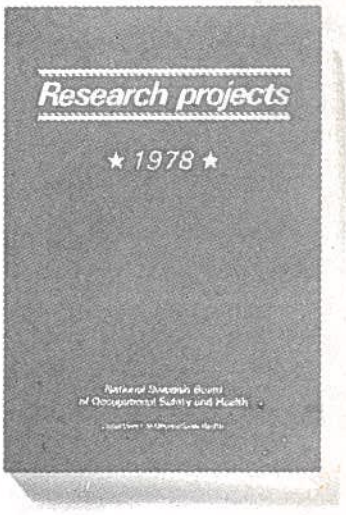
ARBETE OCH HÄLSA 1979:35

Xylene. Nordic expert group. *In Swedish.*

Survey on literature on xylene to be used as background for discussion of occupational exposure limits. Acute, early central nervous effects are recommended to be used in this discussion.

Research projects 1978

An English translation of the Board's research project catalogue for 1978 has recently appeared. The catalogue is a summary of the research projects which were concluded or in progress at the Board's Occupational Health Department during 1978. The catalogue can be obtained from the Board. See order form.



Single copies of the publications of the Board mentioned in this Newsletter are submitted free of charge to foreign addresses on request. See order form.

Change of address:
Write to
International Secretariat,
Arbetarskyddsstyrelsen,
National Board of
Occupational Safety
and Health,
S- 171 84 Solna
Sweden

ISSN 0348–7598

Investigation reports —in Swedish— issued by the Board

INVESTIGATION REPORT 1979:14

Olle Bobjer:
Exposure to organic solvents during painting work in shipyards.

INVESTIGATION REPORT 1979:15, 42 pages.

Thommy Ekström, Staffan Krantz and Per-Erik Werner:
Studies with powder diffraction methods for identification and characterization of small dust samples.

INVESTIGATION REPORT 1979:16, 15 pages.

Thommy Ekström and Staffan Krantz:
Oxidation of dust sampled filters with low-temperature ashing for analysis of cristalline silicon dioxide.

INVESTIGATION REPORT 1979:17, 65 pages.

Kjell Hansson Mild:
Radiofrequent electromagnetic fields in radiostations and in power pylons.

INVESTIGATION REPORT 1979:18, 29 pages.

Ing-Marie Andersson and Gunnar Rosén:
Exposure to organic solvents at paint fabrication. A study of 51 employees' exposure to organic solvents in eight paint factories.

INVESTIGATION REPORT 1979:19, 23 pages.

Ing-Marie Andersson, Mirja Ekdahl and Gunnar Rosén:
Dish-washing at a paint factory. A study and a description of a dish-washing method.

INVESTIGATION REPORT 1979:20, 14 pages.

Helga Meyer and Ove Säberg:
Paint colours of epoxy at temporary working sites.

INVESTIGATION REPORT 1979:21

Ewa Gunnarsson:
Work with visual display units at a newspaper publishing company.

INVESTIGATION REPORT 1979:22, 21 pages.

Jan Asztely:
Evaluation of impulse noise – a preliminary study.

INVESTIGATION REPORT 1979:23, 41 pages.

Rasmus Bjurström:
Measurement of isocyanates in the working environment with a fluid chromatographic method.

INVESTIGATION REPORT 1979:24, 72 pages.

Thommy Ekström:
X-ray diffraction analysis for airborne particulates – a review and a literature study.

INVESTIGATION REPORT 1979:25, 12 pages.

Björn Sköldström and Ingvar Holmér:
A microprocessor based collecting system for ambulatory monitoring. A summary in English from the report is reproduced below.

The measurement of the physiological strain of a job is of interest in the study of occupational safety and health. In order to measure physiological variables during work in different climates, a portable data collecting system has been developed. Based on a battery powered microprocessor, the system is controlled by an exchangeable program. This permits considerable system flexibility through software modification. Using an analogue to digital converter and a multiplexer, seven temperatures are measured. Heart rate is also measured simultaneously. The values are stored in semiconductor memories, which are easily exchangeable. Each memory contains 1024 datawords. The data may be quickly evaluated by dumping the memories into a minicomputersystem, for storage and further treatment such as listing and plotting. The equipment has been developed and tested under both laboratory and field conditions.

INVESTIGATION REPORT 1979:26, 47 pages.

Johan Geben and Christer Lindeman:
Dust problems and dust-fighting measures in mining.

INVESTIGATION REPORT 1979:27

Per Lövstedt:
Important generation mechanisms of infrasound.

INVESTIGATION REPORT 1979:28, 20 pages.

Ingvar Holmér and Sture Elnäs:
Physiological studies concerning the science of clothing. Determination of the heat-insulating capacity of clothing.

INVESTIGATION REPORT 1979:29, 6 pages.

Jan Rudling:
Reading measuring instruments for gases and vapours – a market survey.

INVESTIGATION REPORT 1979:30, 13 pages.

Ulf Hallne, Björn Bergström and Bengt-Olov Hallberg:
Welding problems connected with work environment. Part 12 Efficiency of Millipore filters in cadmium fume sampling.
An English summary from the report is reproduced below.

The efficiency of membrane filters in air sampling to check exposure to cadmium in brazing operations has been questioned in a few unpublished reports. Cadmium could pass through the membrane filter in both the particle and the vapor phase, it was objected.

In the present investigation, sampling trains consisting of a membrane filter and two midget fritted absorbers (bubblers) were used. The main difficulty in carrying out the investigation was to eliminate the cadmium present in the absorbers themselves (background level).

When air samples were taken during 40 minutes of continuous brazing, the amount of cadmium in the absorber was under the limit of detection of the atomic absorption analysis method used, 0,1/ug / sample. The cadmium amounts collected on the membrane filters were at the same time several hundred times higher. This was confirmed in a number of tests.

List of reports in English or with English summaries from the Board's occupational health department 1979-01-01—06-30

Alexandersson, R:
Studies on the effects of exposure to cobalt.
II. Reactions in the respiratory organs to cobalt in relation to exposure in hard metal industry.
Arbete och Hälsa 1979:2, 34 pp, 40 refs.
Swedish with English summary.

Alexandersson, R& Hedenstierna, G:
Studies on effects of exposure to cobalt.
III. Studies on gas distribution and airway closure before and after four weeks of vacation.
Arbete och Hälsa 1979:7, 25 pp, 30 refs.
Swedish with English summary.

Alexandersson, R & Lidums, V:
Studies on effects of exposure to cobalt.
IV. Concentration of cobalt in blood and urine as indicators of exposure.
Arbete och Hälsa 1979:8, 23 pp, 33 refs.
Swedish with English summary.

Alexandersson, R:
Studies on effects of exposure to cobalt.
VI. Uptake and respiratory effects of cobalt in tungsten carbide workers.
Arbete och Hälsa 1979:10, 24 pp, 19 refs.
Swedish with English summary.

Anshelm-Olsson, B, Gamberale, F, Grönqvist, B & Andersson, K:
Reaction time changes among steel workers exposed to solvent vapor. A longitudinal study.
Arbete och Hälsa 1979:16, 16 pp, 7 refs.
Swedish with English summary.

Blomquist, G, Johansson, E, Söderström, B & Wold, S:
Classification of fungi by means of pyrolysis-gas chromatography-pattern recognition.
Journal of Chromatography, 173 (1979), pp 7-17.

Blomquist, G, Johansson, E, Söderström, B & Wold, S:
Reproducibility of pyrolysis-gas chromatographic analyses of the mould penicillium brevi-compactum.
Journal of Chromatography, 173 (1979), pp 7-17.

Blomquist, G, Söderström, B & Wold, S:
Data analysis of pyrolysis-chromatograms by means of simca pattern recognition.
Journal of Analytical and Applied Pyrolysis, 1 (1979), pp 53-65.

Einarsson, Ö, Eriksson, E, Lindstedt, G & Wahlberg, J-E:
Dissolution of cobalt from hard metal alloys by cutting fluids.
Contact Dermatitis 5 (1979), pp 129-132, 2 refs.

Eriksson, B-E & Hagberg, M:
EMG power spectra versus muscular contraction level.
Acta Neurol.Scand.Suppl. 73, Vol 60 (1979), p 163.

Friberg, M:
An ergonomic comparison of two library carts.
Arbete och Hälsa 1979:19, 12 pp, 4 refs.
Swedish with English summary.

Gustavsson, P Lidums, V & Swensson, Å:
Studies on effects of exposure to cobalt.
V. Uptake, distribution and elimination after intratracheal injection of a suspension of cobalt to rats.
Arbete och Hälsa 1979:9, 13 pp, 17 refs.
Swedish with English summary.

Hagberg, M:
The amplitude distribution of surface EMG in static and intermittent static muscular performance.
Eur. J. Appl. Physiol. 40 (1979), pp 265-272.

Hagberg, M & Eriksson, B-E:
Amplitude distribution in vocational electromyography.
Acta Neurolog.Scand.Suppl. 73, vol 60 (1979), p 164.

Hansson, J-E & Wikström, B-O:
Comparison of some technical methods for evaluation of whole-body vibration.
Arbete och Hälsa 1979:23, 33 pp, 20 refs.
Swedish with English summary.

Holmberg, B:
Setting of exposure standards.
In: Advances in medical oncology, research and education. A. Canonico, O. Estevez and R. Chacon (eds.).
Vol 3: Epidemiology. The Proceedings of the 12th International Cancer Congress, Buenos Aires 1978. (Pergamon Press, Oxford, 1979), 37 refs.

Holmberg, B, Elofsson, S, Holmlund, L, Maasing, R, Molina, G & Westerholm, P:
Mortality and cancer morbidity in Swedish PVC-production workers.
Arbete och Hälsa 1979:4, 37 pp, 18 refs.
Swedish with English summary.

Holmberg, B & Sjöström, B:
A toxicological survey of chemicals used in the Swedish rubber industry.
English version of investigation report 1977:19, 127 pp, 288 refs.

Holmér, I, Elnäs,S, Sköldström, B & Kilström, G:
Heat stress during dives in warm water.
Arbete och Hälsa 1979:20, 30 pp, 19 refs.
Swedish with English summary.

Jacobson, I:
The significance of glutathione S-transferases in biochemical toxicology: Kinetic and binding studies designed to establish a mechanism of action of glutathione S-transferase A from rat liver.
Doctoral dissertation 1979, Stockholm University.

Jacobson, I, Warholm, M & Mannervik, B:
Multiple inhibition of glutathione S-transferase A from rat liver by glutathione derivatives: Kinetic analysis supporting a steady-state random sequential mechanism.
Biochem. J. 177 (1979), pp 861-868, 15 refs.

Jacobson, I, Warholm, M & Mannervik, B:
The effect of ethanol on the steady-state kinetics of glutathione S-transferase A from rat liver.
FEBS Letters, Vol 102 (1979), No 1, pp 165-168, 14 refs.

Jonsson, B:
Electromyography and muscular overexertion — methodological aspects.
Acta Neurol.Scand.Suppl. 73, Vol 60 (1979), p 159.

Kilbom, Å:
Physical work capacity among firefighters with special consideration to physical job-demands at smoke-diving.
Arbete och Hälsa 1979:12, 26 pp, 11 refs.
Swedish with English summary.

Kjellberg, A, Wigaeus, E, Engström, J, Åstrand, I & Ljungquist, E:
Long-term effects of exposure to styrene in a polyester plant.
Arbete och Hälsa 1978:18, 25 pp, 19 refs.
Swedish with English summary.

Knave, B, Minus, P & Struwe, G:
Neurasthenic symptoms in workers occupationally exposed to jet fuel.
Acta psychiat.scand. 60 (1979), pp 39-49, 18 refs.

Knave, B Gamberale, F, Bergström, S, Birke, E, Iregren, A, Kolmodin-Hedman, B & Wennberg, A:
Long-term exposure to electric fields. A cross-sectional epidemiologic investigation of occupationally exposed workers in high-voltage substations.
Scand. J. Work Environ.& Health 5 (1979), pp 115-125, 34 refs.

Kolmodin-Hedman, B, Erne, K, Håkansson, M & Engqvist, A:
Occupational exposure to phenoxy acids (2,4-D and 2,4,5-T).
Arbete och hälsa 1979:17, 26 pp, 21 refs.
Swedish with English summary.

Kronevi, I, Wahlberg, J-E & Holmberg, B:
Histopathology of skin, liver and kidney after epicutaneous administration of five industrial solvents to guinea pigs.
Envir. Res. 19 (1979), pp 56-69, 16 refs.

Kronevi, I & Holmberg, B:
Acute and subchronic kidney injuries in mice induced by diphenylamine (DPA).
Exp. Path. 17 (1979), pp 77-81, 6 refs.

Lindberg, E:
Exposure to saw-fumes. Correlation between exposure and irritation as well as between exposure and certain lung-function variables.
Arbete och Hälsa 1979:27, 26 pp, 10 refs.
Swedish with English summary.

Lindstedt, G, Gottberg, I, Holmgren, B, Jonsson, T & Karlsson, G:
Individual mercury exposure of chlor-alkali workers and its relation to blood and urinary mercury levels.
Scand. J. Work Environ. & Health 5 (1979), pp 59-69, 17 refs.

Ljungberg, A-S, Enander, A & Holmér, I:
Evaluation of heat stress during sedentary work.
Scand. J. Work Environ. & Health 5 (1979), pp 23-30, 18 refs.

Lundberg, I Sjögren, B, Hallne, U, Hedström, L & Holgersson, M:
Work environment problems in welding. 8. Work environment factors and cadmium uptake in brazing with cadmium-containing hard-solders.
Arbete och Hälsa 1979:21, 42 pp, 21 refs.
Swedish with English summary.

Magnusson, B, Fregert, S & Wahlberg, J-E:
Determination of allergenic properties of chemicals in respect of skin allergy. Predictive guinea pig testing of sensitization capacity of substances.
Arbete och Hälsa 1979:26, 30 pp, 11 refs.
Swedish with English summary.

Mannervik, B, Jacobson, I & Warholm, M:
A new procedure to derive weighting factors for nonlinear regression analysis applied to enzyme kinetic data.
Biochem. biophys. Acta 567 (1979), pp 43-48, 16 refs.

Nordic expert group. **Toluene.**
Arbete och Hälsa 1979:5, 63 pp, 177 refs.
Danish with English summary.

Nordic expert group.**Trichloroenthylene.**
Arbete och Hälsa 1979:13, 38 pp, 59 refs.
Danish with English summary.

Nordic expert group. **Styrene.**
Arbete och Hälsa 1979:14, 37 pp, 100 refs.
Swedish with English summary.

Nordic expert group. **Methylene chloride.**
Arbete och Hälsa 1979:15, 37 pp, 80 refs.
Swedish with English summary.

Nordic expert group. **Inorganic lead.**
Arbete och Hälsa 1979:24, 55 pp, 147 refs.
Swedish with English summary.

Nordic expert group. **Tetrachloroethylene.**
Arbete och Hälsa 1979:25, 39 pp, 78 refs.
Swedish with English summary.

Persson, H E, Knave, B, Goldberg, J M, Johansson, B & Holmqvist, I:
Long-term exposure to lead. III. A neurological and neuro-physiological study of the personnel at Rönnskärsverken, Boliden Ltd.
Arbete och Hälsa 1979:1, 28 pp, 36 refs.
Swedish with English summary.

Steby, M & Levin, M:
Automobile painters' exposure to organic solvents, dust, and metals.
Arbete och Hälsa 1979:3, 46 pp, 22 refs.
Swedish with English summary.

Swensson, Å:
Experimental studies of the fibrogenetic effect of particles from grinding of coal fiber reinforced plastic material.
Arbete och Hälsa 1979:6, 13 pp, 5 refs.
Swedish with English summary.

Swensson, Å:
Experimental studies of the fibrogenetic effect of particles from aluminium silicate.
Arbete och Hälsa 1979:11, 16 pp, 5 refs.
Swedish with English summary.

Swensson, Å:
Experimental evaluation of the fibrogenetic effect of an amorphous silica.
Arbete och Hälsa 1979:22, 17 pp, 9 refs.

Wahlberg, J-E:
Transfer of paraphenylenediamene delayed-type hypersensitivity: A comparative investigation in the guinea pig, using arteriovenous crosstransfusion and parabiosis.
J. Invest. Dem. Vol 72, No 1 (1979), pp 52-54, 11 refs.

Waernbaum, G & Wallin, I:
Hazards in the work environment — hydrogen sulfide. Spectrophotometric determination of hydrogen sulfide.
Scand. J. Work Environ & Health 5 (1979), pp 31-34, 3 refs.

Reprints of the reports are only obtainable from the author(s), the publishing company or the scientific journal in question.

The Board's scientific series "Arbete och Hälsa" (Work and Health), traning reports and investigation reports can - as long as stocks are available - be obtained from the Board (see order form).

From the Board's foreign visitors file

12 October 1979
Mr Carl Johnston, Senior Project Officer, Quality of Working life, Employment, Relations, Canada Department of Labour, Quebec.

15 October
Dr D. Djordjevic, Occupational Safety and Health Branch, ILO,Geneva, Switzerland.

19 October
Mr. V.V. Sjachaparonov, Deputy Director of CNIIOMTP, Mr. V.A. Alexejev, Head of Department of Safety Technique at CNIIOMTP, Mr. G.A. Gudzovskij, Head of Department of Hygiene at the Medical Institute in Stavropol, USSR.

30 October
Mr. Jørgen Spove, Head of Legal Division, National Board of Occupational Safety and Health, Copenhagen, Denmark.

1 November
Mr. Svein Ragnar Kristensen, Deputy Director, National Norvegian Board of Occupational Safety and Health, Mr. Ivar Ofstad, The Norvegian Employers' Confederation, Mr. J. Skau-Jacobsen, the Norvegian Confederation of Contractors, Mr. Bjørn Kolby, Norvegian Confederation of Trade Unions, Mr. Håkan Nilsson, Ms. Henriette Munkebye, Norwegian Ministry of Labour.

6 November
Ms. Patricia Foster, Research Officer, Australian Public Service Association, Victoria, Australia.

9 November
Dr Jack Sandover, Department of Human Sciences, University of Technology, Loughborough, UK.

27 November
Dr. M.I. Mikheev, Regional Officer for Workers' Health, WHO, Copenhagen, Denmark.

Mr. Alan Palmer, Head of Center for Occupational Safety and Health, Stanford Research Institute, Calif., USA.

Mr. Ali Raif Isin, Head of Department, Turkish Employment Services, Ankara,Turkey.

7 December
Committee of Inquiry into Technological Change in Australia; Professor Rupert Myers, Mr. Alan Coogan, Mr. William Mansfield, Dr. Malcolm McIntosh, Canberra City, Australia.

12 December
Mr. Keijo Kaittola, Head of Division, Mr. Tapio Luoto, Eng,. Mr. Kari Kannas, Eng., National Board of Occupational Safety and Health, Tampere, Finland.

No. 4 December 1979

Please note that, if not otherwise indicated the publications exist in Swedish only.

ORDER FORM

Dear Sir, Madam
I am very interested by all your reports in French or English just as a professor and researcher, as an expert who could be commissioned by the group of Ministers of Nordic countries to examine some programs of research on working conditions
Truly yours

To be sent to

National Board of Occupational Safety and Health
Arbetarskyddsstyrelsen
Publication Service
S-171 84 SOLNA, SWEDEN

Please send me the following material:

Pamphlet about the National Occupational Safety and Health Administration

☒ in English ☒ in French ☐ in German

☐ in Finnish ☐ in Swedish

☐ Ordinance No 1 3 5 6 11 12 14 15 17 18 20 21 22 24 25

☒ Arbete och Hälsa No ..... 1 2 4 7 9 10 16 19 23 26 27 — all reports from 1 to 27

☒ Investigation Report No .... all reports

☐ Training Report No .....

☒ Catalogue of research projects 1978. In English .....

☒ Work Environment Act and Work Environment Ordinance. In English .....

General Machine Directions No. 29. Price: Skr 50 (excluding service charge).

☒ in English ☐ in German

☒ Investigation Report 1977:19 on chemicals in the rubber industry. In English. Price: Skr 15 (excluding service charge).

Signature, name _____

Name of Institution _____

Address _____

_____